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After Latour: Globalisation, Inequity and Climate Change

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After Latour: Globalisation, Inequity and Climate Change

Springer

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Preface

The papers in this volume constitute the proceedings of a joint working conference organized by IFIP Working Groups 8.2 (Information Systems and Organizations) and 9.4 (Implications of Information and Communication Technologies for Development) held in Hyderabad, India on 7 and 8 December 2023. The conference was a follow-up to the 2020 Joint Working Conference that had been planned to take place in Hyderabad, but that had to be held virtually, due to the Covid pandemic.

The theme of the 2023 conference was chosen to be on the legacy of Bruno Latour, who had died in October 2022. Latour's work had a significant influence on IS research, especially among scholars drawing on Science and Technology Studies and those affiliated with IFIP Working Group 8.2. In his later work Latour also addressed themes of globalisation, inequity and climate change that resonate with the work of IFIP Working Group 9.4.

The call for papers for the conference specifically invited submissions reflecting on the contribution of Latour's work to IS research and on the contribution of IS to globalisation, inequity, and climate change, but submissions addressing more traditional research themes of the two Working Groups were also welcome. 67 submissions were received, of which 28 were accepted for presentation (15 full papers and 13 shorter, "Research in Progress" papers). Each accepted paper received at least two double-blind reviews, with the review time being 14 weeks for full papers and 11 weeks for Research in Progress Papers.

There were keynotes from Janaki Srinavasan of the International Institute of Information Technology Bangalore, and from Subhabrata (Bobby) Banerjee of Bayes Business School at City University, London. Janaki Srinavasan's talk challenged the commonly-held view of the Information Age as representing a break with the past. Such a framing, she argued, depoliticizes the relationship between technology and social change. Rather, greater attention to history and continuities is needed if we are to understand the evolution and radical possibilities of digitalization. Bobby Banerjee's talk called for the decolonizing of climate change. This will require, he argues, not just challenging the human-nature dualism, which he describes as a product of Enlightenment thinking and colonial rationality, but also the embracing of alternative worldviews, in particular those of Indigenous communities. The relational ontologies on which these worldviews are based have been overlooked, he suggests, even by critics of Western modernity, such as Latour.

In addition to the keynotes and paper presentations the conference included two panel sessions. The first looked at how Research Networks based in the global South might be strengthened to catalyze effective research-based action. Drawing on experiences from the FairWork network, which seeks to understand and improve labor conditions in the gig economy, the panel explored the potential for inclusive and emancipatory forms of collaboration that could contribute to more impactful research driving positive change both in the global South and the rest of the world.

The second panel sought to explore alternative theoretical perspectives that have not been widely applied in IS research to date, or new perspectives on established theories. Relating to the theme of the conference, the panel discussed how theory may contribute to new insights on the relationship between digital technology and social development, the environment, and social justice.

We would like to express our thanks to all the contributors to this volume, as well as the panelists and presenters at the conference. We would also like to express our gratitude for the excellent work of all the members of the Program Committee, as well as additional reviewers, during the review process.

October 2023   Matthew Jones
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Keynote Abstracts

Of Disruption and Continuities: The Place of History and Politics in Researching the Information Age

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Abstract. The times we live in have been characterised variously as the Information Revolution, Digital Age, 4th Industrial Revolution and Age of AI. Many of these terms are imbued with the optimism that today is different (and better) than what came before. As people who research these transformations and their implications for inequality, how should we think about what came before? In this talk, I will outline why, regardless of what exactly we research in this domain, we must challenge its framing as a "break" or as "disruption." I will argue that such a framing enables new forms of what development theorists have long referred to as "depoliticization," or a stripping away of the political character of technologies and of social change. A much more productive way to study the changes that digitalisation is bringing about, I suggest, is to trace their continuities with what came before. I will draw on my own research on village computer centres, mobile phones and gig work platforms in India to show how an approach that foregrounds history and pays attention to continuities can tell us more about the evolution – and radical possibilities – of social relations and technologies alike.

Decolonizing Climate Change: Towards a Political Ontology of Sustainability

Bobby Banerjee

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Abstract. In this talk I call for decolonizing climate change as a first step to address the inequitable impacts of the climate crisis, a crisis that is an outcome of colonial legacies that have shaped the contemporary global economy. I argue that our current approach to climate action is based on a flawed epistemic logic arising from an ontological fallacy that creates a false separation between humans and nature. This human–nature dualism, a product of Enlightenment thought and colonial rationality, is primarily responsible for the ecological crisis and cannot be the basis for any meaningful solutions. Decolonizing therefore involves confronting colonial legacies that have defined relationships between humans and nature as well as embracing alternate forms of knowledge and being in the world. Indigenous knowledges for example are based on relational ontologies where creating and sustaining harmonious relationships between humans and nature are central to organizing economic activity. Yet this knowledge has been systematically delegitimized by the colonial project of modernity that justified land appropriation as part of the civilizing mission designed to eliminate Indigenous societies through assimilation, legal domination and even genocide. European critiques of Western modernity for the most part fail to acknowledge Indigenous relational ontologies and the inextricable links between colonialism and modernity. Enacting Indigenous relational ontologies becomes a political task because it disrupts power practices based on the stability of human/nonhuman or nature/culture dualisms. Developing a political ontology of sustainability based on a decolonial imagination will be able to generate new insights into understanding and addressing the ecological crisis.

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After Latour

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Abstract. The contribution of Bruno Latour to IS research is discussed and the organization of papers in these proceedings is explained. Key issues addressed in each of the papers are described.

1 Introduction: Latour and Information Systems

Although there had already been some interest in the work of Bruno Latour in the Information Systems field prior to his keynote speech at the IFIPWG8.2 conference in Cambridge in December 1995, this was among the first occasions on which IS researchers engaged directly with his ideas. Despite his claim to be "an ignorant, trying to understand what has changed in his field, social theory, because of the development of information technology" [1] his account of the dispersion of agency and its recombination in hybrid, fluid networks was widely seen as providing a potential way of transcending the long-standing opposition between technical and social determinist positions in the IS field.

The main focus of IS researchers' engagement with Latour's work, at the time and subsequently, was consequently broadly concerned with what became known as Actor-Network Theory (ANT) – a term that Latour, on different occasions, both repudiated [2] and endorsed [3]. With its analytical skepticism, anti-essentialism and symmetrical treatment of human and non-human actors ANT provided a rich, if not always well-understood, vocabulary and a novel and provocative perspective from which to understand IS phenomena.

Exchanges between Latour and IS researchers were further enhanced by his appointment as a visiting Centennial Professor at the Department of Information Systems at the London School of Economics between 1999 and 2001 and his presentation of the Clarendon Lectures in Management Studies at the University of Oxford in 2004. The latter, published under the title *Reassembling the Social* [3], offered an introduction to Actor Network Theory and discussed its relevance to management and organization theory.

A regular stream of articles in the IS literature both applying and critiquing Actor Network Theory, emerged from this engagement, including a special issue of *IT and People* [4]. Latour's work was also later identified by Orlikowski and Scott [5] as the "most prominent body of literature" contributing to the genre of research that they termed *sociomateriality*. As such, Latour's ideas had a continuing influence on IS research.

It therefore seemed timely that the Joint Working Conference should take the opportunity to mark Bruno Latour's death by reflecting on his influence on the field. While this influence may have been predominantly manifested in IS scholars' application of, and debate around, concepts from Actor Network Theory, Latour's later work sought to pursue a broader agenda, initially in the form of a critique of mainstream conceptions of modernity [6, 7], and then in works addressing themes of globalization, inequity and climate change that have arguably been under-represented in the IS literature. Given the increasing significance of these themes in contemporary society and their relevance to research on the implications of information and digital technologies for development the discussion of Latour's legacy therefore also provided an opportunity to promote reflection on the ways in which IS phenomena are implicated in processes contributing to, but also potentially addressing, these global challenges.

For Latour, as he argued in *Facing Gaia* [8] *Down to Earth* [9] *After Lockdown* [10] and *On the Emergence of an Ecological Class* [11], globalisation, inequity and climate change are not independent crises, rather they all stem from an abandonment of belief in a common world shared by everyone. In *Down to Earth* he identified three responses to this situation. The first, that is certainly evident in some IS research, is to ignore it. Continuing technological progress in domains such as geo-engineering, trans-humanism or AI, it is assumed, will be sufficient to overcome the challenges, so we can carry on with business as usual. Latour called this "neo-hyper-modernism".

The second response is to reject the idea that there are any material limits to our actions – a position that Latour names as "Out-of-this-World" for its refusal to consider that "nature" may act upon us in ways that are increasingly beyond our control. This is the realm of the repudiation of internationalism, of libertarian individualism and of climate change denial.

Against these positions Latour proposes a third, that he refers to as the "Terrestrial", which acknowledges that we operate within planetary constraints. He talks of this as expressing both an attachment to the soil, that is to the material conditions of our existence, and an attachment to a world that we share in common. He explicitly associates this position with the Gaia hypothesis of James Lovelock [12], and its view of living beings as agents, actively engaged in generating the conditions of our existence on Earth.

While the scale of the challenge posed by unconstrained globalization and inequity in a finite world may tend to prompt pessimism about the future, we should not allow this to obscure the evidence of initiatives that offer more hopeful ways forward. Understanding how IS may be implicated in forces that promote the loss of a shared destiny, we can also recognize how IS may contribute to its reconstruction. In this we may identify commonalities between Latour's work and that of other scholars, such as Appadurai [13], who view future making as grounded in day-to-day cultural practices and local experiences. Inviting us to consider how IS may support the radical innovation necessary

to address contemporary and future challenges of climate change, globalisation and inequity.

Following the two keynote abstracts, the papers included in this volume have been organized under a number of broad headings, reflecting common areas of focus. The first of these comprises those papers directly addressing Latour's work on climate change.

1.1 Digital Sustainability and Climate Change

The paper by *Hovorka and Auerbach* takes its cue from Latour's argument that climate change is not simply an ecological crisis, for which we may hope to find technological solutions, but requires a profound rethinking of our relation to the world. Such a reorientation, they argue, will require the recognition of our expectations, of system dynamics, of ideology and of alternative futures.

Pignot et al., adopt a different perspective on IS and climate change – examining how social media can contribute to climate activism. Viewing climate awareness and effective action as the product of the interplay of affective, discursive and technological agencies they explore this through interviews with 120 actors in the government, media, industry, political and scientific sectors in France. Alignment of these agencies, they propose, is necessary to ensure affective circulation and ongoing change.

For *Brooks et al.,* the focus shifts again, to the ethics of climate engineering and the development of a set of principles to guide its development. They identify a number of ethical values and principles applicable to climate engineering and use these to propose improvements to existing guidelines (known as the Tollgate principles). A similar approach, they argue is relevant in other technological fields such as Information Systems.

The last two papers of this section ask how the IS field may need to change in response to Latour's analysis in *Down to Earth. Allen* discusses the ways in which current innovation systems for digital transformation often seem to be aligned with elite strategies that deny planetary constraints and considers how digital innovation might be made more pluralistic. This is seen as an opportunity for IS research to contribute to critical social debates and help shape our digital future in more inclusive ways.

Aanestad also considers an alternative future for IS in which environmental sustainability becomes the primary goal. Rejecting technological solutionism and green growth arguments as unrealistic, attention is turned to a variety of postgrowth approaches that may offer ways for the IS field to begin to think seriously about digital solutions that support, rather than threaten, the continuation of life on earth.

1.2 ICTs and Sustainable Development

A second group of papers discuss the contribution of a variety of different types of ICTs to sustainable development. The first paper in this group from *Prinsloo and Adebesin* takes an overview of ICTs and sustainability. Drawing on a systematic literature review of 25 papers reporting on ICT for development pilot projects they identify potential causes and remedies for these projects' failure to be replicated in other contexts. There is an urgent need to address this 'pilotitis', it is argued, if we are to achieve the UN Sustainable Development Goals by the 2030 deadline.

Prabhakar and Prakash examine state-society tensions in the implementation of ICTs for development. They contrast the low adoption of a state-mandated ICT initiative in India to transform agricultural markets into e-markets with the extensive use of locally-enabled non-state apps by the same actors. These solutions they argue reflect a local preference for simple, inclusive solutions that deliver immediate micro-efficiencies, over complex, disruptive systems that prioritize elegance and efficiency.

The focus for *Patnaik and Dixit* is on risk factors affecting the sustainability of ICT initiatives in rural e-governance. A number of factors are identified and categorized as either government- or user-related. Among the former, they report risks due to inadequate funding, inadequate internet connectivity, and lack of system maintenance. User-related risks include fraud, low digital literacy, and digital exclusion.

The final paper in this group by *Kumaralalita and Zheng* employs Sen's capabilities approach to examine the impact that Digital Financial Inclusion initiatives have on the improvement of women's livelihoods. Evidence from a study of a crowd-funded microloan platform in Indonesia highlights that building financial resilience is key in ensuring the sustainability of financial inclusion, enhancing women's agency and avoiding creating new vulnerabilities such as over-indebtedness and financial dependency.

1.3   IS in the Education Sector

The third group of papers report on studies in the education sector in a variety of different settings. *Uache et al.* discuss the challenges of data integration from multiple local database management systems to support Business Intelligence in the University sector in Mozambique. Using the ITPOSMO framework, different groups were found to face different challenges. External developers faced challenges relating to objectives and values and staffing, while internal participants faced problems of interoperability and limited technical staff and financial resources.

Jallow and Sanner take a more system-wide perspective, examining the use of a decentralized Education Management Information System (EMIS) to try to improve equitable service delivery in the Gambia. Focusing on the implementation of a daily teacher attendance system at the school level and its reporting through sub-national dashboards, organisational, institutional, capacity, infrastructural and resource challenges are identified. Overcoming lack of access to and capacity to use data, however, is argued to be key to improving the effectiveness, efficiency, and equity of service delivery.

The same decentralized EMIS is the focus of the paper by *Amuha et al.*, this time in the context of Uganda. The paper asks how implementation in the education sector can be informed by earlier experiences with comparable systems in healthcare. Rather than focusing on technology, it is argued, implementation of EMIS should pay more attention to organizational factors. Aligning stakeholders, harmonizing data needs and the appropriate allocation of qualified human resources are identified as critical for the delivery of an effective and comprehensive EMIS that can support sustainable improvement in the education system.

The paper by *Tampubolon and Srinivasan* reports on a study of the effect of online schooling in Indonesia during the Covid 19 epidemic on the paid and unpaid work done by women. Their findings showed that rather than freeing up time, online schooling

increased the burden of unpaid work done by mothers. Moreover, mothers took primary responsibility for online schooling in households regardless of which parent earned more, had more free time or was more digitally literate. The gendered effects of online schooling, they argue, should not be overlooked.

Iivari et al. address a more positive role for digital technology in education – to empower children suffering from bullying. They outline a design process for digital technology as part of the children's computing education that employs a variety of empowerment theories to support the promotion of social justice. The insights offered by their study, they suggest, may contribute to IS research pursuing social justice and empowerment more widely.

1.4   Privacy, Trust and Surveillance

Although the literature on ICT for development often emphasizes the positive outcomes of IS for local communities, there can also be a dark side to such system as the fourth group of papers discuss. *Wyers et al.* address the case of digital identity platforms and their potential to enable the identification of LGBTQ + individuals in countries with Anti-LGBTQ + legislation. Drawing on experience with a free and open-source District Health Information System platform in use in 114 countries worldwide, the authors use Actor-Network Theory to identify risks of data-induced harm and to suggest ways in which they may be overcome.

Another type of sensitive data is addressed in the paper by *Zhou et al.* Examining the use of civic technology in the delivery of youth sexual and reproductive health services, the case of the MobiSAfAIDS initiative in Southern Africa is used to explore how the Responsible Data concept may inform its design, implementation and use. Adopting the Theory of Data Privacy as Contextual Integrity, a roadmap for the responsible delivery of civic tech to safeguard citizens' data is proposed.

Civic tech is also the focus of the paper by *Khene*. Reflecting on the limited implementation of civic tech in Africa, despite the promise of citizen engagement and democratic societies that motivated initial enthusiasm in the concept, issues of power and trust are identified as key issues. A distinction is made between power 'over', power 'to' and power 'with' with the last being seen as dependent on trust – in the case of civic tech, in abstract systems. A number of access points, including representatives, artefacts and standards are identified as enabling 'power with' to support learning and collaboration.

The last paper in this group from *Sheombar and Klovig Skelton* analyses the supply of surveillance technology from the global North to African governments for the illegal surveillance of their citizens. The key exporting states and the specific technologies transferred are reported and a thematic analysis is employed to identify the motives for state surveillance. These include as legitimacy for state security, as diplomacy, as neo-colonialism and as a business opportunity. It is argued that such a mapping of surveillance technology exports is necessary if initiatives to protect human rights are to be effective.

1.5 Theory and Methods

Reflecting the long-standing interest of both Working Groups in the investigation of new theories and methods, the last group of papers engage with theoretical and methodological debates in the IS field. The first paper, from *Lanamäki,* addresses Affordance Theory and challenges the widely-assumed association, at least in the IS field, between this theory and Critical Realism. Examples of papers that use Affordance Theory with perspectives other than Critical Realism are presented and are used to support the claim that the affordance concept can be applied with any theoretical approach.

Affordance Theory is also applied in the paper by *Matewere and Kaasbøl* who use it to analyze the use of a mobile-based Integrated Community Case Management application by Community Health Workers (CHW) in rural areas of Malawi. They report that the application was effective in enabling CHWs to assess sick children and to classify their illness and recommend treatment where there were no danger signs or to refer the child to higher level facilities when the signs were present. For the CHWs the application improved and simplified their decision-making process and increased their confidence in the referrals they made.

Institutional work and institutional pressures in the development and use of healthcare IS are addressed in papers by *Thakral* and *Kaunda et al. Thackral* discusses the interplay of technology and institutional work involved in developing a monitoring system for Anti-microbial resistance. Employing concepts from Actor-Network Theory, three stages are identified in building a digitally-mediated institution: enrolling actors; using generated reports as mediators to promote improvements in data quality; and translating actors through conversations around data to generate state-level data. Technology is seen as playing a pivotal role in supporting interactions and facilitating institutional work.

Coercive and normative institutional pressures influencing the use of Health Management Information System (HMIS) data at the district level in Malawi are the focus of *Kaunda et al.'s* paper. Healthcare staffs' data use practices, they argue, are shaped by directives from the government and health partner organizations and inconsistencies between the reporting structures for the two parties lead to redundancies that weakened district level data utilization.

Abbott and Wagg discuss post-hoc theorization of action research projects in ICT4D. Using a case study of a project to develop a robust infrastructure for open science in Africa, concepts from Actor-Network Theory and Activity Theory were employed separately and complementarily. Combining the different levels of perspective of the two theories it is argued can provide rich insights to develop theories of change informing ICT4D action research.

Akbari and Masiero call for a paradigm change in ICT4D research to make a critical perspective, that problematizes the core assumptions of the field, central to theorization, design and execution. Such a Critical ICT4D, they propose, would acknowledge the potential harms that ICTs can bring to their supposed beneficiaries but also contribute to the development of fairer technology-informed systems in conditions of structural vulnerability.

Responding to what they identify as the crumbling of the "tech for good" beliefs that inspired early work on ICT4D, *Masiero and Hattaka* propose antifascism as the basis

for a revised ethos of research in the field. This would combine opposition to violently oppressive ideas and systems and a commitment to the creation of societies committed to freedom of thought and action. The application of these ideas is illustrated in relation to research on political and human rights activism, LGBTQIA + issues, and migration and refugees.

The last two papers in the proceedings take a more methodological perspective *Wilf et al.* discuss utopian fiction as a potential source of ideas for thinking about the ways in which technological development may shape future society. Analysing a sample of utopian fiction published from the late 19th Century to the 21st Century, four possible technological paths (instrumentalism, determinism, substantivism and critical theory) are identified that may inform our thinking on how human actors might control the influence of technology on society. Through engagement with the contradictions and connections between these paths, it is argued, we may be able to learn how institutions and practices may better direct technological development.

Rather than speculative fiction, *Imran et al.,* discuss the potential of indigenous research methods to explore the effects of technology. Specifically, they employ yarning circles, traditional storytelling and knowledge exchange forums in Australian Aboriginal communities, as a way of studying the perceptions of Aboriginal parents on their children's' interactions with the online world. The findings are hoped to provide insights that may inform the design of interventions to bridge knowledge gaps of parents and caregivers.

That only a minority of the papers in this volume directly reference Latour's work, might be seen to indicate that his legacy in the IS field is quite limited and that, as so often in IS research, the theoretical bandwagon has moved on, restlessly, in search of the next "big thing". To view Latour in this way, however, would be to treat his contribution to the field as a single, self-contained theory that has been tried and found wanting and to overlook the way in which the vocabulary and methodological precepts that he offers have infiltrated IS research practice, at least in the domains of the two IFIP Working Groups represented here.

It may be debated whether that influence has been wholly beneficial, but in unsettling some of the taken for granted assumptions of IS research, Latour's unconventional and provocative thinking may be considered to have made a difference to the field. If this conference contributes to increasing the awareness of Latour's later work among IS researchers, then his legacy may also lie in awakening a greater interest in global connectedness, inequity and environmental and economic sustainability in a field that has sometimes been criticized for being too narrow and socially disengaged.

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Climate Change and Digital Sustainability

Climate, Biodiversity and IS: Four Recognitions

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Abstract. The assertion that humans can adapt or be resilient in the face of the multiple climate-related crises we have created invites simple and often techno-logical solutions. The smooth and simple narrative obscures the fundamentally new relationship humans have with *the world* in which we live. Latour's analysis reveals a fundamental reorientation of humankind to the world is necessary for a future that is livable – for humans and the species with whom we share the world. This will require substantive changes to our expectations of the possible, a deeper understanding of system dynamics at scale, changes to our taken-for-granted ideology of continuous growth and recognition of our responsibility to futures.

Keywords: Latour · Expectations · System Dynamics · Futures · Ideology of Growth

1 Introduction

Our language is important. Our concepts are critical. The language we deploy makes visible the relations of the world, how we think and feel about them, which in turn make the world. We can wish now that as we face the crises of climate, and biosphere integrity, and other planetary boundaries that they were *only* a crisis. That would reassure us by implying that this poly-crisis too shall pass as long as we humans are resilient and adaptable [1]. Instead, some people are experiencing a slow realization that "we have shifted from a mere ecological crisis to a profound mutation in our relation to the world" [1, p. 8]. For Latour, this mutation has challenged and undermined our conceptions of the world, ourselves, our culture, and nature in ways from which there is no recovery, no going back. If we take this unsettling seriously, what is needed is resilience [2] and adaptation to researching the New Climate Regime [1, 3], a project IS researchers have not yet recognized.

Information Systems researchers seek to respond to the climate crisis through "green IS" [4, 5], frameworks for resilient information infrastructure [6, 7] and organization of the field's collective voice [8]. Yet this perspective sets a perceptual regime in which the environment has no role beyond being an object to be viewed with a particular technological gaze [1]. Although the field recognizes that its own subject matter is

implicated in the climate crisis, the self-same suite of technologies is offered as the solution to the crisis. In reading Latour, this very reinforcement of the divide between humans at the center, and the environment as distinctly outside, is the heart of the problem.

In much of the Information Systems (IS) research related to environmental concerns, the very evidence of the world in crisis - the rising temperatures, the increasing rate of extinction of species following radical declines in populations, and the increasing frequency of extreme weather events – is held at arm's length. Our research may examine the psychological factors which might mobilize behaviours leading to sustainability [9], the various economic and organizational forces which produce a lack of action [10, 11] or the concept of resilience of technological infrastructure itself [6]. But despite Latour's interpretation of Gaia, the multitude of ways in which scientists describe the crises (e.g. Anthropocene, great acceleration, safe operating space), always mark as separate the world which is at stake, and the realm of humans and the technology we wield.

There have been thousands of studies and calls to action regarding the increasingly unsustainable activities of humans. But there is one voice notably absent: the inhabitants of the future. What will they say when they reflect on our present cultural-political time— the Anthropocene—as an era when we realized human activity was irrevocably altering our planet's life-sustaining climate and ecosystems, yet we did little to alter our actions? A future historian might well write that "the people … knew what was happening to them but were unable to stop it. Indeed, the most startling aspect of this story is just how much these people knew, yet how little they acted upon what they knew" [12, p. 41]. Climate and ecological degradations are increasing despite repeated warnings that the temporal window for avoiding significant climate transformation and biodiversity loss is rapidly narrowing and the potential for civilizational collapse is rising. It does not serve future inhabitants to understate the magnitude of this problem. The current growth-oriented business practices are forging a path to a fundamentally unrecognizable future world, yet the narrative that we can address the climate change crisis through technology, without significant changes to the market-driven economy, is ubiquitous in society and in IS research.

The many societies of the present are following in the footsteps of numerous civilizations which arose, grew prosperous, achieved regional dominance, and mastered artistic and technological sophistication only to disappear into obscurity [13]. Although reasons for their downfall are numerous, at least a few faced existential risks from changing climate. But it is likely that none of them envisioned their own demise because each had a limited understanding of the biophysical systems upon which life depends and a limited view of environmental patterns beyond their immediate surrounds. In contrast, in our modern World, we face no such constraints on knowledge—we can easily view calamities in distant lands. We can analyse trends in climate change, population growth, material resource extraction (e.g. oil, timber, rare earth metals), and species decline and extinction over thousands of years. We have no excuse for blind spots, short-sightedness or existential risk [14–16] when it comes to the direction the planet is headed. We cannot excuse our lack of action by saying "no one anticipated that."

We can model the environmental and societal health of the Earth with increasingly sophisticated planetary and space-based data collection, but future inhabitants will question whether we have learned anything or whether we chose to bequeath a degraded future to them. The World3 Limits to Growth (LgT) report provided a global-scale simulation of multiple plausible scenarios of interactions between the earth and human systems under constraints of finite resources. Without significant adjustments to resources utilization and emissions growth, all scenarios ultimately modelled societal collapse [17]. Fifty years later, with an updated World3 model, the empirical evidence is tracking closely with the trajectory of increasingly negative environmental conditions rather than the more optimistic scenario of climate stabilization through extensive technology implementation [18]. The risk of the abrupt environmental change predicted by the World3 model is consistent with research by the Intergovernmental Panel on Climate Change, examination of planetary boundaries [19], and the impending crisis outlined in the UN Human Development 2020 report [20]. A critical insight in the LtG study is the plurality of "limits" in limits to growth: "Yes, humanity can innovate itself out of one limit … But in a system like our global society, creating a solution to one limit inevitably causes interactions with other parts of the system … giving rise to a new limit which then becomes the new binding constraint to growth" [21].

In aggregate, we can, and future historians will, conclude that despite 50+ years of accumulated knowledge and the backing of thousands of studies on climate change, biodiversity loss and other planetary thresholds, we have been unable to achieve meaningful action to alter climate change at the global level. Across the spectrum of climate and biological measures, we are losing ground and "it may be possible for our actions now to all but lock in …. a disaster for the future. If so, this could still be the time of the existential catastrophe—the time when humanity's potential is destroyed" [22]. If this is indeed a realistic scenario, then climate change is graver than the IS field recognizes in its attempts to adapt around the edges of climate change through technological innovation.

While there is a substantive difference between bad outcomes and catastrophic outcomes [23], as IS researchers we must begin with a clear-eyed recognition that altering current trajectories of the multiple crises we face is not a simple matter of technological innovation nor a unification of society and nature. As suggested by Latour, "every time we attempt to 'bring humans closer to nature,' we are prevented from doing so by the objection that a human is above all, or is also, a cultural being who has to escape from, or in any case be distinguished from, nature" [1, p. 14]. Nor is it possible to appeal to a "global" urgency that will reconstruct the uncoordinated agents competing for dwindling natural resources and opportunities. Instead, there is first a need to shift the conversation to a deeper understanding of planetary and civilizational challenges and second, to present new approaches to research and political motivation [3] that provide productive ground for effective responses.

Importantly, to the historian of the future present-day humans know these global alterations are anthropogenically caused: We seem to passively accept the growth ideology of the corporate, technological monsters we have created [23]. But if we place ourselves in the very futures we are complicit in creating, "How can we not feel rather ashamed that we have made a situation irreversible because we moved along like sleepwalkers when the alarms sounded?" [1, p. 9]. Our relationship to possible futures seems

to be one of passive acceptance or denial of responsibility for the conditions of life for our descendants and the multitude of beings with whom we share this planet. How else to explain the outright hostility and unwillingness to act? A first course of action is to recognise that, as researchers, we must not rely on an assumption that technology is a deterministic solution but rather, we must mobilize political action through our collective science. Latour's New Climate Regime reflects this dissolution of previously impermeable boundaries such that "From this moment on, everything changes in the way stories are told, so much so that the political order now includes everything that previously belonged to nature–a figure that, in an ongoing backlash effect, becomes an ever more undecipherable enigma" [1]. To forge a new relationship with this enigma, we can begin by giving voice to the human and more-than-human inhabitants who will suffer the consequences of our inability to act substantively to avert a climate disaster.

Here we offer four recognitions through which IS research can begin this process:

- Recognizing expectations
- Recognizing system dynamics
- Recognizing ideology
- Recognizing futures

Less robust responses to the call for leadership on the climate poly-crisis are inadequate for the enormous task at hand.

2   Recognizing Expectations

Addressing the planetary crises that we face requires a reset of expectations and focus that can only be achieved through more careful attention to the language with which we describe our expectations for the future [24]. Expectations are crucial in agenda building and shaping research attention and "provide a means for taking responsibility for what is to come" [24]. For example, short-term framing of *digital resilience* as a capacity to adapt to adversity and stressful events is event-level thinking focused on how technology infrastructure can 'bounce back' and transform to 'new states' in the face of climate shocks. Developing technologies that can withstand and help in the mitigation of, and recovery from, floods, wildfires, water shortages and fatal heat domes is valuable for temporary disruptions. But this expectation obscures the scientific reality that what the human and non-human world is facing is irreversible surpassing of the planetary thresholds that guard biosphere and human well-being itself. There is no *resilience* [2] in the face of new climate (in)stabilities if they include unlivable heat and drought, megafires, atmospheric rivers, and broad-scale biodiversity loss through species extinction. What is necessary is to clearly listen to what "mute actors would say if only they could speak" [1] such that the environment itself, as a voice in a 'parliament of things' [25], can tell us what is at stake.

If the problem is framed in terms of the potential for ecosystem collapse [26] and existential risk [22] then adaptation to, and recovery from, events is inadequate. When taking the bio-geophysical science seriously, we should conclude that "without ambitious action, the physical and socioeconomic impacts of climate change will be devastating. Irreversible physical changes in the climate system, known as tipping points, cannot

be ruled out and could have significant global and regional consequences" [27]. The potential for this eventuation should jolt our attention to research which fundamentally reshapes human-driven impacts on the natural world. Our ability to adapt should refer to the approaches and inclusions of our research itself and to the apparatus and concepts we deploy.

We must also clearly articulate what we mean by *sustainability*. Who are we trying to sustain—those people living now, or future generations not yet born? What do we expect of the natural world when our economic structures, business ideologies and research foci are almost entirely centered around *the human* as the recipient of value, and nature is merely *natural capital* [28] for exploitation and a backdrop for human activities, with the natural world's own limits and lives ignored? The oft-cited report from the Brundtland Commission [29] saw the possibility of "a new era of economic growth, one that must be based on policies that sustain and expand the *environmental resource base*" [ibid; emphasis added29]. Here we can read Latour's discussion of 'Gaia' not merely as a set of resources to be consumed but instead to recognize that humans and other living beings *inhabit* the climate and are not separate from it. Focusing on technologies which increase our distance and diminish our awareness of the natural world [30, 31] reflects an organizational irresponsibility that values short-term benefits over ongoing and long-term risk to life quality [32].

To alter our current short-termism, and to address what we owe the future [33], we need to unsettle the systems which eliminate care of other-than-human lives whose ecological relations are at odds with human production and growth. This is not merely a matter of valuing nature for its ecosystem services, extractive potential or the human dependence on the biophysical world. Instead, there is a deeply moral and spiritual imperative that we accept that the world does not actually revolve around human beings, and that non-human inhabitants have a right to exist and that our fates are intertwined – with humans being the ones with the power to change, or the power to destroy.

3   Recognizing System Dynamics

One of the key challenges for IS researchers is to incorporate an understanding of the complex interrelations and scale of biophysical-social-political-economic systems. Our approaches to research are frequently linear, reductionist and decontextualized and missing the element of human and non-human beings. Powerful data analytic and computer systems, forecasting techniques and vast data capture provide an illusion of prediction and control of the future. Both the biosphere and future human behavior are nonlinear feedback systems which "are inherently unpredictable. They are not controllable. The goal of foreseeing the future exactly and preparing for it perfectly is unrealizable. …. We can never fully understand our world, not in the way our reductionistic science has led us to expect" [34]. We must resist confusing our as yet incomplete understanding of dynamic mechanisms with our ability to control or influence them in part due to what we *do* know about them.

We can optimize the environmental performance of relatively small-scale business systems including local transportation, energy and supply chain systems. However we don't even know *what* to optimize for the biophysical and social systems we seek to

build, sustain and inhabit, which limits our ability to address or agree on a shared goal [34]. Furthermore, to think seriously of planetary and civilizational sustainability, it is critical to consider scale. A thought experiment is revelatory: "would an ant be able to read if we shrunk a book to its scale?" This question does not concern literacy or language. The issue is that the molecular attraction between pages at ant-book scale would make the book impossible to open. Scalar variance means that changes in scale produce different system dynamics than solutions at small scale would indicate. As the architects of the technological systems we propose as "solutions," we must begin serious studies of the material and energy costs for technologies of the future *at the scale* they will be enacted. For example, proposed blockchain systems consume significant energy [35] and broad implementation of sophisticated algorithmic computing systems require increased mining of limited materials and need for new extractive discoveries [36]. As technology becomes increasingly ubiquitous, energy demands increase, thus driving the need for cheap, and often dirty, energy production in many parts of the world. This simple example illustrates the interconnections among material, energy, technological and economic systems that are often not explored in IS research.

But an increased understanding of complex dynamics may serve to help us "to feel the consequences of your action before you are able to represent to yourself what you have really done and become aware of the tenor of the world that has resisted your action" [1, p. 79]. Making feedbacks visible is one approach IS can pursue if it can be harnessed to political-economic actions. Latour suggests that "it is only when humans see pollution falling back on them that they begin really to feel that the Earth is in fact round" (*ibid* p 139). By making these loops denser, they gain greater verisimilitude in knowing the place we inhabit, its requirements and the urgency with which we must act. In addressing questions about informing knowledgeable institutions and publics, IS research could better engage with the intersections of science, society, and policy where issues of scale and governance are contested and legitimized [37].

4   Recognizing Ideology

Based on an analysis of 659 articles published in the AIS Basket of Eight journals over a three-year period, Clarke and Davison [38] conclude that a vast majority of articles only address the needs of the corporate sponsor and considered only economic aspects of IS phenomena. Critiques of growth ideologies are not new. In critiquing GDP as an indicator of societal success, J.F. Kennedy stated "That single number 'measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country… It measures everything in short, except that which makes life worthwhile" [as cited: 39]. Focusing IS research on sustainability at environmental and biological levels will require recognition that "we need to act on the knowledge that we are being governed by a defunct system of beliefs that is driving us off a cliff" [40] in emphasizing growth, and prioritizing today's consumption over the wellbeing of the future. What is called for is development of socio-technical systems which unsettle the growth ideology by decoupling prosperity from economic expansion [41], that identify human skills of craft and care as being more important to human prosperity than automation and material growth [39] and that develop and use regional/global measures

of human [42] and ecosystem well-being [43]. We must recognise that "Capitalism wants or needs what it cannot have: that is, limitless growth on a finite planet. This ecological predicament is the defining contradiction of capitalism in the 21st century, insofar as growth is now causing the problems that growth was supposed to be solving" [44]. In addition to the cumulative effects of individual and organization conservation, IS should begin to research descent pathways which will fundamentally change the "oil civilization's" dependency on production and consumption [45] and, in Latour's terms, humanities mutated relationship with technology, society and nature. By directly engaging with the dominant narrative myth of progress, IS research has the opportunity to support human agency in moving beyond the vision of cataclysmic decline, to a vitalized rethinking of a more symbiotic relation with nature [1].

5   Recognizing Future(s)

Reclaiming a liveable future is an urgent undertaking which will require IS researchers to challenge well-established orthodoxies. Recognizing that we can neither predict nor control the technocultural systems we create, nor the natural world in which they are a part, will require rethinking the foundational narratives of competition, continual growth, and technological solutionism. These foundations underlie the social, economic, and environmental systems we have constructed with our science, technologies and markets at a scale and density which we grasp in only a limited sense [46]. These systems and the expectations, ideologies, and cultures which they constitute have persistence and durability – they will precede us into the futures our descendants and all other living things will inhabit. It is not individual humans who form the Anthropocene, but rather the systems of belief and activity we have constructed that now shape our collective behaviour and our expectations and visions of plausible futures.

To alter the goals of these interconnected social, political, economic and environmental systems we must recognize and challenge the existing foundational narratives and develop alternative future configurations that include descent pathways [44, 47], circular or donut economies [48, 49] and generational justice and responsibility [33, 50]. As a discipline, we will have to overcome institutional barriers to fundamentally trans-disciplinary research and explicit recognition of political action [3]. Most critically, IS itself must loosen the constraints of empiricism – looking at the past to extrapolate the future. We must ground research in a future-oriented ethic for the Anthropocene and pursue imaginative and speculative research which offers alternative imaginaries to our empirical understanding [51, 52]. We can expand upon advances in forecasting, system dynamics and social imaginaries to create concepts and language for new economic models and prosperity based in human well-being as a part of nature.

6   Moving Within

The fact that we have "drawn the devastation of life on Earth into the realm of possibility close enough that we can see clearly what it would look like, and know, with some degree of precision, how it will punish our children and grandchildren is perhaps the overwhelming cultural and historical fact of the modern era" [16, p. 16]. Information

Systems scholarship and practice can begin to address this precarious Climate Regime by developing technology which changes the behavior of large-scale systems. We reside within the figuration of 'Gaia', not in a distanced, objective, 'view from nowhere' and we must intervene in the goals of social, political, economic, and environmental systems as well as their specific performance parameters. Identifying where to intervene (Meadows 2001) in these hybrid systems will be critical to achieving long-term impact. This goes beyond the common focus in IS on technological solutionism by recognizing and embracing the inherently political nature of both science and technology. We can delve into this unsettled reality and enter a "zone that we have learned to recognize and that is leading us, little by little, beneath and beyond the superficial characterizations, to a radically new distribution of the forms granted to humans, societies, nonhumans, and divinities" [1]. What is called for is more than an unwarranted faith in technology, no matter how intelligent or advanced, and instead involves deep systemic changes in how humanity lives within Gaia.

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Affective Circulation via Social Media: Examining Climate Change as an Example

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Abstract. Social media are increasingly recognized as powerful tools for social and political activism. The focus of this paper is on climate change activism and how social media can leverage awareness and effective action through the interplay between three agencies: affective, discursive and technological. Building on data collected via 120 semi-structured interviews, the aim of this research is to uncover different configurations related to a state of alignment (flow) or mis-alignment (paralysis) between these three components and their potential to offer a revealing lens through which to address whether users' interaction with social media platforms may result in them becoming alienated or sustainably engaged with the cause they are supporting, in a way which is detached, genuine and meaningful, rather than aggressive and overwhelming.

Keywords: Climate Activism · Affective agency · Social media

1 Introduction

Melville defines IS for environmental sustainability as IS-enabled organizational practices and processes that improve environmental and economic performance, arguing that more research is needed to generate knowledge and investigate the nexus of information, organizations, and the natural environment [1]. Innovations within information systems (e. g. Sun Microsystem's "Open Work" is a network initiative which expands the definition of local while reducing Sun's employees' need to travel to work locations as well as their overall carbon footprint – [2]) demonstrate the role that IS can play in affecting beliefs about environment and enabling and transforming sustainable processes and practices in organizations [1].

Our motivation in this paper is to connect Latour and Schultz's notion of affective alignment (such as with environmental messages, for example) to an interrogation of socio-technological 'flow' [3]: a fluid state covering timing, attentionality, and undergoing, which together explain the dynamics of sensing, and actualization of (trans)formative possibilities for action. However, we argue that such flow is contingent on a successful circulation between social, technological and affective agency.

How users of social media can try to understand, and engage with, their own identification process in a way which is balanced, genuine and meaningful, rather than aggressive and overwhelming? To illuminate this issue, we draw on notions of affect (pre-cognitive; interoceptive) and emotions (a result of cognitive appraisal: interoceptive information conceptualized – e.g., see [4]). Put simply, affect refers to the feelings individuals experience and share.

The paper's structure is as follows: The initial section provides a summary of the existing body of literature on information systems and climate activism. We then clarify the significance of augmenting this literature by incorporating an affective aspect to broaden our comprehension of agency in IS. Following that, we demonstrate the theoretical and practical value of this novel approach within the realm of climate activism. In the ensuing discussion, we emphasize our two main contributions: firstly, we enhance the social media literature by introducing a model of affective (mis)alignment rooted in social media framing and mechanisms; secondly, we present a three-part model of agency that elucidates how affective positioning drives IS practices. This offers a theoretically-grounded empirical framework employing our model in real-world applications.

2 Prior Literature

2.1 Digital Activism and Connective Emotions

A group of initial authors examine the advantages and challenges linked with integrating social media and digital technologies into the practice of advocacy-centered community organizing [5–7]. With the rise of communication tools such as cell phones, mobile devices, and the Internet, new terminology and strategies have emerged to encompass the use of these technologies in advocacy and activism [8, 9]. Terms like digital advocacy, digital activism, online social movement, cyber-activism, and e-advocacy are now commonly found in the literature [5–10]. In this article, we define digital advocacy as the tools, methods, and approaches of traditional advocacy, incorporating various social media and related web-based technologies.

At the heart of digital activism lies the capacity for individuals to interact and participate in the global sphere [11]. The essence of connective action centers on defining individualized communication and its significance, along with digital media, in coordinating what we term as connective action [11, 12]. 'Personalized communication' comprises two elements [11]: firstly, the political content presented in easily adaptable forms, such as the slogan 'we are the 99%' in subsequent Occupy Wall Street demonstrations. These tailored action frames encompass various individual motivations for contesting a situation that calls for change. Secondly, a variety of personal communication technologies that facilitate the dissemination of these ideas. Whether through messages, tweets, sharing on social platforms, or creating and posting YouTube compilations, the communication process frequently involves additional personalization through the widespread connectivity provided by digital means. In essence, the crucial aspect of connective action is the fundamental process of 'sharing': the customization that results in actions and content being widely spread across social networks [11, 13].

Further, George and Leidner have introduced the concept of "connective emotions," a novel idea where individuals organize digitally without a specific identifiable cause. While previous research has demonstrated that both positive and negative emotions can impact the use of Information Systems (IS) [14, 15], emotion goes beyond "impacting use" to connecting individuals via technology and storytelling [16, 17].

2.2   The Case of Climate Change

Activists like Greta Thunberg utilize intense emotions to disseminate their message, urging leaders to respond to climate change issues with a sense of urgency [18]. Additionally, they employ open letters to induce politicians to feel a sense of apprehension [18]. Emotions, actions, and understanding can be linked, albeit through different channels. Regarding the acknowledgment of climate change on social media, there is a substantial body of literature exploring the connection between misinformation and climate change denial [e.g. 19], but the relationship between misinformation and catastrophism has not been thoroughly investigated [20]. A small minority of climate scientists dissent from the consensus stance, and climate denial has a very limited presence in scientific literature, though their views tend to be amplified by groups like conservative think-tanks, the fossil fuel industry, and mainstream media outlets [21]. It is important not to downplay or exaggerate catastrophic climate risks, as an exaggerated emphasis on apocalyptic futures can be exploited to support authoritarianism [22]. An instance of exaggeration is the Sri Lankan government, which, in its concern for pollution, abruptly prohibited synthetic fertilizers and pesticides in 2021, contributing to a broader agricultural and economic crisis [22].

3   An Affect-Based Theory of Agency

Drawing on existing theoretical framework [23, 24] and using an empirical case study on climate activism, we plan to explain and illustrate the circulation of affect in social media. The affective politics of technology framing has been a source of investigation for some authors. For example, Pignot et al. [24] use the notion of 'technology buy-in' to capture actors' susceptibility to technology framing, deploying *The Logics of Critical Explanation* [25] that interrogate the degree to which actors are likely to either reproduce or contest the status quo, based on their level of affective identification with a technology. For these authors, affective politics is constitutively involved in the construction of, negotiation of, and buy-in to such framing. At the same time, conflict and incongruence between framing are experienced affectively as a threat to self-identification and leads to responses that are apparently "irrational" or emotionally driven [24].

We plan to introduce an affective "ontology of lack"; and an enrichment of existing perspectives on agency within IS in the form of a triadic model of distributed agency, which demonstrates how affective identification motivates IS practices and opens the way to more nuanced accounts of the habitual and the imaginative, as well as the judgmental, registers of IS agency, to paraphrase [26: p. 970].

Ortiz de Guinea and Markus [27] describe emotions as potentially derailing behavioral rationality and suggest that sudden emotions such as the frustration associated with

a system crash, or the pleasure aroused while playing a computer game may have more agency than intentional behavior. In response to this, perhaps startling, suggestion, we have attempted to sketch an ontological framework and supporting lexicon to deepen existing agency studies involving the interaction between social and material dimensions of organizing [28–32].

4   Research Setting and Methods

Following an interpretive orientation [32], factual and perceptual data were collected by conducting semi-structured interviews with a range of social media users presenting different sociodemographic profiles and politico-affectual positionings toward climate activism. Using selective sampling, five categories of actors were targeted:

- Governmental actors (local, regional, national officials)
- Political and opinion leaders (associations' members, religious, activists, artists)
- Actors in the media (bloggers, journalists, influencers)
- Scientists (researchers and scientific experts, meteorologists)
- Actors in the industry (in particular, the energy and transport)

120 semi-structured interviews were conducted in France, using the same interview guide built upon the issues raised in our literature review. Thus, discussion with the interviewees was structured around four major themes: (1) social media usage (habits, platforms used, intensity of use, usage purposes, passive vs active usage); (2) climate change consciousness (levels of engagement, motivation, sources of information); (3) How social media supports, enables or constrains and distorts climate activism activities and cognitive and affectual perceptions; and (4) to further stimulate respondents, two tweets were presented: one about the link between the French oil company Total and the Russian President Putin's regime. The other one about the NGO Just stop Oil and the paintings of Van Gogh. The idea was to ask questions such as: Would you share? And why? What do you think? Do you think we are doing too much or not enough on the subject?

We adopted a retroductive inference approach, going back and forth between theory and data to make sense of the reality under study [33]. As such, coding was partially guided by the literature review. Following [34], we applied an iterative coding process including three steps: open coding, axial coding and selective coding. Open coding commenced with the creation of preliminary codes based on the interview guide and the issues arising from our literature review. Other codes emerged from the data and completed the set of codes (i.e., 16 codes organized in three categories). During axial coding, we uncovered 10 categories and subcategories and their possible interrelationships arising from the literature, drawing inspiration from [24] and [35]. Finally, through selective coding, we put forward the core concept of politico-affective (mis)alignment and initiate further investigations to theorize its manifestations and effects (see Fig. 1 below).
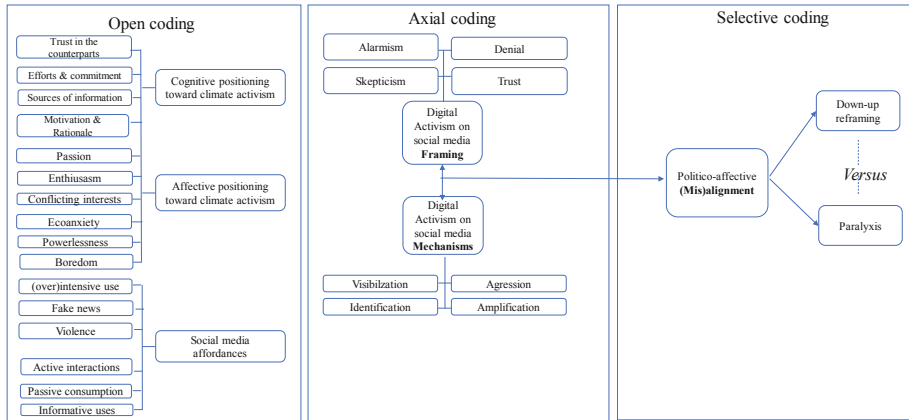
Fig. 1. Data coding

5 Expected Contributions

In the final paper, the question of absence of automatism – what we call the radical contingency of social relations [25] – will lead us to challenge notions of flow [3]) and posthumanism in the literature by foregrounding the underexplored affective component of human agency. More precisely, our discussion will reveal the importance of (mis)alignment as the double outcome of social media framing and social media mechanism. Social media framing – whether actors buy-in to the ecological information spread in the social media – is at the intersection between affective and discursive agency. Social mechanism works at the intersection between affective and technological agency – whether actors use identification, visibilization, amplification or aggression mechanisms through various technical affordances including retweets, mentions, and hashtags. In this paper, we propose that alignment between affective, discursive and technological agency is required to ensure affective circulation and continuous change, characterized by mobility [36], interconnectivity, [37], virtuality [38], complexity [39], hybridity [31], and fluidity [40]. Further results will be presented and discussed during the conference.

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Developing Proposals for Ethically Informed Operational Guidelines for Climate Engineering Technologies

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Abstract. It is generally acknowledged in the 21st century that climate change and hence climate engineering (CE) is one of the biggest issues facing the planet. If we cannot get this under control, in some way, then the future looks very bleak. As Latour says, the issue is both political and ecological, and some people prefer to look away and deny climate change [1]. In this paper, we aim to look at climate engineering technologies from an ethical viewpoint and develop a set of proposals for possible re-engineering of existing guidelines (the Tollgate Principles [2]) in the light of these ethics values and principles.

Keywords: Solar Radiation Management (SRM) · Climate Engineering · Ethics · guidelines

1 Climate Engineering Technologies

Climate change, such as global warming, can be argued to be one of the biggest issues of our age, or a complex 'wicked problem' [3]. While the potential for climate engineering to produce some form of mitigation for the ongoing climate issues is a real possibility, the format for this emerging set of technologies is not clear, even among the experts. Climate engineering technologies can be split into two broad camps, those of Solar Radiation Management (SRM) and Carbon Dioxide Reduction (CDR).

However, several significant concerns with these technologies have been identified. Notably, from our perspective, there are a set of ethical values and principles that need to be considered. As noted in the information introducing this conference, Latour also noted one of the ethical elements often associated with climate change and specifically SRM, which resonates with Actor Network Theory (ANT) [4], the concept of irreversibility. Here, the scale and potential impact of SRM, means that once introduced into the ecosystem, it may not be possible to reverse the effects. Equally, once introduced into

the ecosystem, it might be that we could stop it, but would not want to, which itself could become a political issue, as this operates at the global level. Schultz and Latour [5], argue similarly for system change in the face of climate change and how following the Covid pandemic, things that would have once seemed implausible in 2018 were accepted and deployed in the face of a global crisis. So, with the emerging crisis arising from climate change, might other changes, such as those of consciousness, policy and structure be possible?

This also combines with another ethical principle, that of responsibility to future generations, and all that entails in terms of the legacy of a 'good planet'. But of course, as this is Latour, it cannot be seen without reference to ANT, and the role of the technology itself as actant in the situation [6]. This blurs the boundaries between humans and technology in terms of responsibility and agency. For example, should we be looking at technology in climate engineering, as a solution to the problems caused by technology (usually others) in the first place? What are the vested interests in climate engineering technologies and does the potential for SRM imply that people will stop trying to minimise climate change/global warming in the same way (and is that another reason not to explore the technology itself)?

2   Background

While there is not sufficient room in this paper to go into the details of each of these climate engineering technology families, the broad-brush picture is as follows:

Climate engineering (CE), also known as geoengineering, refers to "… the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming" [7].

The literature usually differentiates between two forms of CE: a) Solar Radiation Management (SRM) techniques, which aim to reflect some sunlight and heat back into space; and b) Carbon Dioxide Removal (CDR) techniques (also known as 'Negative Emissions techniques'), which remove atmospheric CO2 and store it in geological, terrestrial, or oceanic reservoirs.

As well as their different aims, a key difference between SRM and CDR is with their timescale: with SRM believed to be fast-acting and CDR slow-acting and operates on similar timescales to conventional mitigation. CE as a deliberate policy intervention distinguishes it from any similar effects produced unintentionally or by the Earth's systems and processes, such as the temporary temperature reduction seen close to a volcano eruption. Again, due to space constraints, this paper is going to focus mainly on the ethical issues surrounding Solar Radiation Management (SRM).

This paper reports on one part of the EU funded project 'TechEthos - Ethics for Technologies with High Socio-Economic Impact' (www.techethos.eu). This project is an EU-funded project that deals with the ethics of the new and emerging technologies anticipated to have high socio-economic impact. The project involves ten scientific partners and six science engagement organisations and started in January 2021 and will finish at the end of 2023. TechEthos aims to facilitate "ethics-by-design", namely, to bring ethical and societal values into the design and development of new and emerging technologies from the very beginning of the process. The three technologies investigated are "climate

engineering" (CE), "digital extended reality" (dXR) and "neuro-technologies" (NT). The project will produce proposals for developments to operational ethics guidelines for each of these technologies for users such as researchers, research ethics committees and policy makers. To reconcile the needs of research and innovation and the concerns of society, the project has explored the awareness, acceptance and aspirations of academia, industry, and the general public alike and reflected them in these guidelines. TechEthos receives funding from the EU H2020 research and innovation programme under Grant Agreement No 101006249.

2.1 Ethical Values and Principles in Climate Engineering

As this research is part of a wider project, the TechEthos project, while there is not space to situate the arguments properly in the problem space, further discussion of the background to the Climate Engineering and specifically the SRM field can be found in the TechEthos Deliverable D5.3 [8].

As noted above, there are a number of ethical values and principles which can be seen as relevant to Climate Engineering and in particular SRM [9]. These include:

Moral hazard: does climate engineering undermine climate mitigation? This dilemma raises the issue of, if artificial changes are promised as solutions to the climate crises, whether meaningful climate change mitigation is still possible. This also reflects Latour's position on 'neo-hyper-modernism'. There are two options: Firstly, when mitigation is modelled over longer time periods, the use of cheaper climate engineering in the far future might be preferred over more expensive mitigation costs now or in the near future. Secondly, this choice of waiting until later to mitigate climate change can be particularly attractive at a political level, slowing down policy makers' current efforts. Further, as some techniques promise to mask the effects of climate change, could mitigation risks be abandoned altogether, despite it not being empirically clear whether CDR or SRM are possible and realistic at larger scale.

Moral corruption: Does climate engineering reflect a self-serving interest in avoiding politically difficult transitions away from fossil fuels? This issue is closely related to moral hazard in so far as the availability of climate engineering may be used by current generations to justify that they believe that they do not need to mitigate more rapidly now, and so passing the responsibility onto the next generation. This also relates to the 'responsibility to future generations' concept and whether it can be morally justified to just defer the actions that need to be taken.

Hubris: Can climate engineering be justified by limited human foresight? This issue directly reflects the relationship between humanity and nature. Climate engineering seems to assume we can control or have dominance over nature, to make it serve human beings. This reflects Latour's arguments around the tensions between 'Terrestrial' and 'Out-of-this-world' positions. Researchers and ethicists consider that our current knowledge does not support some of the assumptions made about the possibility of achieving control over things such as the global carbon cycle, while underestimating the harmful effects this could have. In the 'Terrestrial', the recognition that we may have to acknowledge and admit to the limits of control over the global carbon cycle and our attachment to the planet A further set of specific ethical values and principles for SRM are illustrated in Fig. 1.

The next section explains the process followed to identify and refine the set of guidelines for climate engineering, bringing out a more ethical perspective.
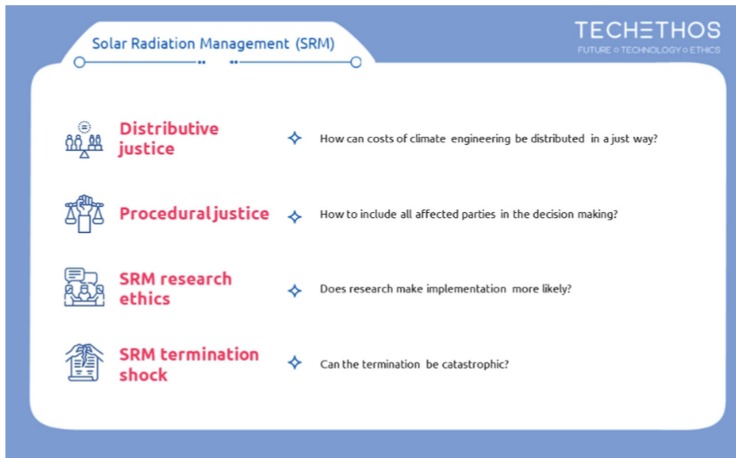
Fig. 1. Values and principles in Solar Radiation Management [9]

3   Methodology

3.1   Identifying SRM Guidelines

Having identified the set of three technology families in the early part of the TechEthos project, the set of specific technologies that could be classed in each technology family, including SRM were then identified. However, while there are some guidelines and codes that do generally cover the area of SRM, the question was whether there is any that could be seen as a potential starting point for a set of proposed ethically informed guidelines. To this end, the project developed a methodology for identifying the relevant set of guidelines to work with, which is as follows:

1. Step one, review relevant literature, in order to locate the existing guidelines, codes and frameworks for Solar Radiation Management (SRM) technology family.
2. Step two, identify one or two subject experts within the technology family to review the existing selection of guidelines, codes and frameworks.
3. Step three, use their expertise to identify at least 3 additional guidelines, codes and frameworks. This is to ensure that a more comprehensive set is considered.
4. Step four, to build a mind-map (or similar) of the Solar Radiation Management (SRM) technology family (see Fig. 2). The mind-map was built as follows:

   - The **title** and a **hyperlink** to the code/guideline/framework being reviewed.
   - An **introduction/descriptive statement** of all the identified guidelines and codes.
   - A **summary** of the key contribution of the guideline, code.

- An indication of its **relevance** with respect to the tech family or specific tech application. See the example below (Fig. 1) on how the project illustrated the relevance to the technology family.
- **Links to Techethos findings**: identify any ethical principles that were identified in TechEthos Deliverable D2.2 [9] or other deliverables/outputs, e.g., scenarios, legal case studies, games etc. See the example (Fig. 1) for how the project illustrated the link to the Techethos findings.
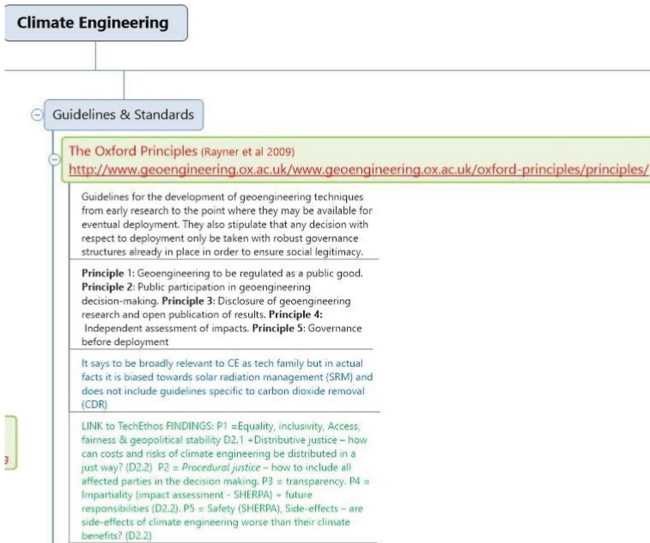
Fig. 2. Snapshot of a specific section of the Climate Engineering mind-map

3.2 Identifying Gaps with Regards to Ethical Issues in the Current Operational Guidelines

Step five, in collaboration with the experts (these can be the same ones from before, or others, but need to be in the relevant field), select (one or two) operational guidelines that likely have ethical gaps and therefore might benefit from some refinement. Meet with the experts to discuss the existing ethical gaps in the chosen guidelines and identify ways in which these can be refined (in this case through the use of the TechEthos project results). Capture these contributions using a template/table/spreadsheet.

3.3 Method Used to Generate Proposals for Developing/Refining Operational Guidelines

Adopting a mixed methods approach, the first step is to establish a set of principles constituting a methodology for generating proposals for developing and refining operational

guidelines. We started with looking at 'ethics by design', as drawn from the methodology developed within the SHERPA (http://www.project-sherpa.eu/) and SIENNA (https://www.sienna-project.eu/) projects. This consists of the following steps:

a. Reach consensus on the key moral values and principles that apply to the technology field.
b. Derive ethical requisites (or norms) from these values.
c. Choose and describe an established design methodology for the development of technology in the technology field.
d. **Develop operational ethics guidelines that involve a translation of the ethical requisites to actionable methodological guidelines.**
e. Develop tools, methods and special topics.

Within the ethics by design guidelines, the focus was on step d., which also focuses on developing operational guidelines. This included reviewing up to two existing ethical guidelines - so for example, within climate engineering we selected the Tollgate Principles for SRM (and another for CDR, which will not be discussed here) and selected relevant sections that would serve as starting points for the TechEthos refined ethical guideline.

The project sought to operationalise these existing guidelines by breaking down the selected principles within each guideline into key component parts which were previously identified as bearing gaps, in a workshop with subject experts. These components were refined using the TechEthos findings concerning both theoretical contributions (e.g.
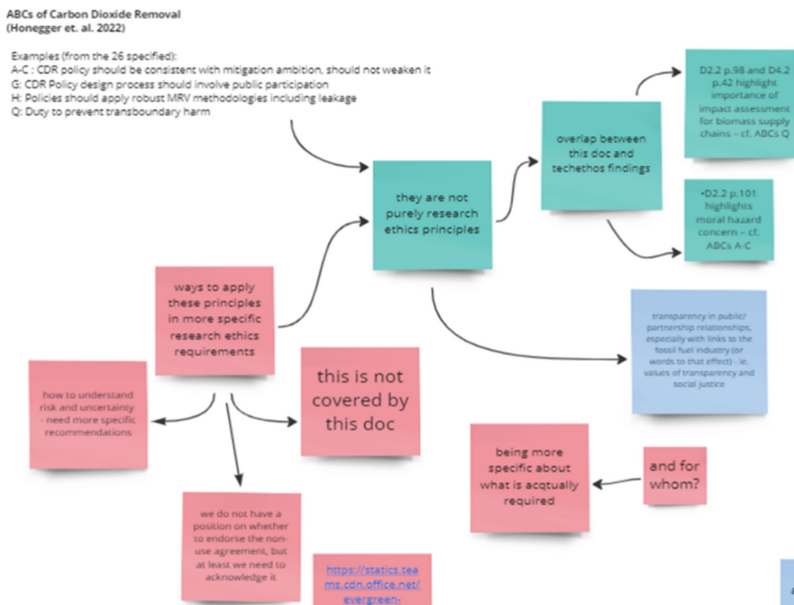
Fig. 3. Section of Miro board which we used during the CE guidelines development/refinement workshop used to lay out gaps next to TechEthos findings.

relevant theoretical principles as previously identified) as well as empirical results (e.g. from the stakeholder engagement part of the project), see Fig. 3.

4 Proposed Improvements to Guidelines for Climate Engineering

4.1 Approach

A mind-map exercise on guidelines relevant to climate engineering research and development was conducted. This literature was divided into "codes", "frameworks" and "guidelines/standards". The mind-map of operational guidelines, frameworks and codes for Climate Engineering is shown in Fig. 4.

On the basis of the mind-map, expert consultation was used to determine which of these existing documents most closely approximated current best practice. This process encompassed two stages. In the first instance, some preliminary expert consultation exercise elicited responses to a series of three scenarios representing possible futures in the context of imagined research and innovation pathways. This was to refine the scenarios to ensure they interrogate the most salient ethical intuitions as precisely as possible, and second to detect expert attitudes to the scenarios themselves, in order to identify concerns to be addressed through operational guidance.

These exercises surfaced a number of directly relevant considerations. In particular, a key cross-cutting concern was the need for a holistic, policy level perspective on technological innovation and development. This was manifested most forcefully in discussions of SRM and CDR, where the importance of viewing the role of technology in the context of an overall climate strategy was emphasised, a strategy encompassing the energy, industrial policy, food, built environment and transportation sectors. The call for a holistic policy-oriented approach was contrasted against the tendency towards "techno-fixes": the flawed assumption that the optimal solution to a given problem must be engineering-based.

In a related concern, expert workshop participants also foregrounded the importance of ensuring ethical guidelines do not promote or presuppose a conception of "development" which privileges a narrow technical-elite perspective. This overarching consideration might find expression in ethical guidelines' recognition of potential power imbalances between R&I actors on the one hand, and communities who might be affected by research outcomes on the other; including recognition of the need to respect global and ideally intergenerational perspectives in stakeholder analyses, actively empowering marginalized communities where necessary to ground meaningful participation.

These considerations guided the process of guideline selection on the basis of the mind-map. In the first instance, priority was given to those proposals which bore most directly on the field of CE in particular, rather than adjacent or superordinate fields. This narrowed the mind-map significantly, as several of the documents identified related to, for instance, CCS, offsetting or renewable energy. All of these have a bearing on CE in the broader policy context, but as the corresponding documents address technical aspects of the adjacent technology fields, they do not in themselves promote engagement with that broader context. Focusing on explicitly CE-oriented guidelines ensured relevance while not limiting researchers from taking the kind of synoptic view the expert workshop participants envisaged.
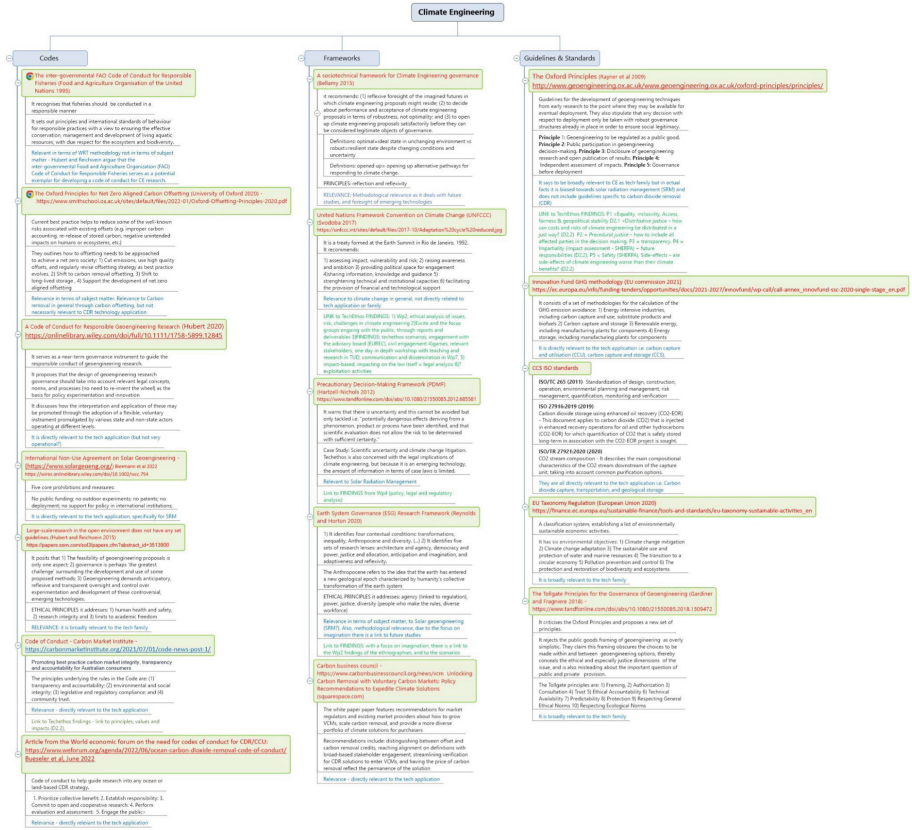
Fig. 4. Mind-map of operational guidelines, frameworks and codes for Climate Engineering

In the second stage of the shortlisted guidelines, further expert consultation was used to guide selection, this time through discussion with internal experts. The Oxford Principles [10] were initially determined to be the most appropriate starting point. This set of principles was produced in 2009 by an interdisciplinary group centred around the University of Oxford. It was produced, in part, pursuant to the Royal Society's recommendation for '[t]he development and implementation of governance frameworks to guide both research and development in the short term, and possible deployment in the longer term' [7, p. 57]. Although an early contribution to that project, it remains one with unique status.

The initial selection of the Oxford Principles was made according to the following criteria. Firstly, the Oxford Principles enjoy quasi-institutionalized recognition in policy circles, insofar as they are, and remain, the only set of CE ethics principles to receive (qualified) endorsement by a government, as well as a committee of a national legislature. Following the publication of the Royal Society's report in September 2009, the House of Commons Science of Technology Select Committee in the UK convened an inquiry on the regulation of geo-engineering, inviting expert submissions. The principles were

submitted in evidence to the committee, and were endorsed in the committee's report, which was then endorsed by the UK government. Although more recent proposals have been advanced as part of government-commissioned research, notably in Germany [11] and in the United States [12], these proposals remain advisory.

Secondly, they remain influential in academia, with an authoritative 2019 review of solar geoengineering governance literature in Proceedings of the Royal Society referring to them as 'the most influential set of principles on climate engineering' [13, p. 11]. Rayner et al. [10] has the highest citation count of surveyed publications directly on CE ethics and governance (Web of Science - 122, Scopus - 147, Google Scholar – 253, retrieved 03 March 2023.).

However, as an early contribution to this literature, the Oxford Principles have since their original formulation and subsequent publication received sustained critical evaluation. It was judged important to reflect these developments, while continuing to acknowledge the principles' ongoing significance. In this respect, the Tollgate Principles [2] were identified as a complement to the Oxford principles. The proposal was that Tollgate principles should not be treated as a novel competing framework, but rather as an updating and correction of the Oxford principles in light of compelling philosophical analysis, which retains the earlier proposal's basic structure and central concerns while adding a further level of ethical precision.

A method of expert consultation was applied to identify gaps in the selected guidance documents, the Oxford Principles, and the Tollgate principles. The most significant gap identified was the treatment these documents gave to the distinction between the ethics and governance of Solar Geoengineering, as against Carbon Dioxide Removal techniques. As noted, the Oxford Principles were in part a response to the Royal Society's 2009 report, which defined its subject matter as 'geoengineering' understood as 'the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change' [7, p. 1], and thus the principles' authors retained this designation of their subject matter.

Despite formally being directed at both CDR and SRM, the Oxford principles have little to say on specificities of CDR governance. Their application to CDR may also be misleading. For instance, it is implausible the authors intended through principle 5 – 'Governance before deployment' [10, p. 507] – to promote a moratorium on all carbon removal activities until legal governance frameworks were in place, including, for instance, all tree-planting and land-use changes. At the time, the field of CDR ethics and governance was less advanced than it is at present, and the disadvantages of attempting to capture both CDR and SRM under a common framework were less clearly identified.

The Tollgate authors explicitly restrict the focus of their concern to SRM. They state that they 'aim to sidestep definitional discussions' by 'assuming that we are discussing the paradigm case of stratospheric sulphate injection (SSI)', adding '[t]he extent to which other interventions share the features that make all or some of the Tollgate Principles appropriate…are topics for another occasion' [2, p.145]. In other words, they make explicit what the Oxford Principles arguably leave implicit: that the principles are formulated with SRM in mind (in particular, Stratospheric Aerosol Injection (SRI)), and leave open the question of whether they apply to other interventions standardly termed "geoengineering".

Neither of these approaches to the question of the guidelines' interoperability between CDR and SRM applications was determined to be entirely satisfactory in expert consultation. Since the publication of the Oxford Principles, a norm has emerged across disciplines according to which CDR and SRM are treated as fundamentally different categories of intervention. The IPCC's 6th Assessment report, analyses CDR under Working Group II, thus regarding it as mitigation, while SRM is analysed separately [14, 14.4.5]. CDR is regarded as a form of mitigation in international law, while SRM is not [15]. There is also philosophical literature arguing that CDR and SRM should not for most purposes be analysed together under the term "geoengineering", for example an influential intervention by one of the Oxford Principles' authors [16]. In the Climate Ethics literature specifically, the ethics of SRM and the ethics of CDR are increasingly becoming two separate sets of literature (while there used to be a subfield in climate ethics called "the ethics of geoengineering/climate engineering", it is increasingly standard practice to distinguish between the two different subfields of the ethics of SRM and the ethics of CDR).

This norm reflects substantive ethical, technical and policy considerations. For instance, while it is possible to draw a sharp distinction between the ethical and regulatory requirements of testing vs deployment in relation to CDR technologies, the same cannot be said for SRM. This is because evidence suggests that any test of the scale and duration required to produce data sufficient to predict the effects of a full-scale deployment of Stratospheric Aerosol Injection (SAI) would not fit plausible definitions of a test, given it would likely require decades of operation and have global impact [17].

Thus, across Science Policy, Law and Ethics, the fields of CDR and SRM research have diverged so markedly as to make a unified research guidance framework for CDR and SRM impracticable, despite the attempt of the Oxford authors. Experts noted that the Tollgate authors' decision to treat Stratospheric Aerosol Injection (SAI) as a 'paradigm' offers some guidance as to an appropriate approach: moving forward, the principles should be treated as applying only to SRM. If certain forms of SRM diverge markedly from the SAI paradigm, further specification of operational guidelines should determine how they are to be applied.

A brief comment on a methodological disagreement between the Oxford and Tollgate principles: [18], defending the Oxford Principles (of which they were co-authors) against rival proposals, point out that the authors deliberately confined themselves to appeal to procedural values, on the grounds that sets of principles which go beyond procedural values and appeal to substantive values fail to cohere with norms of procedural justice. The claim is that it would not be compatible with procedural justice to compel people to adopt principles based on substantive values they themselves do not acknowledge. The Tollgate Principles appeal to substantive ethical values. It can therefore be argued that they fail to cohere with norms of procedural justice.

It was determined this methodological concern was overstated, on the following grounds. The Oxford Principles' authors' claim that the principles are not substantive but merely procedural is contentious. The argument that 'ethical worldviews… are to be expressed in the public discussion which the Principles make space for, rather than being assumed at the outset' [18, p.112] obscures the difficulty in distinguishing supposedly uncontroversial procedural values from values which are substantive and therefore

essentially contested. For instance, there are implicit ethical assumptions embodied in the constitution of publics and the selection of deliberative procedures. The Tollgate authors contend that the relevant public for discussions of geoengineering governance is 'global, intergenerational and ecological' [2, p.155]. This indeed is a substantive ethical claim, but it also sheds light on the substantive ethical claim the Oxford Principles make implicitly: that the relevant public is not global, intergenerational, and ecological, but restricted to geographically demarcated, currently extant human individuals whose interests might be materially affected by geoengineering deployment. The decision to treat substantive ethical values as unavoidable coheres with the mode of ethical analysis adopted under TechEthos Deliverable 2.2, which highlights the tendency of approaches which purport to be neutral to 'rationalize the status quo' [9, p. 22, quoting Mills 2005 p. 181].

4.2   Tollgate Principles for SRM [2]

Below we present the Tollgate principles which will be used as a starting point for the proposed refined guideline for climate engineering.

   Tollgate Principles for SRM [2]**:**

1. Framing: Geoengineering should be administered by or on behalf of the global, intergenerational and ecological public, in light of their interests and other ethically relevant norms.
2. Authorization: Geoengineering decision-making (e.g. authorising research programs, large-scale field trials, deployment) should be done by bodies acting on behalf of (e.g. representing) the global, intergenerational and ecological public, with appropriate authority and in accordance with suitably strong ethical norms, including of justice and political legitimacy.
3. Consultation: Decisions about geoengineering research activities should be made only after proper notification and consultation of those materially affected and their appropriate representatives, and after due consideration of their self-declared interests and values.
4. Trust: Geoengineering policy should be organized so as to facilitate reliability, trust and accountability across nations, generations and species."
5. Ethical Accountability: Robust governance systems (including of authority, legitimacy, justification, and management) are increasingly needed and ethically necessary at each stage from advanced research to deployment.
6. Technical Availability: For a geoengineering technique to be policy-relevant, ethically defensible forms of it must be technically feasible on the relevant timeframe.
7. Predictability: For a geoengineering technique to be policy relevant, ethically defensible forms of it must be reasonably predictable on the relevant timeframe and in relation to the threat being addressed.
8. Protection: Climate policies that include geoengineering schemes should be socially and ecologically preferable37 to other available climate policies, and focus on protecting basic ethical interests and concerns (e.g. human rights, capabilities, fundamental ecological values).

9. Respecting General Ethical Norms: Geoengineering policy should respect general ethical norms that are well-founded and salient to global environmental policy (e.g. justice, autonomy, beneficence).

10. Respecting Ecological Norms: Geoengineering policy should respect well-founded ecological norms, including norms of environmental ethics and governance (e.g. sustainability, precaution, respect for nature, ecological accommodation).

4.3 CE Guideline Gaps

The template guidelines selected represent high-level policy guidance for SRM. No operational guideline documents for R&I in these fields are currently extant in a sufficiently developed form. The guidelines selected therefore represent best practice in terms of high-level guidance - some of the principles listed have direct implications for the operational guidance of research and development, while for others, further work is needed to operationalise the guidance for the R&I context in particular, distinguishing this function from legislative and policy guidance. As high-level guidance, it has been remarked [19, 20] that putting the Oxford and Tollgate principles into practice in the context of project development, public policy, etc. is far from a straightforward matter.

This criticism should not be overstated, since the authors' aim to set out a framework which applies to a broad range of institutional contexts - from international policy to internal science policy and funding, to research - necessarily precludes detailed context-specific guidance. Nevertheless, the principles' authors themselves acknowledge that further work is needed to translate the high-level principles into operational guidance. Furthermore, as noted, the Tollgate principles constitute a moment in an ongoing academic debate, awareness of which is important when interpreting the principles' content. Some alterations to the text are necessary to bring this context into the foreground, in order to produce self-standing guidance that can be applied by an end-user without the need to do additional interpretive work.

The processes of identifying gaps therefore have two components: one, the identification of gaps in the ethical content of the principles themselves (based on TechEthos findings and more recent developments in the literature), two, reframing the updated sets of principles in a more operationally accessible form.

4.4 Proposed Refinement/Development of CE Guidelines

Our strategy is to build on existing guidelines in order to refine them. As such, we built on the Tollgate principles applicable to SRM. To that end, we organised a hybrid workshop in which we identified potential gaps in the selected guidelines, drawing on the expert knowledge of the consortium members. In the following section, we juxtapose the principles identified within the two existing ethical guidelines for SRM with the gaps identified during expert consultation.

4.5 Tollgate Principles for SRM [2]

Starting with the Tollgate principles, the juxtaposition works as follows: the outlined principle is matched up with a corresponding "gap" or suggestions for how the guideline might be refined and then with a proposed, see Table 1.

Table 1. Refining the Tollgate Principles

Tollgate principle guidelines	Annotations for the refinement of the operational guidelines	Proposed refined operational guidelines
1. Framing: Geoengineering should be administered by or on behalf of the global, intergenerational and ecological public, in light of their interests and other ethically relevant norms	The term "Geoengineering" in this principle is ambiguous as to whether it refers to deployment or research. The principle should be specified as "SRM as a research and policy programme", thereby applying to the administration of research as well as any potential deployment This principle must be relativised to particular contexts to determine what administration on behalf of the global, intergenerational and ecological public demands for actors in those specific spheres, with concurrent consideration of the global, intergenerational and ecological concerns related to foregoing SRM and allowing the planet to continue warming. It should contemplate an economical, technological and political feasibility of the technology family, that is also ethically acceptable At a minimum, administration on behalf of the public precludes administration on behalf of an interest group, for instance, a group of shareholders or private investors in a given project Policymakers should direct research strategy so as to ensure the acquisition of intellectual property in SRM technologies is managed in the public interest, in certain cases restricting the conditions under which private entities can acquire intellectual property Technology providers should manage intellectual property in a manner which serves the public interest Researchers should be cognisant that their primary responsibility is to the global, intergenerational and ecological public, and not to any private interest	1. Framing: SRM as a research and policy programme should be administered by or on behalf of the global, intergenerational and ecological public, in light of their interests and other ethically relevant norms. This should contemplate an economical, technological and political feasibility of SRM as a research and policy programme, that is also ethically acceptable

(*continued*)

Table 1. (*continued*)

Tollgate principle guidelines	Annotations for the refinement of the operational guidelines	Proposed refined operational guidelines
2. Authorization: Geoengineering decision-making (e.g. authorising research programs, large-scale field trials, deployment) should be done by bodies acting on behalf of (e.g. representing) the global, intergenerational and ecological public, with appropriate authority and in accordance with suitably strong ethical norms, including of justice and political legitimacy	The norms of political legitimacy need to be even handed and imply an extremely demanding standard for the authorisation of any open-air tests of stratospheric SRM techniques that would be expected to have significant transboundary physical risks. (Morrow et al., 2013) This implies an effective moratorium on deployment, and on open-air experiments that have significant risk of transboundary harm Policymakers, with contributions from the public: should co-produce appropriate research ethics and governance standards, prior to any decision to expand SRM research Technology providers: should not enter into partnerships which envisage deployment until there is international recognition that the conditions for legitimating an SRM policy programme set out in this document have been met Researchers: Since there remains great polarisation about SRM research, researchers may choose to endorse the view of two open letters from prominent groups of researchers which call for expanded SRM research to ensure future decision-making on deployment can be made on an informed basis (Open Letter, 27 Feb 2023; Call for Balance, March 2023). Alternately, researchers may choose to endorse the proposal by one group of researchers which calls upon states not to fund the development of solar geoengineering technologies, the so-called non-use agreement (Biermann et al., 2022). The present document acknowledges but does not actively endorse these proposals	2. Authorization: SRM decision-making (e.g. authorising research programs, large-scale field trials, deployment) should be done by bodies acting on behalf of (e.g. representing) the global, intergenerational and ecological public, with appropriate authority and in accordance with suitably strong ethical norms, including of justice and political legitimacy

Table 1. (*continued*)

Tollgate principle guidelines	Annotations for the refinement of the operational guidelines	Proposed refined operational guidelines
3. Consultation: Decisions about geoengineering research activities should be made only after proper notification and consultation of those materially affected and their appropriate representatives, and after due consideration of their self-declared interests and values	Different levels of consultation are appropriate alongside different levels of research: formulation of research policy, lab research and modelling, open-air experimentation TechEthos's engagement with public groups across Europe, including under-represented groups, has identified key values in relation to SRM that should be taken into consideration in future consultations. Most notably the key values are: Ecosystem health, safety and reliability, effectiveness and efficiency, justice (both global distribution of justice & intergenerational justice, from D3.1, p.100), and naturality TechEthos consultation identified key concerns in relation to the unilateral deployment of SRM technologies (SAI). It also identified a call to evaluate SRM in comparison to the alternative, the negative impacts of non-deployment Alongside consultation, capacity-building would be should be pursued - so that participants have knowledge and understanding to inform their contributions to the consultation process. One of such ways is gamification as used in TechEthos (D3.2) to engage with citizens from different backgrounds Policymakers and researchers should engage in cooperation to ensure that sufficient capacity for relevant public bodies to meaningfully participate in consultation is in place. This capacity building process should run in parallel to consultation, rather than acting as a barrier to it. Steps should be taken to ensure the process of constituting deliberative democratic bodies is itself sufficiently inclusive and unbiased	3. Consultation: Decisions about SRM research activities should be made only after proper notification and consultation of those materially affected and their appropriate representatives, and after due consideration of their self-declared interests and values. Alongside consultation, capacity-building should be pursued. Policymakers and researchers should engage in cooperation to ensure that sufficient capacity for relevant public bodies to meaningfully participate in consultation is in place

Table 1. (*continued*)

Tollgate principle guidelines	Annotations for the refinement of the operational guidelines	Proposed refined operational guidelines
4. Trust: Geoengineering policy should be organized so as to facilitate reliability, trust and accountability across nations, generations and species	When considering trust, there is the need to underline/foreground the values of transparency and social justice Particularly, trust needs to be complemented with transparency (and explainability) in public/private partnership relationships, especially when it comes to the links to the fossil fuel industry/parties with vested interests in the development of SRM SRM research programmes, including social science and modelling, and certainly any experimentation, should as far as possible be internationally cooperative, and should be subject to public periodic reporting, and open publication of results, including negative results and balanced reporting of positive results. Policymakers and researchers should cooperate to ensure these conditions are implemented There are different types of trust - in the technologies and in the institutions that develop and those that regulate it	4. Trust: SRM policy should be organized so as to facilitate reliability, trust, transparency and social justice and accountability across nations, generations and species

Table 1. (*continued*)

Tollgate principle guidelines	Annotations for the refinement of the operational guidelines	Proposed refined operational guidelines
5. Ethical Accountability: Robust governance systems (including of authority, legitimacy, justification and management) are increasingly needed and ethically necessary at each stage from advanced research to deployment	Policymakers: Should ensure that governance institutions for SRM are constituted to manifest, inter alia, the virtues of transparency and accountability (see Morrow, Kopp & Oppenheimer 2013). This implies an effective mechanism for affected parties to collectively monitor and collectively approve or reject the decisions and actions of those governance institutions Monitoring requires that institutions provide information on their goals and behaviour in a format intelligible to all relevant global publics	5. Ethical Accountability for SRM: Robust governance systems (including of authority, legitimacy, transparency, justification and management) are increasingly needed and ethically necessary at each stage from advanced research to deployment
6. Technical Availability: For a geoengineering technique to be policy-relevant, ethically defensible forms of it must be technically feasible on the relevant timeframe	Reference to "ethically defensible" forms seems to threaten circularity in the context of an ethical guidance document. "Ethically defensible forms" should here be understood as forms that can reasonably be defended against the charge they violate the norms underlying Tollgate principles 9 and 10 (for this argument see Morrow 2018)	6. Technical Availability: For a SRM technique to be policy-relevant, ethically defensible forms of it must be technically feasible on the relevant timeframe

Table 1. (*continued*)

Tollgate principle guidelines	Annotations for the refinement of the operational guidelines	Proposed refined operational guidelines
7. Predictability: For a geoengineering technique to be policy relevant, ethically defensible forms of it must be reasonably predictable on the relevant timeframe and in relation to the threat being addressed	This principle should include a re-elaboration of the concern of irreversibility from using or rejecting SRM (D2.2) Irreversibility refers to irreversible harm and irreversible changes in the Earth system linked to the crossing of climate tipping points, which are a function both of climate change with, or without, SRM. The likelihood of tipping points is known to increase with warming. Irreversibility also links to the termination-shock concern, i.e. if SRM is deployed to a high level and then suddenly and permanently stopped, the rebound effect may be worse than the situation that was initially tackled by the first intervention	7. Predictability: For a SRM technique to be policy relevant, ethically defensible forms of it must be reasonably predictable on the relevant timeframe and in relation to the threat being addressed. Re-elaboration of the concern of irreversibility from using or rejecting SRM
8. Protection: Climate policies that include geoengineering schemes should be socially and ecologically preferable to other available climate policies, and focus on protecting basic ethical interests and concerns (e.g. human rights, capabilities, fundamental ecological values)	Note that comparisons between policies should factor in consideration of the risk of warming arising from any decision not to develop SRM The risk-risk framing should be attached to "ecological guardrails". Risks of non-implementation of SRM should be considered in the context of climate policy scenarios which are compatible with human rights/human wellbeing, and fundamental ecological values, rather than taking for granted scenarios in which policymakers fail to protect these values	8. Protection: Climate policies that include SRM schemes should be socially and ecologically preferable to other available climate policies, and focus on protecting basic ethical interests and concerns (e.g. human rights, capabilities, fundamental ecological values). Non-implementation of SRM should be considered in the context of climate policy scenarios

Table 1. (*continued*)

Tollgate principle guidelines	Annotations for the refinement of the operational guidelines	Proposed refined operational guidelines
9. Respecting General Ethical Norms: Geoengineering policy should respect general ethical norms that are well-founded and salient to global environmental policy (e.g. justice, autonomy, beneficence)	Note that "geoengineering policy" also comprises decisions to constrain or delay SRM research	9. Respecting General Ethical Norms: SRM policy should respect general ethical norms that are well-founded and salient to global environmental policy (e.g. justice, autonomy, beneficence). Constrain or delay SRM research should also be considered
10. Respecting Ecological Norms: Geoengineering policy should respect well-founded ecological norms, including norms of environmental ethics and governance (e.g. sustainability, precaution, respect for nature, ecological accommodation)	See above clarification of term "geoengineering policy"	10. Respecting Ecological Norms: SRM policy should respect well-founded ecological norms, including norms of environmental ethics and governance (e.g. sustainability, precaution, respect for nature, ecological accommodation). Constrain or delay SRM research should also be considered

5 Discussion

As already intimated, to understand how these principles can be operationalised, it is necessary to recognise the extent to which they form a dialogue with the Oxford principles. The Oxford principles state that 'Wherever possible, those conducting geoengineering research should be required to notify, consult, and ideally obtain the prior informed consent of those affected by the research activities' [10]. The Tollgate authors argue for the modification of this principle, insofar as it limits the scope of public participation to 'research activities' and 'those affected' by them. This excludes from the scope of public participation, for example, oversight of research policy programmes, or indeed, actual deployment of CE. It also excludes from participation those people who are not affected by research, which the Tollgate authors interpret to mean those not whose interests are not materially set back by experimental activities in themselves, which they argue is an unwarranted restriction.

Nericcio [19] has claimed that the Tollgate authors' case for expanding the scope of public participation implies similar wide scope public participation requirements would be necessary for any intervention in the climate system, even for purposes other than climate engineering - for instance, greenhouse gas emissions. The claim is that if we think such requirements implausible, then the same requirements in the case of CE must be too demanding. Nerricio [19] reads the Tollgate authors' rhetorical question "is it not our planet too?" as expressing their argument for wide scope participation: he compares it to the claim that any resident of a city should have participatory rights with respect to any development in the city, on the grounds that it is "their city". This is a misreading

of the Tollgate authors' argument. The claim is not that people who are completely unaffected by an intervention in some domain should nevertheless have the right to participate in decision making about it if that domain is in any sense "theirs". The claim is rather that specifically geoengineering as a research programme, significantly affects extant and future people, even if those effects are indirect or not 'material'. This also reflects Schultz and Latour's argument that society (people) should define what society needs to maintain the planet for ongoing inhabitation, as opposed to systems that are just focused on finance, politics, etc. [5].

Further, the hope from the experts that the importance of ensuring ethical guidelines do not promote or presuppose a conception of "development" which privileges a narrow technical-elite perspective, is now reflected in the proposed revision to the Tollgate guidelines 2–4 regarding Authorization, Consultation and Trust, as well as guideline 5 on Ethical Accountability for SRM. Together these would represent a much broader set of stakeholders which could represent a much broader set of viewpoints.

To complete the process of developing proposals for operationalizing these guidelines, it is necessary to more precisely specify which parties have primary responsibility for, ensuring the fulfilment of each principle, or at least, who are the most relevant actors in relation to each principle.

6 Conclusion

This paper has sought to show how the technologies involved in climate engineering to mitigate the worst impacts of climate change, notably Solar Radiation Management (SRM), need to be viewed through an ethical lens. Latour has adopted the term "hybrid monster" to describe climate change as a product of society and technology, which points us towards a socio-technical approach as a way to address it [21]. While Latour talks about the role of the technology as an actor or 'actant' in the network and system of humans and technology, when it comes to the planetary ecosystem, the question is whether we sufficiently recognize the role that climate engineering technologies might play. At the time of writing this paper, it is still not generally acceptable to carry out research in large scale SRM, due to the wider concerns about the potential ecological consequences. These range from the potentially uncontrolled or uncontrollable nature of the technology, through to the concerns that if it works, it would be used as an excuse for people to stop trying to reduce carbon dioxide production and could even be used for political control.

The range of ethical values and principles seen within the SRM and CE context, those of moral hazard, moral corruption, hubris are part of a series of ethical values and principles that can be seen as cross-cutting a range of technologies. Therefore, these can also be seen as relevant to the wider Information Systems field. The specific ethical values and principles identified for this family of climate engineering technologies, also are linked to a broader set of values and principles and the potential for developing a more holistic anticipatory ethics framework, based around anticipatory technology ethics (ATE) [22] and beyond [23].

However, as we continue with ever increasing industrialization and production, are we nearing that tipping point, or point of no return (similar to Latour's Obligatory Passage

Points (OPP) in that this issue can become the focal point around which the actors coalesce and enable them to find a position in which their interests can become aligned with the wider interests [24])? This leads us to a counter-factual argument, whereby the consequence of not doing something becomes worse than doing it, even with all the caveats it might imply. Therefore, to have the discussion and associate guidelines for SRM in place, with sufficient ethical issues added, seems not only prudent but essential. These proposals for revised ethically informed operational guidelines might just provide that element which we hope will not be needed, but just might.

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Digital Innovation Systems and the Rejection of the Terrestrial

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Abstract. Latour's analysis of the 'elites' of society, and their rejection of politics that accounts for the natural limits of our planet (the Terrestrial), offers Information Systems research a unique opportunity to analyze digital innovations in ways that reflect the overwhelming role of social 'elites' in steering technology directions. A proposed next step for Information Systems research is to follow Latour's lead and map his 'elite' strategies (including the burden of solidarity, the gilded fortress, and denial) on to modern digital innovation systems oriented toward rapid growth and social irresponsibility, with a goal of identifying alternatives and advocating for more pluralistic forms of technology politics.

Keywords: Actor-network theory · Terrestrial · innovation systems

1 Latour's Potential for Information Systems Research

Latour's thinking has not been as influential on Information Systems research as might be expected or hoped, considering how well his semiotic view of both human and technological 'actants' describes a world now thoroughly infused with networks of digital symbolic machinery.

The vocabulary of Actor-Network Theory (ANT) portrays technologies and humans as playing roles according to scripts, with the ongoing associations between them being shaped by how the scripts are executed in practice (will the speed-bump or the police officer be more likely to keep drivers from speeding [1]?). Perhaps one of the main stumbling blocks of this form of analysis was the question of context: who or what was assembling these actor-networks, under what conditions, and for what purposes [2]? Latour offered us an endless sea of connected actor-networks, with some connections temporarily bracketed aside for analytic purposes, making it difficult (one could argue deliberately so) to take those thick descriptions and connect them with any larger theoretical account.

Latour's later arguments about the attempted exclusion of the natural world (the Terrestrial) from these actor-networks are an interesting evolution of his work [3]. As an overtly political project, Latour was compelled to create a contextual account around his actor-network analysis. In addition to introducing Mother Earth as the ultimate 'actant' that can be included or excluded from actor-networks, his Terrestrial story focuses on

a new central character: the 'elites'. While these 'elites' are not precisely defined, for our purposes we will associate the term with those who strive to, and are regularly able to, exclude the majority of people from political decision-making around globalization and technology [4]. This social group is now the prime mover in understanding how the actor-networks around digital technology—embroiled in larger shifts of globalization and automation—incorporate or exclude the natural environment.

The unique opportunity for Information Systems research offered by Latour's later work is to finally bring context into his thick description—to create analyses of digital technology production, distribution, and consumption that reflect the overwhelming roles of social 'elites' in steering technology directions: the wealthy high-risk investors, the tech entrepreneurs, 'big tech' industry players and executives, and influential political interests. This analysis of 'elite' network-building stands in stark contrast to the usual asocial IS discussions of 'technology acceptance', 'design science', 'diffusion', 'use' and 'digital transformation', offering a path out of the wilderness for IS research— widely ignored during the current obsession with AI and technology ethics—and for the digital tech industry as a whole, which has been following a path of almost total and willful irresponsibility as it plunges headlong into a series of aggressive techno-social bets on cryptocurrency, virtual reality, and now generative AI. (See [5] for a definition of 'responsible innovation'—recent waves of digital technology innovation are pursuing almost exactly the opposite path: a lack of anticipation, little reflexivity, social exclusion, and an absence of systematic response to the needs and desires of other stakeholders.)

2 Digital Transformation and the Terrestrial

As a proposed next step for IS research, Latour's analysis of 'elites' and the future of material existence would need to be mapped on to our current structures of technology production and use, with a goal of explaining why digital technology—in theory a powerful force for truth and efficiency that could identify and rectify our collective natural environment problems—contributes so weakly to the cause of saving the planet. Bitcoin stands as an obvious example of how digital solutions have been channeled toward solutions that accelerate environmental degradation, but the metaverse and AI have been at best neutral and at worst escapist or diversionary in this regard.

To follow Latour's analysis, we can begin from the three 'elite decisions' that follow from their desire to engage in a politics of surviving the inevitable environmental collapse to come [3]. It is worth quoting in detail (p. 18–19):

"If the hypothesis is correct, all this is part of a single phenomenon: the elites have been so thoroughly convinced that there would be no future life for everyone that they have decided to get rid of all the burdens of solidarity as fast as possible – hence deregulation; they have decided that a sort of gilded fortress would have to be built for those (a small percentage) who would be able to make it through – hence the explosion of inequalities; and they have decided that, to conceal the crass selfishness of such a flight out of the shared world, they would have to reject absolutely the threat at the origin of this headlong flight – hence the denial of climate change."

This passage identifies three interrelated strategies employed by social elites: the *burden of solidarity*, the *gilded fortress*, and *denial*. The burden of solidarity provides

an impetus to steer technology development in the direction of deregulation, not simply because technology innovation is fast and new and existing laws are a legacy from the past, but as a conscious strategy to remove social obligations and responsibilities from social elites to other members of society. Deregulation can happen by destabilizing or avoiding existing laws, as in the case of 'sharing economy' platforms such as Uber and AirBnb, or by engaging in jurisdictional arbitrage between countries to find favorable taxation and intellectual property regimes, as can be seen in the per capita GDP rise of aggressive nations such as Singapore and Ireland.

The gilded fortress strategy identifies the recurring problems of digital exclusion and inequality not simply as artifacts of a discriminatory past that will be overcome through the economically rational application of digital transformation, but as a necessary outcome to promote elite interests. For digital innovations to maximally serve elite interests without restriction, unequal digital access, skills, and resource distribution will continue to exist.

Finally, an active denial strategy is required to sugar-coat the selfish nature of elites so blatantly serving their own interests during digital transformations at the expense of the rest of human society, and the natural world. In this reading, the spread of misinformation and disinformation in the digital era is not primarily due to a few bad actors or extremists but is much more fundamental to the larger project of perpetuating 'elite' interests. The ability to flood information channels, amplify or deaden certain voices, and manufacture uncertainty about the nature of truth through 'deepfakes' all reinforce and perpetuate some of the most common digital business models around social media, video sites, and search, making the denial strategy more of a feature than a bug.

3   Elites and the Modern Digital Innovation System

Following Latour down this path of 'elite' analysis would no doubt be novel and refreshing for IS research, but it is so counter-cultural to existing mainstream expectations that it might be dismissed out of hand as a bizarre form of European (French!) conspiracy theory.

One path forward for IS research would be to engage in in-depth case studies, using actor-network vocabulary, but tracing the role of 'elite' decision-making in the formation of actant scripts, roles, and associations. What we would propose here, however, is instead an intermediary level of analysis focused on the institutional regularities of innovation formation and shaping, or what economists refer to as an *innovation system* [6]. The gap between a thick description of 'elite' desires and the details of specific digital transformations might be too great to plausibly bridge in a single research project, especially for a skeptical audience. Perhaps a better first step would be to show how Latour's 'elite' strategies are consistent with the biases of the dominant innovation system for producing digital transformations, which then can be connected to specific cases of digital technology's continued exclusion of the Terrestrial.

This path would require a re-evaluation and re-specification of the dominant innovation system for today's digital technology. Unlike the classical approach to innovation systems, which specifies a *triple helix* of government, industry, and academia interacting to various degrees [7], the innovation system around cryptocurrency, virtual reality,

autonomous vehicles, generative AI, etc. would be better described as a 'Silicon Valley' or 'unicorn' innovation system oriented toward serving the needs of a combination of dominant big technology platforms and hypergrowth oriented technology startups within a highly unequal financial and labor market system. In each major phase of this innovation system, which we would tentatively describe as consisting of an *experimental* phase, a *growth* phase, and a *dominant platform* phase, potential digital innovations are backed or strangled in the crib, shaped and shifted by an easily identifiable system reflecting 'elite' interests and decision-making.

The research challenge, then, is to recast the mundane, non-controversial aspects of this innovation system into the terms of Latour's Terrestrial story. For example, the non-controversial *lean startup* approach [8] in the experimental phase benefits from a complete freedom to try out incomplete, low-quality products and services as quickly as possible without restriction. Making technological innovation *venture fundable* [9] requires molding technologies into high growth opportunities, with non-controversial *growth hacking* strategies [10] such as cross-subsidy and 'friction removal' designed to reward the minimization of resistance and consideration of diverse needs. And of course, much has been said about the business desirability of *platforms* as a business model [11], but less about how the preference for these business models shapes every technological opportunity into ones that offer possibilities for domination, regardless of any collateral damage, as can be seen in the latest generative AI rush.

It is at the level of innovation systems and above that we expect to find the kind of alternatives to today's digital technology regimes, just as Latour defined the Terrestrial as an alternative to local, global-plus, and global-minus politics.

4 Strategic Responses: Re-targeting the Terrestrial Through Digital Pluralism

The objective of this stream of IS research should not be to simply introduce another theoretical novelty, but to tackle the relative exclusion of natural and planetary concerns in our march toward digital transformation, as identified in Latour's tale of the Terrestrial.

If the current digital innovation system is left intact, any hope that the addition of a thin layer of 'technology ethics', 'inclusion', 'responsible innovation', 'ESG reporting', or 'SDGs' on top of these massive resource and capacity commitments has to be critiqued and, we would argue, ultimately dismissed. The persistence of widespread social inequality and environmental degradation during the past 50 years of the digital age has to be clue enough that alternatives are needed and have yet to be properly identified. Recent cases of digital transformation, such as Bitcoin and OpenAI, only reinforce this story. With a resurgence of economics research suggesting that the direction of technology can be shaped or chosen [12], Information Systems research has an opportunity to enter the social conversation and influence our digital future.

Philosophers of technology and society such as Latour invite us to imagine more pluralistic modes of innovation, with a more equal balance of power between 'elites' and the remainders of society, which are much more firmly rooted in the politics and needs of what he defined as the Terrestrial. The distance between these philosophers of technology and IS research is still large, however. Latour offers us a productive question: who would exclude the Terrestrial from the future, and why? It is up to us to answer it.

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Digital Degrowth – Beyond Solutionism

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Abstract. This paper argues that environmental sustainability should become a primary goal in IS research. Often, we tend to propose digital technology as a solution that contributes to environmental sustainability. Less frequently we recognize that the energy and material resource flows associated with ICTs in themselves have environmental impacts. The tendency to consider digital technology a solution instead of a challenge is one-sided and tends to drive growth in digital technologies. This is reinforced by the "green growth" discourse which exhibits a continued and unrealistic reliance on economic growth. Alternative paradigms under the larger "postgrowth" umbrella articulates other priorities, including degrowth and sufficiency-oriented approaches. In this Research-in-Progress paper I review some approaches, such as computing within limits, collapse informatics, permacomputing and debates about judicious digital design and frugal innovations, as a starting point for articulating implications and possible directions for how the IS field could engage with a degrowth agenda.

Keywords: Environmental sustainability · Green growth · Degrowth

1 Introduction

1.1 The Relations Between ICT and Sustainability

The "triple planetary crisis" of climate change, biodiversity loss and pollution pose an existential threat, not just to our current civilization, but to conditions for life on earth. It is also not only a future crisis, but already now impacts the livelihoods of people, most often in LMIC contexts. These issues cannot simply be 'solved' – they require fundamental changes in how human societies operate. The realization is spreading that merely adjusting the current world order in a 'greener' direction is not sufficient; we cannot continue with "business as usual". This implies also that we as IS researchers cannot consider the sustainability transition as just yet another business opportunity that calls for digital innovation.

The policies that respond to these crises are broad and seek to achieve both environmental, social and economic sustainability. For instance, the UN Sustainable Development Goals, launched by the United Nations General Assembly in 2015, seeks to end poverty, protect the planet, and ensure a better and more sustainable future for all by

2030. The 17 SDGs address aspects of both social, economic, and environmental sustainability, and the domains they are addressing are inter-connected so that action in one area will also impact outcomes in others. Despite this, the SDG goals are not necessarily internally consistent; for instance, SDG 8 aims to sustain economic growth in Gross Domestic Product (GDP), aiming to sustain per capita economic growth in accordance with national circumstances. This aim of continued economic growth might undermine SDG 13 which seeks "to take urgent action to combat climate change."

Technology plays a significant role in these policies. Electrification, hydrogen-fueled vehicles, innovative carbon-capture technologies as well as digitalization are examples of technologies proposed and promoted. While promising in theory, to actually mobilize technologies at the required scale is immensely challenging. Not only will it be challenging to organize and coordinate actors that need to develop novel technologies. Also, the proposed production of new technologies will have environmental impacts. For instance, there are significant environmental costs associated with building renewable energy production. Scalable carbon capture technologies at a realistic price are still a chimera, and the continued promotion of this as a solution may have the counter-productive effect of postponing emission reduction. Gains from eco-efficiency initiatives, such as more fuel-efficient engines, can be counter-balanced by increased consumption – known as the "rebound effect" or Jevon's Paradox, which occurs because improved efficiency lowers the relative cost of using a resource, which in turn increases the quantity demanded [1]. Therefore, there is a need to look critically at the role of technology in addressing the sustainability challenges. This includes digital technologies and information systems.

1.2 The Sustainability Challenge of Digital Technologies

So far, there has been continuous growth of digital technologies. This has negative effects on sustainability, because it is followed by growth in power consumption, which again cause greenhouse gas (GHG) emissions (if fossil fuel based) and/or destruction of nature (if renewable energy-based). Also, the fast growth leads to continuous replacement and obsolescence of digital devices, which requires use of both rare earth minerals and hazardous materials, and where both the manufacturing and disposals of these materials are challenging. E-waste (waste from electronic and electrical equipment) has become the fastest growing waste stream globally. Much of this is hazardous waste that has detrimental effects on natural and social ecosystems, and the vast majority of this waste is not handled securely [2].

Information Systems has traditionally had a 'constructive' orientation towards development and progress, and critical engagement with premises, processes or effects of IS hasn't yet become mainstream. We need to develop this and go beyond a simplistic "solutionism" – the belief that there exist technological solutions for (all) human problems [3]. We need to be aware of "greenwashing through digitalization", and we need to point out the duality of digital technologies as both solution and challenge related to their consumption of energy and resources and producers of pollution from e-waste. More fundamentally, we need to question our allegiance to continuous growth and innovation as an unquestioned good, which is implied in the notion of 'green growth'.

1.3   The Problem with "Green Growth"

Historically, humanity's economic development has consumed natural resources such as energy, materials, water, and land until it reached a state where these resources are under pressure. This needs to change, especially in the Global North. Still, many wishes to still maintain economic growth in the form of "green growth". This involves seeking greater efficiencies in the use of natural resources, waste reduction and energy consumption, stimulating the market demand for green goods and services, or eliminating environmentally harmful subsidies [4]. The idea of green growth is based on the premise that economic growth (growth in GDP) can be "de-coupled" from a growth in greenhouse gas (GHG) emissions [5], based on the hope that "the world does not need to choose between averting climate change and promoting growth and development" [6]. Also, the UN's Sustainable Development Goals (SDGs) builds on this premise (see target 8.4).

There has been an active debate whether such decoupling can possibly occur at the rate and scale required to address the sustainability and climate crisis [7]. While there are examples of empirically documented cases of decoupling, these are mainly local and considers relative decoupling (i.e., continued growth, but at a slower growth rate). Based on a systematic review of 835 studies, Haberl et al. [8] conclude that "large rapid absolute reductions of resource use and GHG emissions cannot be achieved through observed decoupling rates, hence decoupling needs to be complemented by sufficiency-oriented strategies and strict enforcement of absolute reduction targets." Hickel and Kallis [9] conclude that green growth theory lacks empirical support.

2   Alternatives Approaches

2.1   Alternatives to Growth Paradigms

Advocates for limited growth has existed for some time, and one of the earliest policy documents was the "The Limits to Growth" report from the Club of Rome in 1972. More recently, alternatives to a growth paradigm have been articulated by the "post-growth" or "degrowth" movement, arguing for steady state and/or non-growth economics, at least for the already wealthy countries. The term "degrowth" proposes a radical political and economic reorganization with reduction in resource and energy use, aiming for economic stability also without growth [10]. These ways of thinking seek to create *sufficiency* (see e.g.,[11]), i.e., a qualitatively differently oriented goal.

Sufficiency-oriented approaches also address ICTs. For instance, Santarius et al. [12] articulates "digital sufficiency" in four dimensions – hardware, software, user and economic sufficiency. Hardware sufficiency aims for fewer devices needing to be produced and their absolute energy demand being kept to the lowest level possible to perform the desired tasks. Software sufficiency seeks to ensure that data traffic and hardware utilization during application are kept as low as possible. User sufficiency strives for users applying digital devices frugally and using ICT in a way that promotes sustainable lifestyles. Economic sufficiency aspires to prioritize digitalization that support a transition to an economy characterized not by economic growth as the primary goal but by sufficient production and consumption within planetary boundaries.

2.2   HCI Debates on ICT and Sustainability

Researchers in the Human-Computer Interaction field have for some time addressed how sustainability and technology design are intertwined [13, 14]. For instance, the materiality of digital devices, their need for repair and maintenance, and their sources and end states has been addressed [15, 16]. Work on "computing within limits" [17] discuss current and near-future ecological, material, and energy limits, and asks how new forms of computing may help support wellbeing while living within these limits, The authors propose three key principles: 1) question growth, 2) consider models of scarcity, and 3) reduce energy and material consumption. This work is positioned as an alternative to traditional growth-oriented computing research. Also, permacomputing, a nascent concept which seeks to apply permaculture principles to computing (see e.g. [18]), embraces limits and constraints as positive and generative for creativity.

Some HCI researchers have also debated how to evolve their field with an expectation of challenges to come. For instance, Blevis and Blevis [19] foresees the need to design digital tools targeted at preparation and adaptation to disruptive climate effects. This could for instance be technologies that can help people plan and prepare for adaptation, such as identifying locations for possible food production or habitable conditions, through available data, visualizations, tracking, and predictive simulations (ibid., p. 29). Also [20] argues that it is prudent to consider the possibility that the current global industrial civilization will not persist indefinitely. They introduce the notion of *collapse informatics*—"the study, design, and development of socio-technical systems in the abundant present for use in a future of scarcity." In the HCI field also alternative design frames have been articulated: Tomlinson et al. [21] propose to extend the "persona" often used in design practices to that of the "ecosystema – a construct modelled on the persona, but at the level of an entire ecosystem.

2.3   Relevant IS and ICT4D Debates

Also, within IS and ICT4D we can find calls for different approaches to design. For instance, the call for "judicious design" [22] pointed to the need to be context sensitive and to pursue a hybrid design of both paper and digital tools that are appropriate in an Indian rural hospital. Similarly, [23] proposed design principles for hybrid (paper and digital) information systems in the context of health clinics in South Africa. Another concept is "frugal innovations" [24–26] which indicates affordable, simple, and sustainable products and services, and "doing more with less". These approaches, emerging from resource-constrained contexts, can also point forward for less resource-demanding modes of activities with less environmental impacts. Until now, however, these notions are used primarily in relation to design within constraints related to resource limitations (e.g., personnel, financial resources, competence) and not specifically with respect to environmental concerns. If we wish to apply them in a sustainability framing, we should consider both constraints imposed by (voluntary or necessity-driven) *limits on resources*, and constraints related to (environmental) *impacts*. This implies that we need to cultivate a stronger attention to the materiality of the technologies and their impact on ecologies, humans, and non-humans. A 'frugality' directed at sustainability would consider the materials required (and their impacts) and the resources used (and their impacts).

3 Towards Digital Degrowth

Research based in alternatives to growth paradigms would seek to work on other problems and come up with other solutions than the traditional ones. Reducing energy and material resource use while maintaining wellbeing and collective sufficiency would become more important. An example can be found in a recent policy report [27] with a sustainability-driven look at ICTs, recommending attention to: the selection of locations where computing facilities and data centers are built, how energy-efficient various algorithms and data are (build knowledge into models, not calculate everything), how data are made available for sharing to reduce duplication in storage and transfer, how data volume can be reduced as early as possible through edge computing, and how we can address e-waste.

To be able to generate digital solutions that support continuous life on earth we need to question the extractive, anthropocentric mode of being in the world, which acts as if only humans matter. It requires a deeper awareness of the intricate relations of the web of life integral to holistic/systems perspectives. In Latour's words: "So, we need to […] start thinking in terms of *overlapping* and *encroachment*, to come down a bit into the ethology of living things" [28], p. 42 (emphasis in original). Recognizing the centrality of *associations* (a key term in Latour's works) might help us to see the impact of ICT's material as well as symbolic and digital qualities, their effects and consequences for those that relate to them in any stage of their life cycle. This may change our attitudes and values to the more-than-human life forms that share the earth with us. However, such change is a greater task, and this paper is just a very little step in that direction.

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ICT's and Sustainable Development

A Synthesis of the Causes of ICT4D Projects' Pilotitis: Prioritising the Remedies for the SDG2030 Agenda

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Abstract. Countries from low-and-medium income sectors have faced several long-standing challenges, including poverty, unemployment and an overburdened healthcare system. In many of these countries, pilot Information and Communication Technology for Development (ICT4D) projects are typically implemented to help alleviate some of these challenges. However, many of these ICT4D projects have not had much success in being replicated in other contexts, a phenomenon that has earned the title of "pilotitis". Several researchers in the ICT4D field have identified some of the causes of pilotitis, while others have offered solutions. However, despite inching closer to the 2030 deadline to accomplish the United Nations' Sustainable Development Goals, the challenge of pilotitis remains unresolved. In this paper, we present a synthesis of a systematic literature review of 25 research papers. The synthesis identified four broad causes of pilotitis and four broad areas of remedies to the "disease" that has plagued the ICT4D space for many years. The main contribution of the paper is the framework, *"Pilotitis: Cause-Remedies Framework"*, a tool that can be used to ensure that future ICT4D projects do not succumb to pilotitis and experience subsequent failures.

Keywords: Pilotitis · Sustainable ICT4D Projects · Systematic Literature Review · Cause-remedies Framework

1 Introduction

The United Nations (UN) introduced the Sustainable Development Goals (SDGs) in 2015 to address critical global challenges such as poverty reduction, environmental protection, and promoting peace and prosperity [1]. The SDGs comprise seventeen goals, and the target is to accomplish them by 2030 [2]. Environmental degradation, inequality, climate change, an overburdened healthcare system, and poverty are some of the challenges that the SDGs aim to tackle, which are issues that citizens from the Global South have to contend with daily [3]. The global Covid-19 pandemic exacerbated these challenges [4]. Frequently, projects aimed at addressing these issues are unsuccessful despite the efforts of various funding organizations.

The literature extensively documents the long-standing challenge of Information and Communication Technology for Development (ICT4D) projects that are stuck in the pilot phase, as evidenced by Pade-Khene and Lannon [5], and Pant and Poudyal [6]. Over time, researchers such as Sundin, Callan and Mehta [7] and Masiero [8] have attempted to identify the causes of the phenomenon euphemistically referred to as "pilotitis". Others, like Kuipers, Humphreys, Wakerman, Wells, Jones and Entwistle [9] and Egermark, Blasiak, Remus, Sapanel and Ho [10], have tried to offer remedies for the "disease" that plagues ICT4D projects. Despite these efforts, ICT4D researchers still express concerns about scaling up such projects, particularly in low-and-medium income countries [11, 12], often referred to as the Global South. Given the unabated chronic nature of pilotitis, the objective of this paper is to synthesize the causes of pilotitis in ICT4D projects and highlight their remedies before the UN's target year of 2030 for attaining the SDGs. The knowledge gap is identified as timely and relevant, as the majority of ICT4D pilot studies are either completely unsuccessful, or only partially successful, as Heeks [13] points out when identifying the design-reality gaps, yet the SDG deadline is inching closer.

2   Background

In projects related to ICT4D, numerous unsuccessful or partially successful outcomes exist. According to Adywiratama, Ko, Raharjo and Wahbi [14], a significant proportion of IT projects face challenges (53%) or fail outright (18%). A challenged project does not fulfill the expected requirements, such as cost, planning and execution, expertise, time frame, or client specifications [14, 15]. The failure rate for ICT4D projects is even higher, with an overall success rate of just 29% [16]. While there are various documented reasons for failed initiatives, the researchers in this paper aim to focus exclusively on pilotitis. The term pilotitis, first used in the health sector [17], describes projects that are typically short-lived and never scaled [18] to reach their full potential.

Investors often prefer to fund a "proof-of-concept" [18] before committing to a larger project, as a successful pilot project provides evidence that the initiative has potential and justifies further financial support. Nevertheless, the tendency for a succession of pilot projects can lead to pilotitis, which can erode the confidence of the intended beneficiaries in the projects. These initiatives are often short-lived, fail on their promises, and do not provide any long-term benefits [19].

3   Methodology

The research method followed in the study was the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline by Page, McKenzie, Bossuyt, Boutron, Hoffmann, Mulrow, Shamseer, Tetzlaff, Akl, Brennan, Chou, Glanville, Grimshaw, Hróbjartsson, Lalu, Li, Loder, Mayo-Wilson, McDonald, McGuinness, Stewart, Thomas, Tricco, Welch, Whiting and Moher [20]. Peer-reviewed publications were sought from the Google Scholar search engine, the AIS Digital Library, and the Springer-Link databases in November 2022, using the search phrases ("ICT4D" OR "ICT for

development") AND ("Projects" OR "Pilots" OR "Design") AND "Pilotitis" AND "Context". Our search on the AIS Digital Library did not yield any results. Hence, only sources from the Google Scholar search engine and SpringerLink were considered. A total of 54 search results were retrieved from Google Scholar, 17 sources from SpringerLink, eight sources were retrieved through hand searches while another one was retrieved from a source cited in the papers that were retrieved.

The sources were imported into an Excel Comma Separated Values (CSV) file. Initial screening of the sources was done using the free version of Rayyan[1]. A total of eight duplicate documents were detected by Rayyan and they were excluded. Thereafter, both authors independently screened the sources in Rayyan. After the first round of screening, 21 sources were marked as "conflicted" screening. The second round of screening entailed both authors meeting to resolve the "conflicted" screening. The resolution of the "conflicted" screening resulted in 48 sources being included in the third round of screening, with 25 sources excluded. The 48 sources were downloaded for the purpose of full-text reading. Twelve out of the 48 downloaded sources were thesis and were subsequently excluded.

The third round of screening entailed a further assessment of the remaining 36 sources by reading the introduction, methodology and discussion sections of the papers. We then used four quality assessment (QA) questions to evaluate the sources. The QA questions were (i) Does the source adequately discuss pilotitis in relation to ICT4D projects? (ii) Does the source adequately discuss/cover the context within which ICT4D projects are designed? (iii) Is the research methodology used adequately explained? (iv) Are the limitations of the study clearly documented? Sources that fully meet a QA question were awarded a score of 1, those that partially meet a QA question were awarded a score of 0.5, while the ones that did not meet a QA question were awarded a score of 0. A source can have a maximum of 4 scores. Only sources that scored 2 and above were marked for inclusion in the final set of sources that were analysed. This process resulted in a final set of 25 sources that were included in the study. The source screening process is illustrated in Fig. 1.
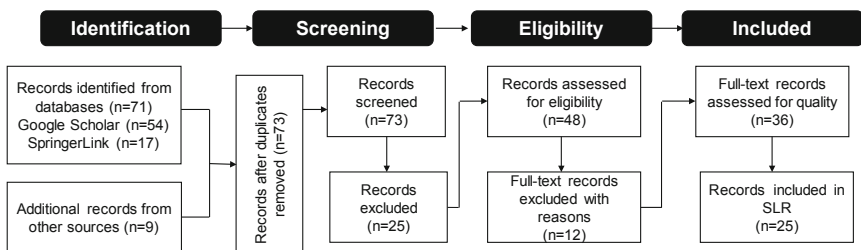
Fig. 1. Source selection process.

4 Synthesis of the Causes and Remedies of Pilotitis

This section presents the results of our synthesis of the 25 sources that were synthesized in this study. Of the 25 sources included in the SLR, five were published in 2017, four in 2020, and three in 2016, 2019, 2021, and 2022, respectively. Two documents were published in 2018, while one document each was published in 2008 and 2011, respectively. There was no restriction placed in the search criteria in terms of what year an article was published. A total of 18 sources included in the SLR were journal papers while the remaining seven were conference papers. In Sect. 4.1, we present our synthesis of the causes of pilotitis and the remedies in Sect. 4.2.

4.1 Causes of Pilotitis

The condition known as "pilotitis" hinders the complete development and replication of ICT4D projects, thereby directly negatively impacting their sustainability. The following sub-sections provide a brief overview of the factors that could contribute to pilotitis.

Local Context-Related Issues
Local Constraints
As stated in Sect. 2, ICT4D projects are besieged with several challenges [14], making it difficult, if not impossible, to scale up. Our analysis of the sources that were synthesized revealed that one of the main causes of pilotitis is a limited understanding of the local context within which ICT4D projects are targeted [18]. Although countries in LMICs are collectively referred to as the Global South, each country is unique in terms of the socio-cultural, demographic, environmental, political, and economic contexts [18, 21]. The context-dependent nature of ICT4D projects often makes it difficult to scale up, replicate or expand what was deemed to be a successful pilot project to new environments [18]. It is necessary to consider whether the project holds local significance [6, 22], to prevent instances where resource-abundant solutions are suggested for resource-scarce settings [23], while considering factors like literacy levels and unstable electricity grids [24].

Cultural Differences
A factor that is closely linked to local constraints is cultural differences. More often than not, different approaches would be required to garner community support for ICT4D projects, wherein the involvement of village elders, chiefs, and tribal leaders [24] would play a pivotal role to get the buy-in of the community. Some of the socio-cultural contexts that could make the replication of pilot projects to other contexts difficult include cultural and religious beliefs, language barriers, low levels of education and literacy, as well as beliefs about the role of technology in development [21]. Inadequate understanding and appreciation of the contextual differences of communities therefore limits the ability to scale up ICT4D projects.

Unsuitable Solution
More often than not, ICT4D pilot projects are funded by donors from developed countries [17]. Many of these pilot projects are typically capacitated with all the necessary skilled human capital, technical and financial resources to demonstrate their usefulness

to the targeted beneficiaries. However, the high-level resources can often not be matched when the project is transferred to new contexts [18]. A solution is then forced to fit the incompatible context, thereby reinforcing pilotitis.

Resource-Related Issued

According to Leonard, de Kock and Bam [21], inadequate human resource is one of the key factors that constrain the deployment of innovative ICT for health solutions in many LMICs. Ashaba and Nabukenya [25] also mentioned that monitoring and evaluation of the impact of ICT for health solutions are often constrained by insufficient resources, including time, money, human capital, and the people required to participate in the evaluations. Other resource-related issues that hamper the scaling up of ICT4D projects include inadequate infrastructures [17]. The majority of the populations that are in dire need of ICT4D projects live in deep rural areas, which often lack basic infrastructures like water, electricity, and Internet connectivity [26].

Lack of Skills Transfer

With the advent of new projects comes the introduction of novel technologies and the necessity for acquiring new skills. It is essential for the local beneficiaries to possess the capability to overcome technical challenges and ensure the sustained use of these technologies [9, 24], yet this aspect is frequently overlooked. Facilitating local ownership and promoting skills transfer is crucial for enabling long-term usage, as it empowers individuals to comprehend the context of use and effectively engage with the technologies involved [12, 27].

Lack of Training

The absence of training is closely associated with the lack of skills transfer; however, it extends beyond mere skill transfer as it is a crucial step that is frequently overlooked. This oversight results in users feeling uncomfortable with using the new technology. Ongoing training is often necessary to address this issue and ensure that users become proficient and confident in using the technology [5, 28].

Lack of Adequate Reporting

Effective communication plays a pivotal role in the implementation of new projects. However, there are instances where the demanded level of reporting becomes excessively challenging to acquire or takes an extended period, leading to inadequate reporting [12]. This issue is once again closely connected to the lack of skills transfer and training, further emphasizing the importance of addressing these aspects.

Business Model-Related Issues

One of the factors that hamper the successful scaling up of ICT4D pilot projects is the absence of a workable business model [18]. Donor funding for ICT4D projects is almost always directed at development costs, with little to no attention being paid to how the project will be self-sustainable or commercially viable when donor funding has dried up [7, 29]. Nitturkar [29] laments the negative impact that the absence of a workable business model could have on the sustainability of ICT4D projects. For example, a private organization that provides agricultural produce daily market pricing information using a digital agriculture solution to stakeholders in Mali was on the verge of closing

down when they were interviewed. This was due to lack of funding and inability to determine who should pay for the service being provided [8, 29]. Although this example was not a classical donor-funded ICT4D project, ICT4D pilot projects will continue to be challenged in terms of their self-sustainability without a business model of how the projects would be funded throughout their useful life.

Incompatibility

The challenges faced by the Global South are often unfathomable to those in the Global North. These challenges encompass limitations in mobile technology, high illiteracy rates, and unreliable electricity supply [24]. Unfortunately, when funding projects, the Global North tends to approach them from their own perspective, overlooking the fact that there are external challenges beyond their control [11, 12, 23]. For example, the vaccines produced in Kenya were rendered unusable and unsafe due to the inability to maintain the required storage temperatures for their preservation [30]. In another instance, implementing a new eHealth system in Botswana required a significant investment of time and resources to align their hardware and software with the solution given to the beneficiary, since the older hardware was not compatible with the version of the software [31].

Lack of Government Support

The majority of the populations that are in dire need of ICT4D projects live in deep rural areas, which often lack basic infrastructures like water, electricity, and Internet connectivity [26, 29]. Well-intended pilot ICT4D projects have a limited probability of being scaled up successfully in the absence of commitment by the Government and policymakers to address the basic infrastructure challenges in rural communities [32].

Unsuitable Solution

While we have previously discussed this issue under the local context-related issues, it is essential to reiterate this point here. Frequently, a new project becomes financially unfeasible for adoption in impoverished communities. It is crucial to consider who will provide ongoing funding for the project once the initial financial investment is withdrawn. The solution must be dictated by the local context, recognising that, in many Global South countries, acquiring a mobile device is far more feasible than purchasing an expensive laptop [33], for instance.

The Design-Reality Gap-Related Issues

In 2006, Richard Heeks introduced the term "Design-reality Gap," which serves as a tool for assessing the misalignment between the intended design and the actual state of affairs. This tool can be used both before project implementation as a pre-assessment, or after completion as a post-evaluation measure [8, 34]. By dedicating time to evaluating the disparity between the envisioned design and the tangible reality experienced by project beneficiaries, one can identify potential failure risks associated with numerous pilot projects. Presented below are three key risks associated with this misalignment.

Unnecessary Technology

During times of hardship, compassionate individuals often generate commendable ideas. However, these ideas sometimes lead to impractical solutions. A case in point was observed in a refugee camp, where the proposed remedy for lost limbs was to use

3D printing technology to create new limbs. Unfortunately, this solution proved to be costly, impractical, and unsustainable due to the intricate tools and techniques required for printing limbs [35]. A wooden limb would have been more practical in this context.

More Pressing Needs

It is sometimes the case that the intended beneficiaries of ICT4D projects have far more pressing needs than that new technology that is being planned for implementation. A classic example is the case of farmers residing in the Beitbridge community in Zimbabwe that faced challenges due to water shortages, which hinder their agricultural endeavors. Funds were allocated to establish a local telecentre [36]. However, upon further investigation, it was discovered that the community's primary requirement was access to boreholes for effective crop cultivation. If this crucial need is addressed and farmers can successfully grow crops, the telecentre will then hold value for them, enabling them to access information on crop growth and market prices.

Unique Needs

The beneficiaries of ICT4D projects sometimes have unique needs that a project should address. For example, because of rain and unfavorable weather conditions in Malawi, there were instances where physically printed forms could not be delivered punctually. The printing and sending of the forms were cumbersome. There is an essential requirement for staff to use mobile reports, a relatively simple solution. Surprisingly, no one has taken the initiative to inquire about the staff's preferred method [12]. The lack of stationery in offices poses a further challenge when it comes to printing reports.

In another instance, a project to vaccinate vulnerable people was tested in California, but its implementation took place in Kenya. The contrasting conditions between the two contexts proved to be significantly different, rendering the project unsuitable and unadaptable for Kenya [30], as real-time data were not available, and the required cold storage of the vaccines was not always possible.

4.2   Remedies to Pilotitis

Technical Remedies

User-Centric Approach

As indicated in Sect. 4.1, one of the main causes of pilotitis is an inadequate understanding of the context within which ICT4D pilot projects will be deployed for scale-up. Implementers cannot simply assume that because a pilot project was deemed as a success by one community, it would be perceived as such in other contexts. It is vital to understand the perceptions of local communities on the role of digital technologies in development [8, 18, 23].

ICT4D pilot projects are often provided with all the necessary resources to ensure their successful implementation and demonstrate their usefulness in a specific context to funders [5, 18]. This then creates an unrealistic expectation when the project needs to be upscaled in another community [12, 18]. Conducting a needs assessment of the new context is vitally important to determine the extent to which the technology that is being replicated/scaled up will be able to meet the needs of the new community. There should

be an agreement, in consultation with the community, on what could be viably achieved by the technology, given the current context and the available resources [18, 37].

Offline Functionality
In the Global North, a stable and reliable Internet connection is assured, whereas the same cannot be said for the Global South. When designing a technological solution for impoverished communities, it becomes imperative to consider offline functionality due to the lack of reliable Internet access [33] or lack of electricity [7].

Provision of the Data to Stakeholders
Displaying the most pertinent and significant data in the form of dashboards is crucial, as it allows project beneficiaries, government officials, and other stakeholders to visualize and comprehend the project's impact. This visibility and quantifiability enable informed decision-making regarding the project's future and direction [33].

Economic Remedies
Adequate Financing
Financing ICT4D projects can be costly. Often, the initiation of a project relies on donor funding, resulting in project dependencies that increase the vulnerability to failure [6, 10, 27]. To mitigate potential risks, a viable approach is to secure financial buy-in from the local government representing the project beneficiaries. This commitment from the local government ensures their dedicated involvement and support for the project [7, 20].

Long-Term Financing
Closely associated with the need for sufficient financing is the imperative of securing long-term funding for projects [8, 33]. When project beneficiaries receive equipment or tools at no cost during the initial phase, there is an expectation that they will continue to receive them for free in the future. Anticipating payment at a later stage can lead to resistance and opposition towards adopting the new technology. It is crucial to be mindful of this reality when offering seed funding or financial support [8, 37].

Cost Considerations
Comprehensive planning should account for all costs associated with a project [23]. Within the budget, a portion should be allocated for unforeseen expenses that may arise. For instance, if beneficiaries are expected to use devices such as smartphones or work in an office setting, it is important to include the cost of supplying solar panels and power banks [33]. Additionally, expenses such as data plans for smart devices should be considered, particularly in countries with limited access to reliable Internet connections. If expensive equipment is required, the cost of equipment replacement and the logistical time required to transport it should also be calculated.

Environmental Remedies
Government/Local Leadership Involvement
An understanding of the power dynamics within a community and the perception of local leaders about ICT4D projects is vital since some local leaders may well perceive ICT4D projects as a threat to their power and authority [21, 37]. Hence, it is important to get the buy-in of local leaders [23, 37]. Equally vital is the identification of the different local

authorities, the factions that may exist among them and their conflicting interests which may impact the project [8, 23, 37]. One of the ways of engaging beneficiaries on the purpose and role of ICT4D projects is by identifying individuals within the community who can act as project champions. Project champions can promote the benefits of the ICT4D project and ensure buy-in from the community at large [23, 37].

Respect for Local Laws and Traditions
It is crucial to involve the local government extensively in new projects, as they play a vital role as key stakeholders [8, 33]. However, in the Global South, it is essential to show respect for local traditions and laws. One such tradition involves reaching agreements in good faith, where trust and mutual understanding are vital for successful negotiations [5, 24, 28]. Trust is a gradual process that develops over time. Therefore, it is necessary to familiarize oneself with the local communities, establish connections, and cultivate relationships.

Partnership with Local Stakeholders
An effective approach to gaining acceptance within a community is to engage in collaboration with local stakeholders, fostering diffusion and establishing connections [9, 33]. As mentioned in the preceding subsection, this collaborative effort builds trust and facilitates the transfer of knowledge in a more seamless and expedited manner [28].

User Acceptance Remedies
The slogan "*nothing about us without us*"[2] aptly illustrates the importance of actively involving the user community throughout the entire ICT4D project development process. The extent to which stakeholders are actively involved in the whole process is a key determinant of the success or otherwise of ICT4D projects when scaling to new contexts [18].

The local community needs to be actively involved in the planning, analysis, design, implementation, and evaluation of ICT4D projects [37]. Not only will active involvement of the local community ensure they understand the potential benefits of the technology that is being developed/deployed, it will also ensure that relevant stakeholders know where they fit in in the entire process [23, 37]. Some of the ways that active community participation can be facilitated include identifying the community members that are best suited to act as project participants and in what capacity (in consultation with the community), conducting needs assessment to determine what the digital technology should provide to the community, explaining the benefits that could accrue to the community once implemented, and constantly providing feedback to the community on the project progress and achievements, once implemented [18, 37, 38].

Provide Training
As much as the development of digital solutions to uplift communities is important, it is also vital to allocate sufficient time to transfer knowledge to the beneficiaries through regular and ongoing training sessions. It is indispensable to consider that some individuals may have a complete lack of IT skills, necessitating the training of community

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[2] https://www.futurelearn.com/info/courses/global-disability/0/steps/37575#:~:text=The%20nothing%2Dabout%2Dus%2D,sector%2C%20industry%20and%20community%20worldwide.

members. Implementers of ICT4D projects should keep in mind that the time invested in training is never wasted. The more training provided, the better the outcomes [8, 33].

Continuous Users' Feedback
Maintaining constant communication with the beneficiaries is vital. This can be achieved by providing continuous feedback to keep them informed about project's progress [30]. It is essential to establish a two-way process where both the funders and the beneficiaries actively engage in regular communication. In this process, not only do the funders provide feedback, but the beneficiaries are also encouraged to share their feedback on how the project and its processes can be enhanced or streamlined to better align with their unique context [8, 33].

Needs-Targeted Solution
It is crucial to comprehend the requirements of project beneficiaries and address their actual needs. Sometimes, what may initially appear to be a necessity, such as a tele-centre, may be overshadowed by more fundamental needs, such as a sustainable water source for agricultural purposes [36]. It is important not to offer extravagant and costly high-tech solutions to individuals who are primarily in need of basic necessities like food and shelter. Proper project planning involves investing time in understanding the beneficiaries' genuine needs rather than imposing preconceived notions of what they should receive.

4.3   The Pilotitis: Cause-Remedies Framework

In Fig. 2, we introduce a framework known as the Pilotitis: Cause-Remedies Framework. The framework provides a condensed overview of Sects. 4.1 and 4.2, highlighting the circular nature of the causes, which contribute to a cycle of failure. Conversely, the remedies are represented as semi-circles, following a specific sequence. It is crucial to address these remedies in a particular order. Beginning with the environmental remedies to better understand the local context is paramount. This is followed by addressing the economic remedies, as substantial funding is required for up-scaling ICT4D project. Subsequently, attention should be directed towards the technical remedies to ensure effective data management. Lastly, it is essential to focus on user-acceptance remedies, which involve providing adequate training, facilitating continuous feedback, and addressing genuine needs.

To achieve the SDGs by 2030, we propose the Pilotitis: Cause-Remedies Framework as a tool that can be used to ensure that future ICT4D projects do not succumb to pilotitis and experience subsequent failure. By adopting the suggested remedies outlined in the framework, we are optimistic that the prospect of future ICT4D projects would be enhanced, thereby increasing the likelihood of their success.

PILOTITIS: CAUSE-REMEDIES FRAMEWORK

CYCLE OF FAILURE - CORE ISSUES

LOCAL CONTEXT	RESOURCES	BUSINESS MODEL	DESIGN-REALITY GAP
1. Constraints 2. Cultural Differences 3. Unsuitable Solution	1. Skills Transfer 2. Training 3. Reporting	1. Incompatibility 2. Lack of Government Support 3. Unsuitable Solution	1. Unnecessary Technology 2. More Pressing Needs 3. Unique Needs

REMEDIES TO SUCCESSFULLY CURE PILOTITIS

TECHNICAL REMEDIES	ECONOMIC REMEDIES	ENVIRONMENTAL REMEDIES	USER ACCEPTANCE REMEDIES
1. User-centric Approach 2. Offline Functionality 3. Provide Data to Stakeholders	1. Adequate Financing 2. Long-term Financing 3. Cost Considerations	1. Government/Local Leadership Involvement 2. Respect for Local Laws and Traditions 3. Partnership with Local Stakeholders	1. Provide Training 2. Continuous Users' Feedback 3. Needs-targeted Solution

Fig. 2. Pilotitis: Cause-Remedies Framework. Adopted and adapted from Van Biljon [39] and Greve et al. [33], supplemented with own research.

5   Discussion

The phenomenon called pilotitis has been long identified by researchers as a chronic condition that besieges ICT4D projects. Despite the recognition of the impediment that pilotitis pose to the attainment of the UN SDGs, there is little evidence that the condition is improving. Based on our synthesis of 25 extant literature, we identified four broad causes of pilotitis, namely, (i) local context-related issues, (ii) resource-related issues, (iii) business model-related issues, and (iv) design-reality gap-related issues. We also identified four broad areas of remedies for pilotitis. These are (i) technical, (ii) economic, (iii) environmental, and (iv) user acceptance remedies.

Without a deep understanding of the local contexts within which an ICT4D project is to be replicated, the project will have little to no chance of success, thereby limiting the potential benefits of the project. Inadequate resource is another impediment to the successful upscaling of ICT4D projects. Without adequate technical skills, time, funding and basic infrastructure, well-intended ICT4D projects have limited prospects of being successfully scaled up. Another important area that funders of ICT4D projects need to be cognisant of is ensuring that technical solutions meet the actual needs of beneficiaries.

By juxtaposing these long-standing issues that result in pilotitis with the SDG 2030 target, the question remains as to why pilotitis has not yet been resolved. Despite the clear global commitment to achieving the SDGs by 2030, the persistence of pilotitis, characterized by the proliferation of small-scale, isolated projects rather than comprehensive, scalable solutions, suggests a significant gap between intention and action. Several factors contribute to this ongoing challenge, as summarized in the framework in Fig. 2. Ample studies have outlined why projects fail to scale. This article discusses the different reasons for pilotitis, as categorized into specific focus areas, and suggests remedies to enable future pilot projects to achieve the desired outcomes. Yet, reducing pilotitis requires a comprehensive step-by-step approach that combines data-driven decision-making, long-term commitment, collaborative partnerships, capacity building, knowledge sharing, flexibility, and policy alignment. By addressing these aspects, we can better bridge the gap between small-scale pilots and achieving broader development goals, such as the SDGs.

6   Conclusion

This paper presents the outcome of a synthesis of 25 research papers that focused on the factors that make it difficult to upscale ICT4D projects. The significance of tackling the issue of "pilotitis" in these projects is emphasized through the introduction of a suggested framework. The findings indicate that a more effective approach to pilot projects can contribute to a greater number of successful ICT4D initiatives that can be expanded and genuinely address the beneficiaries' needs and requirements.

6.1   Limitations

One of the limitations of this paper is that the SLR was based on specific search phrases that were applied to specific databases. This meant that sources that could have been

applicable but did not use the keywords in our search phrases would have been excluded. The fact that the sources were accessed in November 2022 is another limitation, where relevant sources that may have been published from December 2022 onwards would have been excluded.

6.2 Implications for Theory

By synthesizing and condensing the methodology employed and the articles derived from the SLR, the Pilotitis: Cause-Remedies Framework was developed. This new framework empowers donor organizations to prioritize the resolution of implementation challenges encountered in ICT4D pilot projects. Additionally, it offers valuable support to ICT4D scholars and researchers by providing a means to evaluate project success based on the suggested remedies for scaling up new initiatives.

6.3 Implications for Practice

The newly introduced Pilotitis: Cause-Remedies Framework not only tackles the prevalent causes behind projects experiencing pilotitis, but also offers four remedies to minimize the likelihood of projects faltering before achieving scalability. This framework not only supports first-time donor organizations in enhancing their success rate but also serves as a handy reference guide for donor organizations that need to implement an ICT4D project in a different geographical location.

6.4 Future Research

In future, we intend to seek the expertise of ICT4D specialists to evaluate the framework's validity for broader application. Additionally, we plan to undertake fresh ICT4D research initiatives wherein we will implement the framework and evaluate the results by addressing the associated risks and implementing the suggested remedies.

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Use of Locally Valued Non-state ICTs by Market Actors: A Case of Transforming Agriculture Marketing in Karnataka, India

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Abstract. State-mandated ICTD programmes are driven by strong aspirations of modernity where morality is associated with development, and technology is the force to enable that. These aspirations drive the state's attempt to transform agriculture markets into E-Markets in India. While the state's narrative claims economic welfare gains for the end beneficiary through technological intervention, our study shows that state-mandated ICTD initiative is poorly adopted by the local actors. In contrast, locally enabled non-state ICT apps find deep use by the same actors for managing various market operations. The novelty is in the ingenious use of common ICT apps in a self-actuated mode, achieving micro efficiencies. Situating this study in state-society dissonance and lensing it through James Scott's work, Seeing Like a State, shows that vantage matters in development and its consequences on adopting ICTD platforms in the societal systems. In a sort of juxtaposition, the success of non-state ICTs is insightful about what is of value at the local and informs the state that technology adoption and use is not just about the quality or comprehensiveness of the artefact or who is pushing for the change; instead, more about the values that it carries, the appropriateness, and finally how it fits and finds acceptance at the local.

Keywords: State-Mandated ICTD · Non-State ICTs · Agriculture Markets · E-Markets · Locally Valued · Transformation · Counter-Discourse · Resistance

1 Introduction

If the state-sponsored development programmes of the past applied high-yield variety seeds, chemical fertilisers, and pesticides to usher in the 'Green Revolution [6], the ICT enabled unified E-Market platform represents the new generation of mandated development programmes. However, it is still being determined whether the benefits have accrued to all the rightful beneficiaries in such ICT-enabled development (ICTD) programmes [5]. For example, prior studies on large-scale state (government) led ICTD programmes like India's Aadhaar digital identity system or the targeted food security program have narratives of being exclusionary, perpetuating associated injustice, creating new forms of corruption, impacting vulnerable subjects, and resulting in deviant development outcomes for the beneficiaries [13, 15].

On the other hand, a sure sign of 'success' for an ICTD project is 'adoption and use of the system' [20]. Literature about adoption issues [11] lays them at the doorstep of narrow scoping, improper targeting [16], lack of stakeholder participation [1] and mismatch with the local requirements [19]. While all these studies primarily focus on formal programmes of state-mandated ICTD, there are few studies about cases where state-mandated ICTD systems are poorly adopted in contexts that otherwise see an extensive adoption and use of non-state, locally repurposed discrete ICT apps. Though the non-state ICTs contribute to development outcomes, there is no involvement of either the distant state (federal or provincial government) or the local state (lower level governance or its institutions) in its design or adoption.

In this paper, we undertake an exploratory study using the interpretive research approach [30] to understand and describe this phenomenon of widespread use of locally valued non-state ICTs observed in a complex societal system.

This paper is part of a more extensive study about how stakeholder participation is shaped in societal systems that are being transformed through state-mandated ICTD, for which we were studying the case of ICT-enabled agriculture markets in Karnataka, Southern India. The platform known as the ReMS E-Market system is a much-awarded ICTD programme and is widely publicised as the 'Karnataka Model' of ICT-enabled Agri-market reforms [4]. The state's claim of successful adoption and use of the intervention in all its major and sub-major agriculture markets since 2014 exemplifies the system as time-tested and widely used. Contradicting this claim of the state, our study spread over two years, conducted in some of the major agricultural markets in a specific Agri-zone of Karnataka, showed that the on-ground working of the markets was quite different, and the E-Market platform was not in use. On the other hand, we found local market actors using informal, locally configured generic ICTs (mobile-based apps) extensively to enable the agriculture market operations in their own ways. Unlike the platform-based state-mandated E-Market system, the apps that we call 'non-state ICTs' were discrete, innovative, and critical to the market operations and driving micro-efficiencies for all the market actors at the local level.

This is interesting because the state controls most of the development narrative. Given the dominance of state-led technological programmes, often centralised, there is little space for understanding how local actors groups respond to state-mandated ICTD programmes. Some ICTD studies in this trajectory look at the importance of local social contexts, which, when ignored, become exclusionary for citizens [17] and how the local adjustment networks extract rents in the last mile [9]. In all these e-governance projects, the state is the direct service provider to the citizens. In contrast, in our case, the state acts as a regulator and enabler for the functioning of the agriculture markets. In addition to the contextual difference between the cases, our case involves two instantiations of technology where the state-mandated ICTD intervention lies poorly adopted and local non-state ICTs are extensively adopted. These attributes of the case make it interesting to empirically establish how the local actors and their groups interact with technology and adapt and adopt it to drive small micro-level changes. Hence the question, "Within a societal context, how do local actors and their groups adopt and use ICTs; and, from the perspective of adoption and use, what are the attributes of value to these local actors?".

To analyse this, we use the lens of James Scott, whose seminal work in the counter-discourse space, 'Seeing like a State', looks at the dissonance between state and society [24]. Using this lens, we argue that the state's attempt to bring a high degree of legibility and to see the markets through a simplified dimension of economic exchange and efficiencies leads to ignoring other dimensions of complex relationships and local practices. The gaps that develop due to such a view of the distant state result in poor adoption of the state-mandated ICTD while creating space for local non-state ICTs, which are less disruptive and more tuned to bring in micro efficiencies valued by the local actors and their groupings. We posit that the two instantiations of technology represent the discourses that run counter due to the difference between how the state 'sees the market' to formulate the problem and how the local actor groups 'see the market'.

This phenomenon of dual instantiation of technology in a societal system enables us to explore both resistance and adoption of technology and situate the problem in the counter-discourse between state and society and distant and local. The study provides insights to policymakers and technology designers about the need to acknowledge bottom-up views in complex societal contexts and understand the type of changes valued at the local.

The rest of the paper is laid out thus: the next section reviews related research, followed by details of the research design and an introduction to the case study of the agriculture E-Market. The following section presents all the findings and captures the diverse ways the market uses ICTs. This sets the foundation for the discussions where we establish the complexities involved in the market and how local non-state ICTs support market operations more effectively.

2 Related Research

2.1 State-Sponsored Large-Scale ICTD

State-mandated ICTD programmes are typically set in techno-deterministic positivism with specific aims to drive efficiency and productivity [18] or even disrupt structures like intermediation in agriculture markets and transform them [14]. Alternatively, Sen [25] defines development as a multidimensional concept encompassing economic growth, participation, and empowerment. On the other hand, social science studies show that technology is a social product with its creation and use shaped by a range of broader social, economic, cultural, and political factors; hence, technology's design and use have a relationship with development concerns [31].

In that sense, the two trajectories or approaches represent a difference in development discourse, and the technology design and implementation embody that particular underlying motivation.

2.2 Agriculture Markets and ICT Enabled Transformation

While economists tend to view agriculture markets in terms of their role in driving efficient resource allocation and price performance [3], social scientists consider agriculture markets as complex systems performing tasks critical to social reproduction and development [12].

Being under the state's oversight, Indian agriculture markets have been fertile ground for policymakers to advocate reforms, including the use of state-mandated ICTD programmes to address the gaps in the system and transform the markets [3, 14].

While disintermediation and information empowerment [14] have been the twin strategies of the state in most of these ICTD programmes, according to many studies, the idea that markets could exist without intermediaries is a myth [14, 29], and the real need is to accept intermediation and drive accountability from the intermediaries [14].

2.3 The Dissonance Between State and Society and the Role of Policymaking

Our study situates the issue between the state as the sovereign power [10] and society and the counter-discourse about the state's presumption about the adoption of a mandated ICTD intervention and a different reality on the ground. Hence, James Scott's 'Seeing Like the State' [24] comes across as the most appropriate analysis tool as the arena is friction in development discourse.

Scott studies the failure of many grand-scale development projects backed by the state's power. The positivist approach of the high modernist state needs legibility to understand a context, which leads to simplification of complexity concerning the issues in society. The legibility provides an opportunity for a determined state for large-scale re-engineering using a simplified schematic. Often, it ends up ignoring the essential features of any real social system [24].

However, Scott [24] does not address the underlying journey between a policy of the state and how it translates into technological intervention; instead, it is better understood through complexity theory [28]. Complexity in social contexts manifests through heterogeneous constituents and relationships' non-linearity and emergent nature [28]. Hence, it is insufficient to understand only the constituent parts in a complex societal system without attention to the multitude of relationships that make for a holistic system [17, 28].

However, that does not stop the reductionist approach [28], which feeds into the policymakers' domain who see and engage with the world not as a set of problems but, instead, as a set of opportunities and threats [2], and it is in that perception that solutions are planned and implemented, amongst which ICTD takes high precedence and becomes the 'new species of development' [8]. This approach percolates the dissonance between the state and society further, reflected in the technological artefact's inherent attributes.

In conclusion, there are different views on development, and the arena is often fraught with friction. There will be conflict unless a common understanding of the issues and collaboration exists among the policymakers, artefact designers and stakeholders in a continuous manner.

3 Research Design

Our argument draws on fieldwork spread over two phases, between October 2019–February 2020 and December 2021–June 2022, done in Karnataka's eastern dry agricultural zone in Southern India. In agro-climatic terms, the area is dry and rain-fed with a broad spectrum of crop cultivation, including grains and high-value horticulture perishables

like vegetables. Such diversity appealed to us as it created a strong dependency on the market system for the farmers.

Our field site was the agriculture markets in the zone. The studied markets were not pre-selected; instead, they turned out to be the major ones in the zone with large-scale trading, and notably, both the ReMS E-Market platform and the Karnataka Government list them as using the E-Market platform for all their operations. Given that it was an exploratory study to capture the context and uniqueness, we adopted the interpretive research approach along with qualitative methods of participant observation and semi-structured interviews to enable us to understand the case in itself and further explore the phenomenon from the participants' perspective within a particular cultural and contextual setting which is ongoing [30]. This approach allowed us to observe the emergent nature of relationships between the actors and their negotiations during daily activities. Added data sources included the study of press reports, websites, and various secondary sources.

We observed thirteen agriculture markets trading both perishable and produce with shelf life. We traced the produce from harvest to market multiple times. We interviewed seventy respondents comprising farmers, commission agents (intermediary), buyers, market officials and other actors in market spaces and other adjoining informal settings. Many interviews were hour-long or more; some were conversations with multiple participants simultaneously, and some were short interactions of 10–15 min. In a few cases, we conducted follow-up interviews. Then, using the traditional approach, we translated and transcribed the notes as the interviews were in local languages. From these transcriptions, we coded to glean out the interesting themes and analysed them further. All the names were pseudonymised.

4   Case Description

After several reforms in the post-independence era, the Agricultural Produce Market Committee (APMC) operated physically trading regulated market yards has dominated the Indian agriculture markets (in short, the APMC market system). They number about 7566 markets across India, with 162 major and 354 sub-markets in Karnataka [21]. A locally elected market committee called local APMC governs each market yard. The farmers and buyers interact through the APMC-registered Commission Agents, who function as the intermediation layer for a fixed commission fee approved by the law.

Karnataka, a pioneer province in adopting ICT for development, launched the first agriculture E-Market platform in India called ReMS (Rashtriya e-Market Services Pvt Ltd) as a part of the government's development targets to double farm incomes by 2022 [7]. ReMS E-Market system is a much-awarded ICTD programme widely publicised as the 'Karnataka Model' of ICT-enabled Agri-market reforms [4]. Though ReMS is a separate joint venture company, it has to operate the E-Market platform in the physical markets in cooperation with the local APMC/local market operator. According to a NITI Aayog (Government think-tank) policy paper, Karnataka realised 38% more income to farmers in 2015–16 than in 2013–14, immediately following the implementation of the E-Market platform [7, 22]. The ReMS website claims a full-scale rollout across all the APMC markets in Karnataka with support for 60 commodities, including perishables [22].

5 Findings

5.1 Agriculture Market – Tracing the Path from the Farm to the Buyer

Agriculture markets are abuzz 24/7, with produce arriving from the farms all through the night followed by morning auctions, settlements by afternoon, buyers loading the lorries till late afternoon/evening and the produce departing on its journey to all corners of India. The arrival process involves deep coordination between farmers, commission agents and transporters who constantly interact over mobile calls and WhatsApp to drop empty boxes (plastic crates) at the farm a few days before harvest.

Transporters acting as a go-between, the farmer, and the commission agents, pick up the needed number of boxes from the agency and drop them at the farms in the range of 10–40 km distance using their Google map directions or live location coordinates provided by the farmers through WhatsApp. The farmers pluck the tomatoes and load the boxes which in turn are picked up by the transporter. To guard the produce and complete a sale, the farmer also hops into the vehicle and together they reach the specified commission agent shop in the market yard at night. For all this coordination, there is significant use of ICTs with transporters and commission agencies having their own WhatsApp group, allowing them to interact with farmers and other market actors.

Once the vehicle reaches the market, the commission agent's labour gang briskly unloads the boxes in front of their agency shop and stacks them in neat rows and columns, leaving a narrow pathway to separate each farmer's lot. Amid the buzzing mosquitoes and cacophony of vehicular movement, unloading and other noises, farmers lie down for the night, in constant vigil over their lot.

At 7.30 in the morning, the market is a sea of boxes, and there is no more space for new arrivals. The commission agent's representative diligently takes a manual account of each farmer's lot in their ledger and creates scribbled identifiers for each lot. The agency's auctioneer is ready for business when all the lots are onboarded. As if on cue, the buyers make an entry. They go around assaying the contents of the boxes, picking up a tomato or two from different lots, turning them around, tossing them up, taking a bite for taste, and finally throwing the residue to the ground.

By 8:30, the first commission agency is ready for auction. The auctioneer takes a vantage point near a specific lot and starts the auction process manually in an open outcry method. One after the other, the commission agencies conduct their auctions, and the buyers move along bidding as per their interest. The auctions happen briskly. 12,000–15,000 boxes (150–180 tonnes) of tomatoes are traded in about an hour. The post-auction processes are set into motion, and the produce is released to the buyer to load their lorries for the subsequent journeys, some as near as Bangalore, 90 km away and many as far as Delhi, 2,500 km away.

The local APMC market operator is not visible anywhere in the process, nor is the state-mandated ICTD E-Market in use. Within a few hours after entry into the market, the produce is back on the road for its next journey. The system runs like a well-oiled machine.

5.2   Missing State-Mandated ICTD E-Market Platform

While interviewing a few APMC officials about using the ReMS E-Market platform, one of the officials said, *"We have discussed a lot in our meetings with ReMS authorities. We have told them that we cannot use the system. It may work for agriculture crops with fewer lots and only 2–3 varieties. None of us are convinced about its viability."* All the agricultural markets across our fieldwork dealing with various produce used traditional practices along with locally appropriate generic mobile-based non-state ICT apps. Along with poor adoption of the E-Market platform, we also observed that many of the complementary, yet essential infrastructures and processes needed for the E-Market platform to function were not in place. We spotted the following as missing: guarded security gates with weighbridges to issue lot IDs, registered assayers, and assaying labs to assess and issue quality certificates for each lot, warehouses for farmers to unload the produce and exchange with the buyer after payment, the e-settlement process for the buyer to pay the farmer and e-permit system to allow seamless movement of the goods across the geography.

5.3   Non-State ICTs - Innovative Use of Locally Devised ICTs in the Markets

Coordination by Google Maps and Social Media Apps. Apart from using Google Maps and WhatsApp for sharing coordinates to manage the arrivals efficiently, we saw other sophisticated uses of non-state ICTs for market operations. Rama, a young transporter, has created a social media group called "Aditya Transport Kings" and administers that group. The group members are fellow transporters who use the group for aggregating the produce, answering calls for help, and alerts about the checkpoints en route to the market. Aggregation is needed as the exact harvest quantity is not predictable, and one farmer may have an excess lot while another may only fill part of the vehicle. This is particularly important as overloading leads to fines and vehicle seizure by state authorities.

Similarly, intense interaction occurs between the commission agent and farmer over mobile and WhatsApp about sowing decisions, credit support for digging tube wells, and keeping constant track till the crop is ready for harvest—lastly, the back-and-forth coordination to work out the arrival into the market. Coordination is essential between the commission agent and buyer to ensure enough buyers to match the arriving lots. A prominent commission agent observed rhetorically, *"What do you think? The buyer gets a dream that so many farmers are bringing their lots tomorrow. Moreover, the buyers come to the market with a bag full of money to buy them. No, sir, everything has to be coordinated. Many a time, I do not get time to eat my dinner. My time is all spent on calls and messages."*

Video   to   'Authenticate   and   Approve'   and   Unmask the 'Secrets of the Market'. Smartphone-based video is used for multiple purposes, including calling to establish proof of presence at a particular location, for authentication and approval and for video recording to share amongst each other.

The quick approval obtained through a video call with the market scenes in the background was the simplest of the use cases. Commission agents and buyers had the latest and best smartphones. Some had more than one phone sticking out of their shirt pockets.

As the auctions took place, it was common to see the buyers constantly on the sidelines whispering into the mobile about the ongoings and soliciting advice and approvals from their bosses or distant counterparts. Another interesting case was of ICTs being used to prevail over the competition. Amidst a bidding war for a particularly good lot, the lead of a buyer troupe flashed out his smartphone, initiated a video call, turned the camera to show the ongoing auction and started discussing with his distant counterpart in Urdu while keeping the call ongoing, went on increasing the bid and eventually won it.

After much persistence, Sardar Pasha, a local buyer in the market, agreed to talk to us. Sardar looked at us curiously and asked, *"You will not shoot the video? Now, everyone is shooting a video of the auction and putting it in their groups. Presently, there are no more secrets in the market."* We asked how such videos affected him. Sardar looked at us and smiled, *"You do not understand? My customers are distant buyers; there is no more secret when they see this video. In the good old days, we used to earn extra in a few deals as market trends were secret. Now such opportunities are gone."* In other words, non-state ICTs are tightening the supply chain, though it is difficult to fathom in whose favour.

5.4 Omnipresent Price Information – Pulse of the Market

In the markets we studied, price information is disseminated by the agriculture department and shared on SMS and WhatsApp by all the players, including input companies, farmer groups, transporters, and commission agents. However, the mystery was about how price information was compiled, given that the E-Market platform was not in use in the markets of our study. According to the local APMC officials, they compile daily reports based on the data provided by the commission agents. When we verified this with the commission agents, they said they provide data once a week and, most times, fortnightly. Clearing the air about how APMC conjure the daily report even when data is not given to them daily, Gopal, a large commission agent, said, *"It is simple. One APMC official walks around a few auctions, picks the bid prices and uses them to compile the reports. Sometimes, they acquire information informally by calling a few commission agents."* In other words, the APMC officials guestimate the arrival, traded volume, and price information and share it with distant state. Inaccurate data, at best, is further disseminated by the distant state to provide a technological façade of efficient and transformed market operations.

Farmers are always tuned to the market's price movements throughout their harvest cycle. Nagaraju, a vegetable farmer, shared, *"If the price goes up, the value of cultivation also goes up, and we start spraying more pesticides and sprinkling fertiliser. If prices drop, many farmers stop watering and do not harvest as they want to cut the potential losses."*

6 Discussion

6.1 Market is Messy: Gaps Between 'Seeing like a State' and Reality on the Ground

The findings from our study surprised us initially as the state claims a successful ICTD intervention, while on the ground, the reality was quite different. The distant state considers the agriculture market as a place focused on the economistic exchange, operating

as a simple system in alignment with the various laws enacted by it over the years [3, 7]. In this perspective, sector development is about productivity, efficiency and templating for centralised command and control. An approach that provides a more legible, sleek mechanism and thus enables system control from a distance.

In these 'sleek' markets, the distant state recognises only four roles: Farmer, registered intermediary (Commission Agents), buyer and APMC market operator, whereas our fieldwork shows many more roles critical for an orchestrated market operation. These intrinsic roles include:

- Farmers – Farmers, farmgate buyers and transporters who masquerade as farmers.
- Registered Intermediaries – APMC Mandi Commission Agents.
- Informal Mediators – Operate sub-surface informally mediating deals of enormous value on behalf of the food processing industry, commissions agents and buyers.
- Transporters– Genuine transporters and transporters acting as proxies for others.
- Buyers – Local wholesalers, buyers on behalf of food processors, hotels, supermarkets, distant buyers, exporters, and others masquerading as buyers.
- Financiers – Financing the daily cash flow needs of the market actors.
- Market Operator and local governance – Elected body known as local APMC.

6.2 Expanding the Roles and Redefining the Intermediary

Our study profoundly shows the messiness and mingling of the roles. There are two categories of intermediaries. The formal intermediary whom the state has identified but aims to dis-embed through the E-Market platform and the less visible informal intermediaries who flock to the market and play critical roles. We may add the buyers to this list as they are also intermediaries.

The distant state sees the commission agent's role as limited to conducting auctions between farmers and buyers. However, to enact that role even to a minimum, a commission agent must ensure a critical mass of farmers who trust their lots to their agency and buyers with their demands. Nagesh, a 47-year-old farmer, highlighted the commission agents' relevance in the whole exchange process, *"If it is a sample lot (standout lot), the commission agent has a minimal role as it sells by itself. However, the produce is often inconsistent, lots are small, and there might be damage due to pests. Such lots require real effort from the commission agent."* The tacit knowledge of the network is another essential attribute of mediation that the state misses.

The commission agent must also infuse capital to support farmers by extending credit during the cultivation cycle and settling by cash post-auction. At the same time, the buyers try to negotiate favourable credit terms for themselves. Given the commission agent's centrality to the market operations, the buyers and farmers form a loose coalition with the commission agent, as only the commission agent brings all the pieces together and completes the puzzle. The local APMC market operator becomes a mere spectator while perpetuating a sense of 'all is well' by publishing the price information and traded volume report. For the data-driven state, the diligent publication of the reports suggests that the market is transformed and ICTD intervention is successful.

6.3 Flipping the Vantage – 'Seeing the Markets like a Farmer'

Given that the farmer is the beneficiary of the state-led agriculture market reforms, it is essential to 'see the market' from the vantage of the farmer, a flip from the more dominant approach of 'seeing like a state' [24].

We asked a few farmers, *"Will the electronic market be useful to you? Will it improve the market?"*. Many answered, *"We do not know what you are talking about. We need a sound market system. However, it is more about facilities and fair practices. We reach the market with our produce at night. An early start ensures we reach the commission agency inside the market well in time and have the opportunity to display our produce properly. If we reach late or the vehicle breaks down, we cannot even enter the market as the roads will be choked, and there will be no space for our produce display."*

One of the commission agents added another disturbing input, *"When the vehicles start jamming outside the market. The buyers start lowering the bids for the lots inside the market, and value is lost as panic deals are struck outside the market between the farmers and buyers directly. Transport of the auctioned produce from inside the market gets delayed, causing a domino effect where the buyers start lowering the bids. Eventually, the market bottoms out, setting off another chain of price fall across all the markets in the region."*

In the markets of our fieldwork, the most significant need for farmers was a sound market system and infrastructure. During peak season, horticultural farmers are extremely busy as they must harvest their produce, reach the market every 2–3 days, and spend valuable hours there. Time away from the farm has consequences. As Reddy, one of the farmers, pointed out, *"Not being on the farm during the night disturbs the irrigation cycle. We get three-phase power with good voltage for only a few hours at night."* Hence, addressing these uncertainties is a priority as market reverses leave deep scars in the collective memory of the farmers.

6.4 Problems in a Societal System Turned into an Opportunity

Borrowing from Scott [24], the trouble with the high modernist state lies with the representation of an idealised view of how reality 'should be' rather than how 'it is', and in this approach to development, the state's idea of the problem takes precedence over the needs of the actual beneficiaries. In this process, problems that plague a complex societal system are turned into opportunities [2, 23] for policymaking, followed up with enactments and ICTD interventions to effect the actual transformation. The E-Market transformation effort is an example of this approach. The following paragraphs provide a few examples to buttress our claim.

The Problem of Intermediation. Literature shows that intermediation in a market system is inevitable [14, 29]. However, the problem of intermediary accountability, which is more related to the gaps in infrastructure, institutional capacity, and weak local governance, is turned into an opportunity to use technology to disintermediate. In this disintermediation exercise, the state does not recognise the co-existence of the other sub-surface intermediaries. It does not address the critical functions delivered by the commission agents beyond the auction process. Further, the E-Markets bring certain

new forms of market operators and intermediaries into the system, such as distant online buyers' quality assaying agencies who may not have local accountability [14].

The Problem of Weak Local Institutional Capacity. A problem related to local governance, which does need significant concerted attention, is morphed into an opportunity to create a centralised command and control logic in the E-Market design. The logic, in other words, aims to create templated, sleek, and standard versions of the market across the nation irrespective of the specific needs and quirkiness that may govern each market due to the local practices of yore, the type of agriculture crops handled, the material attributes of the crops which may range from tomato which is highly perishable to pepper which has the storage shelf life of a few years. Standardisation, while enabling distant buyers and new investors, may impact the livelihoods of many local actors inside the market.

The Problem of Missing Infrastructure in the Market. Weak market infrastructure was visible across our study, a direct outcome of years of poor investment in the market infrastructure [27]. Farmers deeply agonise when they lose value because the roads to the market and the market itself choke up due to heavy arrivals. Farmers start early to reach the market by nighttime, stay over, and guard their produce until it is sold and changes hands. The time away from their farm means less time for their core farming activity. Even the complementary/essential infrastructure for operationalising the E-Market is missing. However, the claim of the state about successful adoption and extensive use of the ICTD intervention gives credence to the argument that the state sees the missing infrastructure as an opportunity to leapfrog the issue of poor investment in the market and create a façade of development where the use of ICTD is itself seen as development [8].

6.5   Value of Non-state ICTs to Market Actors

While the previous section shows how problems are turned into opportunities and addressed by the state in its vision, the problem of building trust in institutions like assaying labs, which are one of the fulcrums of the E-Market platform to enable bidding by online buyers, is not even touched by the state as they are complex and many a time not even visible clearly unless one involves deeply at the local level. All these findings do not for an instant dispel the need for market reforms, and well-formulated ICTD can have a huge role.

Our findings show that market actors have appropriated 'general-purpose' ICT apps resident on ubiquitous mobile devices into what we call 'non-state ICTs'. We do not claim that non-state ICTs are, in any sense of the definition, complete solutions backed by major policy or strategic directions. However, the quantum of use, their importance to the market operations, and the changes they have brought to market operations are unquestionable. One of the examples is better coordination achieved between the farmer, transporter, and commission agent for the arrival of the produce into the market, by which there is higher predictability about the arrival quantum and positive effects around that downstream. It enables the commission agent to market more confidently to the buyers about the ability of their market to match the demand. The video calling and video clips

empower the distant buyer to operate in the market more confidently as 'the market secrets are unveiled,' and the information asymmetry is reduced. The information flows enable farmers to outsource their participation through proxies or sell at the farm gate. They focus on core farming activities rather than spending days and nights in the markets.

In effect, the non-state ICTs herald small yet important development outcomes. It allows for subtle remodelling of the interdependencies between various actors in the markets; brings visibility and involvement to otherwise invisible roles like transporter and enables it to evolve into something more fulfilling; catalyses local level leadership to co-create efficiencies with other actors; and, in many ways changes the exchange relationships and the way the local actors participate in the market.

6.6 Technological Instantiation as Representative of the Discourse and the Underlay Philosophy

In this study, we come across two instantiations of technology: state-mandated ICTD and locally valued non-state ICTs. We posit that the two instantiations are representative of the underlying values where the state-mandated ICTD carries the philosophy of a templated solution reflecting deterministic traits delivered in a top-down approach with aims to disrupt the existing social structures/groups inside the societal system like the agriculture market, disintermediate by automating specific processes, introduce new actors like the online buyers and disempower the local governance body (local APMC) by ushering in central command and control logic.

On the other hand, in a juxtaposition of sorts, the instantiation of locally valued non-state ICTs carries a philosophy of social shaping of technology [31] as they reflect a technology design and implementation approach that is sensitive to the local social contexts and is exceptionally responsive to the specific concerns and characteristics of the direct and indirect user groups. The technology absorbs the local quotidian practices and fits gracefully into the existing system with the least disruption to the existing social structures. When used in tandem across the market, the non-state ICTs produce locally derived efficiencies that are good enough for the market to find extensive use.

The ubiquitous usage of mobile and social media apps, which form the base for local non-state ICTs, creates 'network effects' [26] whereby when a farmer becomes part of a WhatsApp group run by a commission agent or a transporter, the value to the farmer and the value of the group increases. In such ways, the local non-state ICTs are self-actuated and needed by everyone who wants to be part of the market network, and hence, there is almost no tension in their adoption. These local initiatives at both individual and collective levels enable the market actors and their groups much more than the state-mandated ICTD intervention.

7 Conclusion

Our study shows that the state-mandated ICTD is generally not found to be in use in the markets we studied. However, a slow bottom-up market reformation is underway organically through the innovative use of locally valuable non-state ICTs. Generalising this, it is not the digital technology that is being rejected. Only a particular philosophy

or the underlying discourse that embodies technological design is not being accepted in the complex societal system. The underlying reasons are related to dissonance in the way the distant state has understood the societal system and the starkly different reality at the local level, which we theorise using the counter-discourse lens of Scott [24].

This leads to the failure of the state to achieve transformation as the problem is not well defined, nor does the solution completely cover all the aspects critical to a complex societal system. This is attributed to the reductionist philosophy that comes about when policymakers fail to look at complexities inherent to societal systems, and such complexities may go beyond technical and involve some societal aspects or interaction with people, whereby context is fundamentally important. Hence, technical solutions are insufficient [23].

Our findings show that what may get adopted are solutions that fit into the working system and, by being receptive to constant tweaks delivered locally, manage to follow the problem that is ill-defined and, to an extent, keep pace in terms of solution in least disruptive ways. The preference at the local is for technology that is 'simple', 'least disruptive' and 'most inclusive' rather than which comes with grand claims of being 'most elegant' or 'most efficient'.

More empirical studies involving other Agro-climatic zones and different societal systems may deepen this study further.

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Understanding Potential Risk Factors in the Use of ICTs for Rural e-Governance

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Abstract. Traditional and advanced ICTs have effectively facilitated the implementation of e-governance for rural areas. At the same time, using ICTs for rural e-governance poses considerable risks due to inequality rural communities face, i.e., lack of awareness, limited access to resources, isolation, lack of digital literacy, and limited exposure to the outside world. Against this backdrop, our study employs a qualitative approach to understand potential risk factors that need to be addressed in using ICTs for rural e-governance. In this study, we conducted in-depth interviews with e-district managers, the chief executive officer, Janpad Panchayat (Rural Development), common service centre (CSC) managers, CSC operators, and rural citizens to gain a deeper understanding and insights into the potential risks associated with the use of ICTs for rural e-governance. The results suggest two major themes, i.e., government-related risks for rural areas and rural user-related risks. CSC operator risk, risk due to lack of public order in Naxalite-affected rural regions, risk due to inadequate funding for rural e-governance services, risk due to inadequate internet connectivity in rural areas, and risk due to lack of CSC systems maintenance are substantial government-related risk factors in rural areas. Further, risks due to lack of digital literacy, fraudulent activities perpetrated by fraudsters in rural areas, computer anxiety, digital exclusion, and lack of a bottom-up approach are significant rural user-related risk factors. This research will enhance our understanding of the associated risks in rural e-governance.

Keywords: E-Governance · ICT · Qualitative · Risks · Rural

1 Introduction

The rural population in developing countries generally lives in a remote, relatively isolated, and secluded part of the country. They are often called marginalized, vulnerable, underserved, and underrepresented communities. The COVID-19 pandemic has amplified the importance of digital transformation. Despite limitations on physical interactions, governments have provided public services to reach remote, marginalized, vulnerable, and other underserved populations to ensure that no one is left behind (United

Nations 2022). ICTs are considered effective and optimistic tools for connecting rural villages and empowering villagers to enhance their social well-being, economic growth, and fair and equitable justice, especially for developing countries (Ye et al. 2021). ICTs can substantially accelerate progress toward all 17 United Nations Sustainable Development Goals (SDGs), particularly in low-income countries where narrowing the development divide requires significant effort, inclusive innovation, and investment (Ericsson 2016). In this research, we focus on an emerging economy setting of India, a country with over 1.43 billion populations, with the highest number of people living in rural areas, i.e., over 909 million (World Bank 2018). India's rural landscape is extensive and consistently expanding. In 2019–2020, the rural economy contributed nearly half of the nation's total GDP (i.e., 46%) and employed approximately 350 million people (i.e., 68% of the workforce). Over the past decade, the rural ecosystem has significantly transformed, and physical and digital infrastructure has advanced considerably (Bain and CII 2022). India is one of the leading internet users worldwide, with over 692 million active internet users (IAMAI 2021). India has emerged as the fastest-growing major economy in the world. According to the International Monetary Fund (IMF) working paper, March 2023, India has built a world-class digital public infrastructure (DPI) to help its sustainable development goals. The working paper further stated that digitalization has aided in the formalization of India's economy.

The government of India has introduced several financial and digital initiatives aimed at inclusive rural growth, such as Aadhaar, a digital identity, direct transfer of social benefit payments, Jan Dhan savings bank accounts (zero balance), and the digital payment infrastructure and others (WEF 2020). Despite significant technological initiatives, rural citizens are generally unable to utilize the e-governance initiatives due to the following issues, i.e., lack of education, low income, poverty, no or minimal prior digital interaction, limited resources, and others. A significant deterrent that hinders the use of ICT among rural communities is difficulty in understanding the internet and lack of awareness. In addition, despite being the leading internet users worldwide, the percentage of active internet users in rural India is 37%, compared to their urban counterparts, which is 69%, indicating a substantial digital divide in the country (IAMAI 2021), which further exacerbates existing social and economic disparities between urban and rural areas. In general, both urban and rural citizens are exposed to risks when using ICTs for e-governance. These risks include data security, privacy breaches, cyberattacks, and online fraud. However, apart from these IT-related risks, rural citizens are also vulnerable to misconduct, malpractices, and digital incompetence due to low education and minimal exposure to digital technologies. Based on this context, our research question is as follows: ***What are the potential risk factors associated with the use of ICTs for rural e-governance, and how they might affect rural communities?***

In this research, we employ a qualitative approach through in-depth interviews to understand the risks associated with using ICTs for rural e-governance. Our study makes the following theoretical contributions to information systems (IS) and e-governance literature. Firstly, it is the first study to fill a significant research gap related to risk aspects in e-governance, especially rural e-governance. Secondly, this research followed a more comprehensive approach and identified both the government-related risks and rural user-related risk factors in rural e-governance. The findings of our study suggest

that significant government-related risks for rural areas are operator risk, lack of public order, insufficient funding, inadequate internet connectivity, and lack of maintenance. At the same time, significant rural user-related risks are lack of digital literacy, fraudulent activities, computer anxiety, digital exclusion, and insufficient bottom-up approach. This study also offers practical implications by informing policymakers and other relevant stakeholders to design and develop ICTs artefacts explicitly tailored for the rural masses.

2 Theoretical Background

Risk is a widely used concept studied in IS and e-government research (Bélanger and Carter, 2008; Rana et al., 2015; Distel et al., 2022). The e-governance research has frequently conceptualized risk as "perceived risk" and used it as a significant con-struct in various technology adoption models, like the technology acceptance model (TAM), diffusion of innovation (DOI), theory of planned behaviour (TPB), and unified theory of acceptance and use of technology (UTAUT) in e-governance research (Weerakkody et al. 2015; Xie et al. 2017). Perceived risk refers to an individual's subjective perception and belief about the risk (Akkaya et al. 2010). Weerakkody et al. (2015) highlighted that measuring perceived risk was not the primary objective of earlier studies but is closely linked to another predominant construct, i.e., trust in e-governance adoption. In their study, Xie et al. (2017) integrated TAM, TPB, trust, and perceived risk to determine the intention to reuse e-government services. Roy et al. (2015) studied rural citizen's attitudes to the use of e-governance and found that perceived risk is one of the significant variables influencing the attitude.

This section provides an overview of the literature on IS and other e-governance research on using ICTs for rural e-governance. Earlier researchers have studied rural e-governance in multiple contexts, i.e., digital divide (Song et al. 2020; Lythreatis et al. 2022), community-driven development (Leong et al. 2016; Ye et al. 2021), e-commerce (Leong et al. 2016; Li et al. 2019), ICT4D (Ye et al. 2021; Hoque 2020; Thapa and Sæbø 2014), economic growth (Min et al. 2020; Malodia et al. 2021), and poverty alleviation (Li et al. 2019; Song et al. 2020). Song et al. (2020) found that the critical contributing factor to the digital divide is socio-economic problems rather than institutional and innovation aspects, which must be addressed to improve ICT use and outcomes. Lythreatis et al. (2022) systematically reviewed the digital divide. Further, they segregated the notion into three levels of the digital divide, i.e., first-order digital divide, i.e., access gap, second-order digital divide, i.e., usage gaps, and third-order digital divide, i.e., outcome gaps. Malodia et al. (2021) stated that studying the context of developing countries is crucial because e-government interventions in such countries tend to have higher failure rates than those in developed countries.

CSCs/Telecenters/Kiosks help to narrow the digital gap by facilitating rural communities with access points, fostering citizen participation, and enabling local economic development in rural areas (Madon, 2005; Pick et al. 2014; Siddiquee and Faroqi 2022). Few researchers (Dwivedi et al. 2016; Sharma et al. 2021) have studied the challenges common service centers (CSCs) face in providing e-government services to their citizens. Ferrari et al. (2022) have provided a catalogue of barriers, drivers, and the impact of digitalization among rural communities. To understand the fundamental nature of digital

connectivity, realizing the actual usage of ICTs is crucial. Providing connectivity and technology is one part of staying updated with advancements; adoption and actual use are indispensable for digital connectivity to make a difference (Salemink et al. 2017). Despite having access to ICT, the digital divide can still arise in distinct social, institutional, and cultural contexts due to users' inability to use digital services. Such apparent inability is ubiquitous in developing countries, where people lack the primary education and skill to use e-services (Hoque 2020). Mubarak et al. (2020) confirmed a substantial relationship between ICT and socio-economic factors and provided a positive link between income, education, and internet usage.

Prior investigations have examined risks empirically in e-governance (Bélanger and Carter, 2008; Xie et al. 2017). To the best of our knowledge, no previous research has explicitly explored the risk factors of using ICTs for rural e-governance. Subsequently, we aim to advance the existing body of knowledge by uncovering the potential risk through a qualitative approach, i.e., in-depth interviews. In addition, our research will be an early attempt to uncover the risk factors through the lenses of government and rural citizens simultaneously. Figure 1 represents the research framework for this study.
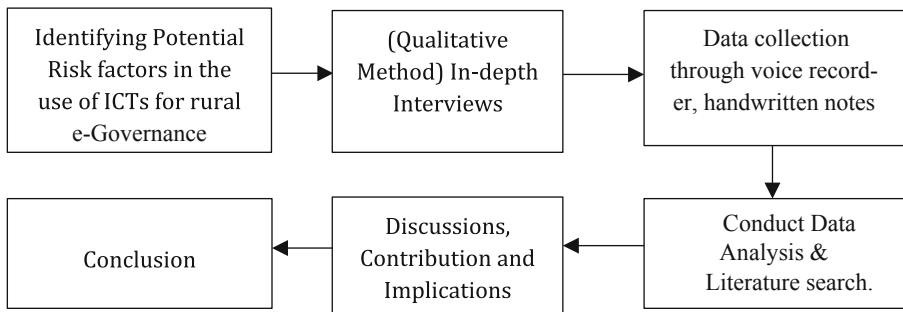
Fig. 1. Research Framework for Risks in the Use of ICTs for Rural e-Governance.

3   Methodology

This study employs a qualitative approach, i.e., In-depth interviews with experts and rural citizens to understand the potential risk factors in using ICTs for rural e-governance. Furthermore, this method is suitable as e-governance research is complex and multifaceted (Malodia et al. 2021). Qualitative methods, such as in-depth interviews, enable researchers to gain a deep and comprehensive understanding of rural residents' experiences, perspectives, and needs. It is essential in e-governance research since it helps uncover nuances and complexities that quantitative methods may overlook (Flick 2021). The significant advantage of in-depth interviews is that they offer much more detailed information than other data collection methods, such as surveys (Boyce & Neale 2006). In this study, primary data were collected through in-depth interviews with 12 experts, including e-district managers, chief executive officer, Janpad Panchayat (Rural Development), CSC managers, and CSC operators. We interviewed from nearly eight distinct districts and blocks (Bemetara, Balod, Balodazaar Bhatapara, Dhamtari, Durg,

Kurud, Mahasamund, Raipur) of Chhattisgarh, India, to gain diverse perspectives and to enhance our understanding of ICT use in rural settings. The experts, such as e-district managers, are state government-appointed officials responsible for the daily activities of e-governance services rendered in the district. They are the single point of contact for all village-level entrepreneurs (who operate kiosks/ CSCs) in the respective district. In addition, CEO Janpad Panchayat is responsible for the overall development in the respective villages, including monitoring e-governance initiatives. This study adopted purposive sampling to select the participants, as this sample fits the research objective; further chain referral was employed to have more respondents working in the same domain (Iong & Phillips 2023). Participants were assured that both individuals and organizations involved in the study would remain confidential and anonymous. All interviews lasted about 60–120 min and were recorded as voice recordings and field notes with pen and paper. All interviews were conducted in both English and local languages, as the researcher was well-versed in both languages. Data were collected from varied genders (male: 58%, female: 42%) and educational backgrounds (postgraduate: 66%, and graduate: 34%).
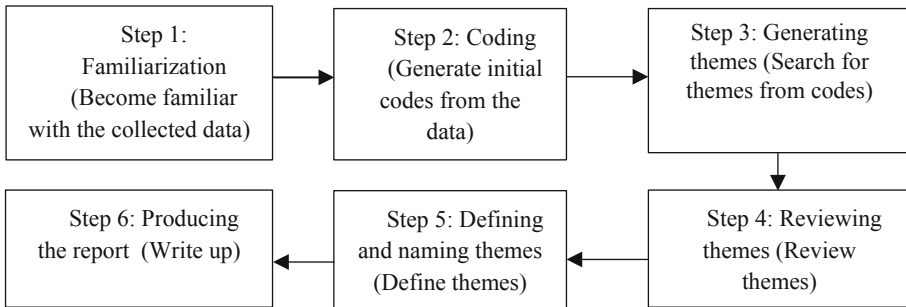
Fig. 2. Six phase framework thematic analysis from Braun & Clarke, 2006

The majority of the participants had more than five years of work experience. We collected data through semi-structured interviews. We conducted a thematic analysis and analyzed the transcribed data to contribute to a better understanding of risks in the use of ICTs. Furthermore, we identified the patterns and grouped the themes according to the relevant factors. Figure 2 illustrates the framework for the thematic analysis carried out in this study. We asked interview questions related to risks to delve into a deeper understanding and insights into rural e-governance. The following are representative questions that were asked during the interviews with the executives:

- Which e-governance initiatives have you been involved in rural settings?
- Could you share your observation of risk associated with using ICTs in rural e-governance?

4   Interview and Data Analysis

The interviews were conducted in distinct districts of Chhattisgarh, India, encompassing a geographically diverse region within the state. We have selected Chhattisgarh as our research location due to its significant relevance and suitability to conduct research on marginalized communities. It is renowned for its substantial forest cover areas, which rank one of the highest among the states and is also significantly affected by anarchist activities, i.e., Naxalites. We have chosen individuals responsible for day-to-day e-governance activities in the respective districts and blocks for in-depth interviews. The study involves a semi-structured interview with experts.

4.1   Government-Related Risk Factors

Most interviewees indicated that the operator's risks pose a substantial risk. It refers to deceptive activities performed by CSC operators while carrying out e-service activities, as explained by one e-district manager:

"Due to low education and less digital knowledge of rural citizens, CSC operators take advantage of them (villagers) and do fraudulent activities such as over-charging fees, charging for services free for rural citizens, and cash deposit frauds".

Concerning anarchist activities, i.e., naxalism, citizens and e-governance stakeholders face substantial risks while carrying out e-governance initiatives, as explained by one e-district manager:

"This (naxalism) poses a substantial risk to e-governance initiatives in rural areas of southern Chhattisgarh, i.e., disruption of e-services, where society cannot function safely. Operating under such conditions is detrimental to the life and property of rural citizens and e-governance stakeholders".

In terms of inadequate funding, experts highlighted the negative consequences of insufficient financial resources for e-governance initiatives, as explained by one e-district manager:

"Rural e-governance initiatives often face significant financial constraints, resulting in limited human resources, service delays, reduced quality, abandonment of e-projects, and inadequate infrastructure for marginalized communities".

Most interviewees highlighted inadequate internet connectivity among rural communities; this refers to the limited or unreliable access to proper internet services in rural areas, in the opinion of one e-district manager:

"They (rural citizens) generally stay in remote or geographically isolated areas, often facing obstacles in accessing essential e-governance services. Network issues persist in the extreme interior part of rural areas. Poor internet connectivity limits the accessibility of various e-governance services".

Most interviewees explained that lack of CSC systems maintenance presents a considerable risk and is prevalent among rural communities due to remoteness and limited technical expertise, as expressed by one e-district manager:

"Many times, they (CSC operators) complain about the servers being down or non-functioning of websites. Due to remoteness, finding trained and competent personnel in rural areas to maintain the systems is difficult. Lack of maintenance results in overwhelming risks, i.e., system failures and frequent breakdowns".

About cyberattacks government institutions can have severe consequences of cyberattacks, in the opinion of one chief executive officer, rural development:

"Despite implementing several safeguarding measures, due to technological advancements, e-governance systems are vulnerable to cyber threats, which continue to pose a greater risk to governments".

As per the report, India saw the highest number of cyberattacks on government websites in 2022 (Cloudsek, 2022).

In terms of risk due to corruption, as explained by one e-district manager:

"In the past, under paper-based systems, government officials used to ask bribes from citizens to provide the services. However, this unethical practice has been eliminated with the use of ICTs. However, corruption at the top level may still occur, particularly when powerful corporations are involved, where political interference and unethical leverages or favors are exploited, which poses a serious threat".

Concerning risk due to lack of leadership refers to a lack of vision and non-aligned goals, which leads to the failure of e-governance initiatives, as explained by one chief executive officer (rural development):

"Usually, leaders disregard e-governance initiatives for communities as they find these initiatives are costly and won't benefit the citizens, further discouraging the use of ICT solutions. Lack of vision and accountability of leaders can result in in-effective goal setting and hinders the achievement of long-term objectives of e-governance initiatives".

In terms of risk due to inadequate collaboration, findings reveal that insufficient coordination or cooperation among stakeholders generates risks to the e-governance initiatives, as indicated by one CSC Manager:

"This (inadequate collaboration) can result in unsatisfactory cooperation, no or poor interoperability, duplication of efforts, ineffective resource utilization, meager planning, poor service delivery, and wastage of assets".

Concerning risk due to inadequate service quality, as explained by an e-district manager:

"Inferior service quality poses numerous risks to e-governance initiatives, i.e., government digital platforms often fail to provide accurate or updated information. Most of the time, these platforms fail to meet people's expectations, raising concerns about reliability, effectiveness, and responsiveness of e-governance initiatives".

4.2   Rural User-Related Risk Factors

To gain insight into the risks of ICT use, we interviewed a few rural citizens with limited exposure to the digital realm. They eventually agreed to share their experience despite having no or minimal knowledge.

Regarding the data security and data privacy of rural citizens, a substantial population is unaware of data security-related risks, in the opinion of one citizen:

"I (rural citizen) do not have any idea about these things (data security & data privacy) as this is new to me. I do not know about the digital things".

In addition, as stated by one e-district manager regarding data security and privacy-related risks:

"Unlike their urban counterparts, they (rural citizens) have no or limited awareness and knowledge about data security and privacy. They can be easily lured by offering enticing prizes or gifts. They (rural citizens) do not understand the implications of sharing personal information. They often click on unwanted links shared from unknown numbers through text or WhatsApp messages and readily allow access to their personal information, which poses a severe threat".

Rural citizens are susceptible to numerous risks due to a lack of digital literacy, as stated by one e-district manager:

"Generally, they (Rural citizens) have limited digital knowledge. To accomplish services digitally, they (rural citizens) rely heavily on others, such as CSC operators or strangers, and readily share their personal information. Lack of digital literacy has numerous negative consequences, i.e., vulnerability to fraud, minimal job opportunities, limited citizen participation, and economic disparity".

Risk due to fraudulent activities perpetrated by fraudsters in rural areas: rural citizens easily get duped by fraudsters due to no or less awareness of digital activities. As highlighted by one e-district manager:

"They (fraudsters) typically target marginalized communities due to their (rural citizens) low education, no or low digital literacy, and unawareness of latest scams, making them more vulnerable and susceptible to scams. Few fraudsters impersonate government officials to access personal information; generally, fraudsters share enticing offers through fake calls or WhatsApp messages, luring them (rural citizens) for jobs generating effortless money or freebies. These (Rural) people easily get trapped in this fake modus operandi".

In terms of risk due to computer anxiety, rural citizens feel overwhelmed by the digital complexities, as stated by one e-district manager:

"There are numerous reasons that make them (rural citizens) anxious about using e-services, such as low education, no prior experience with digital devices, and minimal exposure to the outside world. Computer anxiety is a common issue predominantly experienced among rural citizens. They usually (rural citizens) get nervous or feel uncomfortable when asked to use digital technologies to accomplish certain activities".

In the view of digital exclusion, marginalized communities often bear the most significant burdens of technological advancements, as illustrated by one e-district manager:

"Due to rapid technological advancements and the ubiquitous nature of rural areas, such as poverty, remoteness, and lack of education, these peoples are at risk of being digitally marginalized. Digital exclusion poses severe risks, i.e., hinders access to essential services, increases social isolation, limits the scope of development in rural areas, and makes them (rural citizens) vulnerable to exploitation".

Regarding the risk due to the lack of a bottom-up approach toward e-governance initiatives in rural settings, it refers to decisions taken without the active involvement of rural citizens, in the opinion of one chief executive officer, rural development:

"In many instances, rural e-governance initiatives are introduced without actively involving or taking inputs from them (rural citizens), which results in poor or failed e-governance initiatives. These people (rural citizens) have rich knowledge and expertise about their local surroundings; not considering or tapping their valuable experience and inputs could pose numerous risks. An excessive top-down approach and limited bottom-up approach could exacerbate inequalities and fail to achieve long-term goals, weakening trust in the government".

The abovementioned research has provided valuable insights by revealing potential risk factors in using ICT for rural e-governance. Research findings are reinforced by identifying risk factors through a literature review, as shown in the Table 1.

5 Discussion

The primary purpose of this study is to understand the risks associated with using ICTs in rural e-governance. Despite the potential benefits of using ICTs in rural e-governance, there is a need to delineate the actual risk factors that persist among marginalized communities. Through this research, we could enumerate the actual risk factors that prevail in rural e-governance, as shown in the Table 1. Data was collected through in-depth interviews with e-district managers, the chief executive officer, Janpad Panchayat (Rural Development), CSC managers, and CSC operators. Thematic analysis was carried out to analyze the actual risk factors from the collected data. This section discusses the

risk factors associated with ICT use in the post-adoption stage. The actual risk factors uncovered through the interviews have been further categorized into two major themes, i.e., government-related risk factors and rural user-related risk factors in rural areas.

Government-related risk factors refer to the risks the government may face while deploying ICTs for e-governance initiatives. Common service centers (CSCs) propel e-governance initiatives through single-point access to deliver public services and help bridge the digital divide (Sharma et al. 2021). In this connection, CSC operator risk is one of the significant risk factors in rural India. In a few cases, CSC operators use fake or forged certificates to issue Aadhar cards and do fraudulent activities (Hindustan Times 2023). The lack of public order in Naxalite-affected rural areas is another significant risk factor in the southern part of Chhattisgarh districts. As per the ACLED data, 80% of the Naxalite activities are concentrated in four states, i.e., Chhattisgarh, Jharkhand, Odisha, and Maharashtra, with Chhattisgarh remaining the stronghold for Naxalite insurgency in 2020. Operating CSCs under such conditions is detrimental to the lives and assets of both CSC operators and rural citizens.

Furthermore, inadequate funding for rural e-governance services may give rise to various risks, such as service delivery disruption, outdated software, limited security measures, and heightened vulnerability to security threats. In addition, limited inter-net connectivity in rural areas is a considerable risk factor that results in various consequences, i.e., reduced access to critical information and essential services like healthcare, agriculture, and education, further pushing toward social isolation and economic hindrances, the findings align with the existing literature (Sharma et al. 2021). In addition, due to rugged terrain and extreme interiority, maintenance of CSC systems is problematic and even more so in harsh weather, which underpins numerous risks for marginalized communities; the findings from the respondents support the existing literature (Dwivedi et al. 2016).

The risks faced by both urban and rural users are mentioned in this section. One of the severe threats to e-governance initiatives is cyberattacks. As per the report, India saw the highest number of cyberattacks on government websites in 2022 (Cloudsek 2022). In addition, corruption poses a significant threat to e-governance initiatives. While e-governance is effective in reducing petty corruption but ineffective in combating higher-level corruption, the findings from the interviewees support the extant literature (Khan et al. 2021). Moreover, the absence of effective leadership poses a considerable risk that may result in the negligence of rural requirements and hinder the progress of inclusive development (Samsor 2021). In addition, inadequate collaboration poses a substantial risk to the functioning of e-governance initiatives; the findings from the respondents are consistent with the extant literature (Ashaye and Irani 2019; Samsor 2021). Inadequate service quality is a vital risk factor for rural communities, as they often have fewer options and less access to e-services than their urban counterparts; poor service quality encompasses inefficiencies, technical faults, and unreliable connectivity, the findings from the respondents support the existing literature (Lee et al. 2021).

Rural user-related risk factors refer to risks that result from the actions of citizens or affect citizens while using ICTs for e-governance initiatives. This section aims to explore the rural user-related risk factors. Lack of digital literacy poses a severe threat to rural communities. It exacerbates the digital divide, reduces citizen participation, limits economic opportunities, and increases social isolation. Further, the risk due to fraudulent activities includes operating fake websites similar to government official web pages, producing counterfeit documents, and contacting through fake calls and WhatsApp messages while impersonating government officials or any legitimate officials demanding money or personal documents. The findings from the respondents support the scams going around (Indian Express 2023). Another significant risk factor when introducing digital technologies to rural communities is the risk of computer anxiety. Computer anxiety is a typical problem among rural citizens because of limited exposure and access to digital technologies, which makes rural citizens feel uneasy and discomfort. Furthermore, computer anxiety impedes rural citizens' ability to access important information and essential services, i.e., healthcare, agriculture, education, and relevant schemes; the findings from the respondents aid the extant literature (Venkatesh et al. 2014). In addition, the risk of digital exclusion is a multifaceted and evolving phenomenon, shaped not just by the digital divide but also by various other sections, including age, gender, and literacy; moreover, social inequality forms the basis for digital exclusion (Zheng and Walsham 2021). Another vital risk is limited citizen participation; there could be a risk that decisions acquired for e-governance initiatives will not be in the best interests of rural communities, leading to dissatisfaction and desertion of e-governance initiatives. The findings from the respondents are consistent with the extant literature (Ye et al. 2021). All interviewees mentioned data security and privacy issues as the most critical concern, especially to rural populations, who may be unaware of the risks associated with data collection and use for e-governance initiatives. Data security refers to preventive mechanisms introduced that strive to avert exposure of unauthorized access, illegal modifications, destruction of personal data, or any potential threat posed by viruses and worms. In addition, data privacy assures adequate protection for an individual's personal information, i.e., the personal data collected is securely handled and used only for the intended purpose. Excessive government surveillance, e-governance stakeholder intervention, and third-party mobile applications may hamper data privacy. The findings strongly support the argument found within the extant literature (Glyptis et al. 2020; Königs 2022).

Table 1. Potential risk factors in the use of ICTs for rural e-governance

Risk	Risk Factors	References	Definition
Government-related risks factors	CSC operator risk	Self-contribution	Refers to fraudulent activities executed by CSC operators while performing e-services activities for rural users, i.e., financial frauds, providing fake documents
	Risk due to lack of public order in Naxalite-affected rural areas	Self-contribution	Refers to a situation where rural communities cannot obtain e-services through the nearest CSC safely and systematically
	Risk due to inadequate funding for rural e-governance services	Self-contribution	Refers to the insufficient allocation of funds to run e-governance services in rural areas
	Risk due to inadequate internet connectivity in rural areas	Dwivedi et al. (2016)	Refers to poor or intermittent internet connectivity to access e-services in rural areas
	Risk due to lack of CSC systems maintenance	Self-contribution	Refers to failure to repair and update systems, computing devices, and other infrastructure for rural e-governance initiatives
Risk factors confronted by both urban and rural users			
	Cyberattacks	Self-Contribution	Refers to malicious online attacks by unauthorized users to disrupt or gain unauthorized access to e-systems used in e-governance initiatives

(*continued*)

Table 1. (*continued*)

Risk	Risk Factors	References	Definition
	Risk due to corruption	Khan et al. (2021)	Refers to fraudulent activities or unethical behavior by individuals, organizations, or political leaders, i.e., abusing public office for personal gain
	Risk due to Lack of Leadership	Samsor (2021)	Refers to the inability of leaders to establish clear goals for e-governance initiatives
	Risk due to inadequate collaboration	Ashaye and Irani (2019); Samsor (2021)	Refers to limited coordination or cooperation among government and other e-governance stakeholders
	Risk due to inadequate Service Quality	Lee et al. (2021)	Refers to failure to provide efficient and satisfactory e-services to the people
Rural User-related risk factors	Risk due to Lack of digital literacy	Self-contribution	Refers to limited or poor digital knowledge among rural citizens while using e-governance initiatives
	Risk due to fraudulent activities by fraudsters in rural areas	Self-contribution	Refers to risks performed by fraudulent individuals by duping rural citizens while posing themselves as government officials or representative of e-governance agencies
	Risk due to computer anxiety	Venkatesh et al. (2014)	Refers to nervousness or negative feelings among rural citizens while using digital devices

Table 1. (*continued*)

Risk	Risk Factors	References	Definition
	Risk of digital exclusion	Self-contribution	Refers to the unequal access and capacity to use e-governance initiatives among rural communities
	Risk due to Lack of bottom-up approach	Ye et al. (2021)	Refers to a situation where e-governance initiatives are implemented without considering rural communities' needs and expectations
Risk factors confronted by both urban and rural users			
	Data security-related risk	Glyptis et al. (2020)	Refers to the threats posed by unauthorized access to personal information
	Data privacy-related risk	Glyptis et al. (2020); Königs (2022)	Refers to the threat of misusing personal information by e-governance stakeholders or excessive government surveillance

6 Theoretical Contributions and Practical Implications

Our study is the first of its kind that lists the risk factors associated with using ICTs in rural e-governance. Our study contributes to IS and other e-governance literature. In this study, we focus on the actual risk factors in using ICTs for rural e-governance and uncover two major themes, i.e., government-related risk factors and rural user-related risk factors. This research study provides seventeen risk factors for e-governance in rural settings. These risk factors provide insight into the vulnerabilities associated with using ICTs in rural e-governance.

The findings of this study have significant practical implications for decision-makers, government agencies, and stakeholders involved in rural e-governance. This research study has provided numerous risk factors broadly classifying government-centric and citizen-centric risks. Recognizing potential risk factors allows decision-makers to effectively develop strategies to mitigate these risks, including creating contingency plans and setting up better monitoring mechanisms. Investigating risk factors will enable decision-makers to make informed decisions, prioritize investments, and allocate budgets to risk mitigation measures and support. Understanding critical risk factors would

assist decision-makers in designing ICT artifacts and better policies tailored explicitly to marginalized communities.

7   Conclusion

This article is one of the first to uncover and enumerate the actual risk factors in using ICTs for rural e-governance. Furthermore, we followed the extant literature on e-governance literature. We conducted in-depth interviews and uncovered potential risk factors in using ICTs for rural e-governance. This research aimed to understand potential risk factors in using ICTs for rural e-governance in developing countries, mainly rural India. Our research findings indicated two major themes, i.e., government-related risk factors and rural user-related risk factors. With government-related risk factors, we found ten risk factors, such as CSC operator risk, risk due to lack of public order in Naxalite-affected rural areas, risk due to inadequate funding for rural e-governance services, risk due to inadequate internet connectivity, risk due to lack of CSC systems maintenance in rural areas, cyberattacks, risk due to corruption, risk due to lack of leadership, risk due to inadequate collaboration, and risk due to inadequate service quality. With rural user-related risk factors, we found seven risk factors: risk due to lack of digital literacy, risk due to fraudulent activities, risk due to computer anxiety, risk of digital exclusion, risk due to lack of bottom-up approach, data security-related risk, and data privacy-related risk. This study could help to advance the understanding of IS and e-governance literature. The findings of this research would benefit e-governance researchers, decision-makers, government agencies, and all other stakeholders involved in rural e-governance.

8   Limitations and Future Research Directions

By uncovering the potential risk factors in the use of ICTs for rural e-governance, it is evident that there is much potential to advance the literature on the risk factors in rural settings. According to our study, risk factors have barely been revealed before in the rural context. In addition, our study will create a new avenue for future researchers to determine the risk factors separately and exhaustively. By uncovering the risk factors in using ICTs, it is evident that there is much potential to advance the literature on the risk factors in rural settings. Future researchers can study mitigating practices for the revealed risk factors, which can contribute to richer findings.

Further, they may also look for other countries with different social, economic, and ethnic backgrounds to have a rich understanding of risk factors. This study offers valuable insights to guide future research into emerging technologies and associated risk factors in using ICTs for rural e-governance. The study also has a few limitations. First, our study qualitatively collected data through in-depth interviews. Future studies can employ these factors to conduct quantitative analyses using Multiple Criteria Decision Making (MCDM) methodologies; research findings from the mixed method approach provide a comprehensive and nuanced understanding of the research problem. Second, although substantial efforts were made to collect data from distinct districts, the study was limited to Chhattisgarh state only. Finally, the study was conducted from the Indian perspective. Future researchers can conduct similar studies in other developing nations and compare

and contrast to support its generalizability. This research will aid in developing strategies to ensure the safety, security, and long-term sustainability of rural e-governance systems.

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Digital Financial Inclusion and Resilience – A Crowd-Funded Microloan Platform in Indonesia

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Abstract. Digital financial inclusion (DFI) aims to offer better opportunities for poor women who often face unequal access to financial services. Platformed crowdfunding, for example, has been adopted to connect resourceful urban lenders to rural area borrowers. However, it has not yet been known to what extent the impacts of such initiatives have on the improvement of women's livelihood. The theorisation of ICT for Development (ICT4D) research has focused largely on the access and usage side, and there is limited understanding of the effect of DFI on overcoming gendered inequality. This research explores a case of platformised microfinance in Indonesia and the importance of building women's financial resilience. Drawing on Sen's capability approach (CA) as a theoretical lens, the qualitative study examines the reasons behind the expansion and deprivation of women's capabilities in DFI. Findings reveal the importance of building financial resilience to ensure the sustainability of financial inclusion and the expansion of women's agential capacity. The paper contributes to the DFI literature by highlighting financial resilience as an important capability for grassroots women entrepreneurs.

Keywords: Digital Financial Inclusion · Financial Resilience · Agency · Gender · Capability Approach

1 Introduction

Financial inclusion has been a long strategy in development for overcoming gender asymmetries by providing economic, social, and financial opportunities [5]. Digital technologies are proposed to assist underserved and impoverished people who previously only transacted in cash to gain access to formal financial services such as payment, transfer, savings, and credit [8, 9]. For instance, digital crowdfunding platforms can help bypass traditional financial intermediaries, connecting borrowers via mobile phones and digital platforms [12], whether to fund a business, a specific project, or to meet long-term financial needs.

Financial inclusion instruments for low-income people, such as microcredit/microfinance, are one of many approaches to promoting women's empowerment. Low-income women are 28% less likely than low-income men to have a formal bank account [8]. More women than men who own small and medium enterprises (SMEs) have limited access to financial services [14] and are less likely to own mobile phones [10]. Financial inclusion is found to help increase women's autonomy and decision-making powers [22].

The role of digital platforms in development literature has raised interest for information systems and development scholars [4], yet the existing literature on digital financial inclusion (DFI) focuses on providing access to financial services. It rarely evaluates the sustainable benefits of DFI, or the lack thereof, on marginalised women. The recent literature still largely discusses access [3] and the role of digital technology in accelerating the effect of financial inclusion on economic growth [7]. Some recent literature also explores the impact of digital financial inclusion on poverty alleviation, although only a few on marginalised groups. For example, the discussion on how DFI impacted poverty alleviation from provincial data of China (2011–2019) [15] and the exploration of how DFI contributes to developing the tourism industry in some cities in China [24]. It has not further considered whether access will automatically generate the intended impact on marginalised groups. The research community needs to pay more attention to the complexity of digital financial inclusion and its mixed effects.

This research-in-progress (RIP) paper examines a platformised microfinance program in enacting financial inclusion of women. Based on a case study of Amartha in Indonesia, this paper identifies a critical link often missing between financial inclusion and women's empowerment – financial resilience. Preliminary findings reveal that while DFI expands capabilities, it can also expose women to financial risks due to the lack of capacity building.

2 Theoretical Framework: Capability Approach (CA)

Despite originating from economics academic literature, CA has been operationalised widely across disciplines, including ICT for Development [11, 13, 16, 17, 26]. *Capability* means 'the various combinations of functioning that the person can achieve' [21]. It reflects a person's *freedom* or (real) opportunities, for example, freedom to acquire, be nourished, get a job, or protest. In other words, capabilities are, hence, a set of vectors of *functioning* that reflect a person's freedom to lead one type of life or another [21]. Sen [20] refers to *functioning* as 'the various things a person may value being and doing'.

The CA is used in this paper to evaluate the impact of DFI on grassroots women. In this context, *women's wellbeing* relates to better health conditions, sanitation, and children's education, while women's agency is the ability to manage finances, make financial decisions and so forth. Women's *active agency* means individuals can promote and pursue the value in their lives instead of being reactive agents or 'patients'[2].

The expansion of the capability set of the individual is conditioned by various conditions including *personal, social, and environmental conversion factors*. Structural constraints, for example, social institutions and social and legal norms that individuals in different social positions face, play a crucial role in shaping people's capability and

greatly affect individuals' conversion factors. Structural inequalities affect the opportunities for freedom to participate in the economy and restrict their ability to convert their resources into opportunities. Amartya Sen's CA has the strength to allow for individual diversity [25] to understand better how women's personal and social opportunities translate into wellbeing and agency.

3   Research Methodology

The empirical case focuses on Amartha, Indonesia's homegrown microfinancing lending platform connecting urban lenders to women borrowers (i.e., mostly semi-rural and rural borrowers). This study is a qualitative, interpretivist research [23] which focuses on the diverse understandings and experiences of individual participants as situated in the complexity of social contexts, such as social norms, structures and histories. This study adopts a single case study and aims to answer the research questions for an in-depth analysis to unpack the complexity of DFI in microfinance cases. A single case study on women micropreneurs provides the best option for this study to explain the phenomena in-depth.

3.1   Research Settings

Various MFIs have been operating in Indonesia since 2003 with various degrees of success. Amartha was established in 2010 as a microfinance institution (MFI) with a social agenda, providing microloans only for women borrowers by combining a crowdsourcing-based platform [12] and a women's loan group similar to the Grameen Bank model. It is considered one of the biggest private microfinance providers in the grassroots market alongside the state-owned one, named PNM Mekaar, aiming for financial inclusion and women empowerment. The microfinance market is complex with multiple players (approximately ten legal MFI providers in one rural village).

After six years of operation, Amartha pivoted its business model to a peer-to-peer (P2P) platform-based model, then in 2020 enabled crowdfunding-based microfinance. The new business model allows Amartha to have multiple funding channels, including individual and institutional funding. Thus, the platform enables resourceful urban lenders to directly invest in those in rural areas that are mostly unbankable. Women must borrow in a group of 15–20 members in proximity to their house to enable social collateral and perform weekly microloan repayment for 50 weeks every cycle. Amartha also allows women to be individual borrowers after five successful cycles. To be eligible for the microloan scheme, the borrower must be a woman, from 17 to 58 years old, with a national identity, willingness to repay, and commitment to social collateral. Most of the participants are married, as most rural and semi-urban women are married in early adulthood, around 19 years old.

Amartha grew significantly after transforming its business models in 2016. By 2022, the number of branches increased from less than 100 branches to 500 branches. The platform manages 1,300,000 borrowers, 100,000 individual urban lenders, and more than 20 institutional lenders with USD 492 million in total loans disbursed. Amartha operates with 300 headquarters employees and around 4.000 field officers on the ground.

3.2   Research Methods

Data collection was conducted in several phases from July to September 2022, including an online pilot phase across Indonesia and a fieldwork phase in one of the poorest districts in Indonesia where Amartha first disbursed the microloan in 2010. The fieldwork accommodates a variation of successful and unsuccessful cases across multiple villages and includes semi-urban and urban women participants. Data collection consists of semi-structured interviews, participant observations, and focus group discussions (11 women). The total number of participants is 66 (i.e., 44 in-person, 22 online), consisting of women micropreneurs and some of their husbands, the platform's management and employees, lenders, and Indonesian experts. The total duration of the interviews is 1,847 min, with an average of 30 min and the longest of 85 min. All interviews and focus groups are recorded, transcribed, and imported to NVivo, including field notes.

Interviews were also conducted from the platform side to understand the provision of the service and how the program was designed and implemented. Participants included the headquarters staff, two people from top management, nine middle managers, four staff members working on social impact, technology, and data science, as well as six field officers who have daily direct interactions with the women providing door-to-door services. Two experts based in Indonesia in ICT for development and financial sectors and Amartha's lender were also interviewed. In particular, the field officers' perspective provides rich insights drawing upon years of daily engagement with the borrowers, including the perspective of the women.

Thematic analysis was conducted by generating codes based on the theoretical foundation and emerging codes from the data in connection with the field notes. Guided by the CA, the coding process focuses on the expansion and deprivation of capabilities (categorized into wellbeing and agency aspects), as well as personal, social and environmental conversion factors. We also paid particular attention to the gender power relations that the women borrowers are situated in, although the gender theme is not elaborated in this RIP due to space limits. The process is reflexive, i.e. acknowledging, reflecting, and negotiating the researcher's position to situate the writing materials as a representation of the research subject [6].

4   Preliminary Findings

4.1   The Role of Crowdfunded Platform

The platform-based technology plays an important role as an enabler to allow women to have greater choices of loan providers and to cater for a faster loan process (i.e., loan disbursement from weeks to days) than the traditional model. Showcasing the women's business portfolio and micro business in Amartha's borrower marketplace expands the visibility of their micro business to urban investors across Indonesia.

The platform also leverages mobile technology for rural women. First, although rare, some women groups have some exposure to using the existing messenger application for productive activity, for example, managing loan group communication using WhatsApp group, managing their loans independently, and withdrawing cash from ATM instead of in person from the field officer. However, the emphasis on scaling up the service and

rapid acquisition of market share means the program did not provide robust training to borrowers in terms of financial and risk management when taking up the loans.

4.2 Vulnerabilities and Resilience

Most women associated the loan with better opportunities to lead a better life (*wellbeing),* and some women also see the importance of exercising *agency* by leveraging Amartha's DFI model. On the other hand, the findings also reveal the unintended impact resulting in women's deprivation of capabilities. Table 1 summarises the preliminary findings.

Table 1. Expansion and deprivation of capabilities.

Expansion/Deprivation	Functioning/Dysfunctioning	Capabilities
Expansion of capabilities	Agency	Using digital technology to achieve broader goals;
		To be able to start and grow own micro business from the loan;
		To be financially independent;
	Wellbeing	Funding children's education;
		Renovating house;
		Better sanitation conditions;
		Better economic conditions;
Deprivation of capabilities		To be financially dependent on loans
		To fall into over-indebtedness

What are the impacts of the microloans on the wellbeing and agency of women borrowers? Preliminary analysis shows that most borrower women rely on loans from MFIs for everyday consumption or emergency needs rather than capacity or business building. Most of the women do not own bank accounts or maintain emergency funds. Instead, they heavily rely on personal networks and informal channels at times of difficulty, which is highly unreliable, and risk ridden. Some of them do not develop the capacity to manage their funds and repay the loan and fall into spiral debts. In the worst-case scenario, women often are trapped in alternative high-cost and interest loans [1, 8, 18, 19] and risk their and family wellbeing.

Financial resilience is related to women's ability to tackle financial adversity, for example, income, savings, debt management, and the ability to meet the cost of living expenses and raise funds in an emergency [18]. At the initial state, the MFI targets low-literate borrowers (i.e., majority elementary school level) who possess little knowledge of managing a healthy financial condition and maintaining their micro businesses. Even though the platform has several ongoing literacies (digital and financial) and women empowerment programs, the continuation, consistency, and effect of those programs require further examination.

Further, although microcredit provides a social capital established from the women group social collateral or joint reliability, it has also been seen as the shifting exposure

from the lenders largely to the borrowers (women groups). The relentless pressure to repay the debt on a weekly basis and to take out more microloans contributes to the spiral of debt of some borrowers who are trapped in serious financial trouble.

The tension between expanding the platform's market and strengthening the social program becomes obvious. The capability-building programs are occasional and are subject to the initiatives of the field officers and managers on the ground rather than being treated as the core of the business model. As a result, field officers pay more attention to creating business values rather than generating social impacts.

This phenomenon implies the increasing vulnerability of women due to the shift of financial risks from the platform to the borrowers, i.e., the pressure on the women and field officer to ensure successful weekly loan payback. Borrowers are wary of falling sick because once they commit to the loan, they need to pay in 50 consecutive weeks. The women group leader is responsible for ensuring the weekly loan repayment of group members. In addition, field officers also bear responsibility by managing on average around 300 women groups every week, with little time and energy dedicated to care and capacity building [RBp2]. Field officers often report life-threatening experiences when dealing with some problematic loan cases and bear the burden of losing an extra 20% incentive from the salary for 4 weeks of loan default.

5   Concluding Remarks

The study highlights the importance of building financial resilience as part of digital financial inclusion. Amartha's platform-based crowdfunding microfinance program is innovative in solving the bottleneck of the supply side and improved the access of those unbankable to *financial resources* through micro-loans and strengthened their *social capital* using the women's loan group for joint risk based on social collateral. However, further vulnerabilities (i.e., over-indebtedness and financial dependency) emerged potentially due to the missing link between financial inclusion and financial resilience, as well as the tension between the platform business model and social impact. The pursuit of scale in fact generates vulnerabilities in the system for the women borrowers and undermines the possibility of capacity and resilience building in financial inclusion.

In the next step, the study aims to further conceptualise resilience as a key capability in digital financial inclusion. A more comprehensive analysis based on the CA will be conducted. We expect the next step of our analysis to reveal more insights into the tension between financial inclusion and financial resilience. Due to space constraint, in this RIP we did not explore how gender inequalities affect grassroots women in Indonesia and the impact on digital financial inclusion. This will be addressed as the paper is developed.

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IS in the Education Sector

Integration Challenges from the Perspective of Business Intelligence in Public Universities in Mozambique. The Case of Eduardo Mondlane University

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Abstract. Making the right holistic decisions about the organization also presupposes the availability of holistic information, which is integrated through an integration system. It is currently a challenge to integrate data that are found in different database management systems, maintaining the interoperability of the systems and the consistency of the information. Data integration and interoperability are complex challenges for organizations due to the heterogeneity of data they have. This study analyses the challenges of integration, considering the case of Eduardo Mondlane University (UEM). We adopted a qualitative approach for data collection and analysis. The process considered the participation of UEM members and other participants from the setting where the university operates. Due to the participant's geographical dispersion and enabling their participation on a large scale, the questionnaire was administered through Google Forms. The study adopted the ITPOSMO framework to explore its dimensions to understand all possible challenges faced by the public institutions. Through this research, it was possible to acknowledge that the challenges faced by UEM vary considering the various groups of participants involved in the study. The external developers experienced challenges related to the dimensions of objectives and values, staffing and skills, management skills and other resources. In turn, the internal participants faced challenges related to lack of interoperability, reduced number of technicians, lack of financial resources, conflict of interests, and limited management skills.

Keyword: Integration Systems · BI · Interoperability · Decision making · ITPOSMO Framework

1 Introduction

Data integration is about joining data from different sources, thus providing a more unified view [1]. To make holistic decisions about an organization, it is also necessary to make more holistic processes, that is, integrated. According to [2], the production

of reliable information is the last stage of data processing. The Data Warehouse (DW) aims to integrate multiple data sources, allowing quick access to many data [3]. The DW serves as the basis for the implementation of Business Intelligence (BI). The fundamental goals of BI are, generically, to collect data and transform them into information which in turn is transformed into useful and timely knowledge for making better decisions.

Nowadays, it is a challenge to integrate data found in different Database Management Systems (DBMS), maintaining interoperability of systems and consistency of information [3]. Data integration and interoperability are complex challenges for organizations due to the heterogeneity of data they have [4] and can be the two main areas of focus for organizations that tend to implement advances in their workflow and aim to have a lasting life cycle and quality management [3, 4]. Data integration and interoperability influence the performance of organizations [4]. Therefore, the existence of several data sources with dissimilar DBMS causes heterogeneity of data structures, content, syntax and semantics [5].

Due to the mentioned constraints, there is an urgent need to identify integration challenges from the perspective of BI that compromise better management, since BI presupposes the existence of integrated data for the generation of information to support decision-making [6]. The term BI, emerged in the 80s in the Gartner Group and refers to the intelligent process of collecting, organizing, analyzing, sharing and monitoring data contained in a DW, generating information to support decision-making in the environment of Business [6]. In turn, DW is considered a physical integration of data, as they are extracted from various data sources, manipulated, and stored in a schema, and its environment aims at the integration of various data sources, allowing quick access to a large amount of data [3]. In short, BI presupposes DW and data integration.

The existence of several data sources and non-integrated data, particularly in public universities, at a time when the benefits of data integration and Business Intelligence are known, triggered the need to understand the reasons. Therefore, the general objective of this research was to analyze integration challenges from the perspective of BI in public universities. To accomplish this objective was necessary to determine the relationship between data integration and BI; Identify the information needs of different managers; Identify the main constraints faced in requesting information; Identify the reasons for the prevalence of isolated systems and elaborate a matrix of challenges, based on the ITPOSMO framework.

Business organizations see information systems as fundamental tools to face competitiveness and invest in efficient, integrated, and interoperable systems, public organizations have great difficulty in adopting them and, consequently, in adapting to new work practices [7]. In turn, the success of an educational system depends on the effectiveness of its information system. That is, the system's capacity to support the sharing, storage, classification, and use of Information. Integration technologies seek to provide, at different levels, means of exchanging information between existing systems in a heterogeneous environment [8].

We consider the challenges faced by public educational institutions to effectively control their information. In many cases, they still operate isolated systems, without integration and without prospects of providing information that helps the decision-making process. Eduardo Mondlane University (UEM) is no exception, considering for instance

the example of its Planning, Quality, and Institutional Studies office (GaPQEI). This unit faces enormous challenges to articulate the abnormal amount of information streaming from all other units within the university. Particularly, considering the different sources and the diverse information needed to prepare the annual statistics [9]. Therefore, we draw the following research question:

What are the main barriers to data and systems integration from a BI perspective in higher education institutions?

To operationalize the study, we consider essential the identification of the main barriers that compromise data integration and its implications in the context of BI and based on the ITPOSMO framework we bring the results and benefits of the combination of data integration and BI.

2   Literature Review

The need for data integration arises when there is a need to share data from databases and or systems that are independently designed and implemented [5, 10]. The goal of a data integration system is to provide uniform access to a set of autonomous and heterogeneous data sources [5, 11] and is an aspect of enterprise interoperability that refers to the ability for interactions between enterprise systems [12].

Also involves combining data from various dispersed sources, which are stored using various technologies and provide a unified view of the data [12, 13]. On the other hand, information systems integration is understood as the sharing of information and processes between networked applications or data sources in an organization [14].

Whenever two software systems or services exchange data, data integration is required. The complexity of data integration depends on several factors, such as data models, data formats, and accuracies. However, in most cases it is not trivial, hence a systematic and well-defined approach is required [12].

Very often, data interoperability, data integration and data exchange are confused, possibly because they share some similarities in terms of subject matter and objectives. In data integration, the goal is to synthesize data from different data sources - usually independent of each other - into a unified "view" according to a global schema [15]. In data exchange, the goal is to take data from a given data source and transfer it to a target data source in a way that "reflects" the provided source data as accurately as possible. Although both data integration and data exchange have been widely discussed, they are still considered extremely difficult tasks [15].

Interoperability is the ability of multiple systems to exchange data or functionality. So, when interoperability is established between systems, it means that they are related and incompatibilities between them removed. The concepts of interoperability and integration are on different abstract levels and have separate goals. Although both are significant for collaboration and seamless flow of information, they are established on separate principles.

In summary, it is possible to see that both data integration, systems integration, and interoperability, aim to present a more holistic view of the organization and involve data sharing, and can be seen from different perspectives, that is, of data, systems, and even

interoperability, the author concluded to include the term integration in an abstract way in the theme of this work, without specifying its perspective.

The concept of BI is broad, today related to a certain category of business processes, software applications and specific technologies, i.e. a symbiosis between management and technology. Its fundamental goals are, generically, to collect data, transform it into information (by discovering patterns and trends) and, sequentially, information into useful and timely knowledge for decision-making [16, 17]. Information must be made available in the right format and at the right time so that the company can make the best decisions efficiently and effectively [16].

BI systems are usually associated with: Data Warehouses; Extract, transform, load (ETL); On-Line Analytical Processing (OLAP) and Data Mining [16].

Implementing a BI project today is a critical and complex decision that must be managed with the utmost rigour. From the moment the needs and justification for implementation are studied, through the predictive assessment of its profitability, to the implementation process, significant project management, risk management and change management skills are required so that the result is, in fact, what is expected [17].

3   Methods

The research adopts the exploratory approach, which is carried out especially when the chosen theme is little explored, and it becomes difficult to formulate precise and operational hypotheses about it [18]. This research approach was adopted with the aim to seek for clarification of the rumors that existed about the challenges faced in systems integration in UEM and to explore more challenges in other less or unspoken dimensions, but that caused a significant negative impact on the integration of systems of information from a BI perspective. It was followed by a qualitative approach which provides detailed descriptions of complex phenomena, including their contextual aspects, or focus on in-depth analysis involving few individuals [19]. It was used to interpret the textual information collected through interviews during the study, to ascertain the points of view of the participants and make the appropriate framework in each of the seven dimensions of the ITPOSMO framework.

3.1   Framework

Integration challenges stem from the interaction of technical, human and organizational factors affecting the businesses in organizations. To better understand these factors in the context of BI in public universities, we use the "design-reality gap" proposed by Heeks [20]. Although the ITPOSMO model was originally conceived to be used to measure health information systems failure, explain the causes, and identify the answers. However, we use the ITPOSMO Framework - composed of seven dimensions presented in Table 1 - to better explain the nature of integration challenges in the context of BI in public universities.

Table 1. ITPOSMO Dimensions, adapted from [20]

Dimension	Meaning
Information	Data stores, data flows, etc.
Technology	Both hardware and software
Processes	The activities of users and others
Objectives and values	The key dimension, through which factors such as culture and politics are manifest
Staffing and skills	Both the quantitative and qualitative aspects of competencies
Management skills	Management systems and structures
Other resources	Particularly time and money

3.2   Data Collection Techniques

To collect valid and relevant data, the study employed a semi-structured interview method. This method is considered a high level of an interview that can be held in person or indirectly [21]. The utilization of this method enabled us to obtain reliable and comparable qualitative data.

The interview was held using an online survey for two reasons. On the one hand, the case study is physically represented in four provinces, and there was a need to strategically interview all the relevant stakeholders, on the other hand, most of the questions were close-ended questions, this type of questions was also to guarantee the exactness of the answers and associate with the Likert Scale. Open-ended questions were used to gather details that were not possibly covered by the close-ended questions. The interviews were composed of questions related to each dimension of ITPOSMO framework and were carried out with the main stakeholders of the academic management computer systems and decision-making support systems of the UEM.

The participants were chosen through a purposive sampling method with the intention of gaining insight and understanding of the challenges and factors of integration of existing information system, from a BI perspective. The reason we chose this method was to select the participants who either played certain roles and had experience or presented key criteria's or features to the subject of our study. A total of 25 participants were selected from four relevant academic units. The roles and number of participants is listed in Table 2.

The plan for data collection started from identifying the main information flow for decision-making, starting with the ICT sector for subsequent interviews with key stakeholders and consultation of possible documents. This whole process was accompanied by a literature review.

Table 2. List of respondents

Role	Unit	No. of participants
Head of the Systems and Applications Development	UEM Informatics Center (CIUEM)	1
External developers/suppliers of computer systems	–	4
Head of IT Department	Directorate of Academic Registry	1
Head of academic registry	Academic Units	18
Deputy Director	Planning, Quality, and Institutional Studies Office	1

3.3 Data Analysis and Processing Plan

As previously mentioned, a qualitative approach was used. On the other hand, the structured interview was adopted for data collection, the interview was composed of close-ended and open-ended questions.

For the open questions, a qualitative approach was used for processing and analysis and for the close-ended questions, it was used ITPOSMO framework and the Likert scale of five (5) levels to classify or rate the answers.

A Likert scale was used because it is a scale that allows collecting and classifying the experiences of users or consumers of different products [22, 23].

As a processing tool, we used Microsoft Excel, as it is a tool that, in addition to other benefits, easily allows you to create spreadsheets from models or on your own and use modern formulas to perform calculations [24].

3.4 Answer Qualification

As previously mentioned, the classification of answers was based on the Likert scale of five (5) levels. For each dimension of the ITPOSMO framework, one (1) to three (3) questions with close-ended answers were elaborated, based on the Likert scale of five (5) levels. That is, the answers to the close-ended questions could only be between Very low; Low; Neither low nor high; high and very high corresponding to the values 1, 2, 3, 4 and 5 respectively.

3.5 Participant Selection

To select the participants, it was necessary to identify the sources and information flow, computer systems and the people involved in these processes. From the existing systems, the Integrated Academic Management System (SIGA) was chosen because of being the most used computer system. The main entities involved in the entire information chain of the Integrated SIGA are the Academic units, DRA, CIUEM, GaPQEI and finally developers of IT systems outside the UEM. Only the heads of the Academic units were selected, and because they are the intersection of all stakeholders.

4   Introducing the Case Study

Eduardo Mondlane University (UEM) is a national public institution, the oldest institution of higher education in Mozambique. Eduardo Mondlane University is part of a social market economy context and is present in the provinces of Maputo, Gaza, Inhambane, Zambézia, and, through E-learning, throughout the country and abroad. Its vision is to be a university of national, regional and international reference in the production and dissemination of scientific knowledge and innovation, highlighting research as the foundation of teaching-learning and extension processes, with the mission of producing and disseminate scientific knowledge and promote innovation through research as the foundation of the teaching-learning and extension processes, educating generations with humanistic values in order to face contemporary challenges in favor of the development of the society [25].

According to the UEM organization chart, it is composed of many collegiate organs and organic units. Considering the purpose of this research, it is important to highlight all eighteen (18) academic units, that is, all faculties, schools and the E-Learning Center (CEND), UEM Informatics Center (CIUEM), the Directorate of Academic Registry (DRA) and the Planning Office, today called the Planning, Quality, and Institutional Studies Office (GaPQEI), due to the fact that they are significant stakeholders of academic management computer systems and decision-making support systems at UEM.

The CIUEM is an academic body specializing in the field of information technology, which is dedicated to teaching, fundamental and applied research and services in the search and implementation of solutions and methodologies that allow expanding the use of production processes, provision of services, improvement of teaching and learning, as well as research, with a view to sorting out the needs of Eduardo Mondlane University in particular and of the country in general [26].

The DRA is the body of the UEM, which is responsible for registering students at the University. It is up to the DRA to direct, support and supervise the carrying out of activities of an organizational and normative nature, within the scope of recording all the students' academic information, to allow a better organization of the teaching-learning process, that is, registrations, updating enrollment, supervision of the enrollment process, issuance of documents, graduation ceremony, authenticity of documents, in addition to those described below [27].

The GaPQEI, is an Administrative unit of the UEM created to articulate and coordinate strategic actions related to the organization and functioning of the UEM, which are embodied in the elaboration, monitoring and evaluation of the strategic plan, annual and multiannual plans, central management of UEM statistics, management of evaluation processes and self-evaluation of UEM courses, carrying out institutional studies and managing a Center for documentation and memoirs on institutional studies [9].

UEM already had a total of three academic management systems and currently has a new academic management system (SIGA) in its version 2.0. The development of SIGA 2.0 comes as a response to the constraints presented by the academic units to improve this application [28]. Figure 1 shows the relationship between the various entities and the existing information systems.
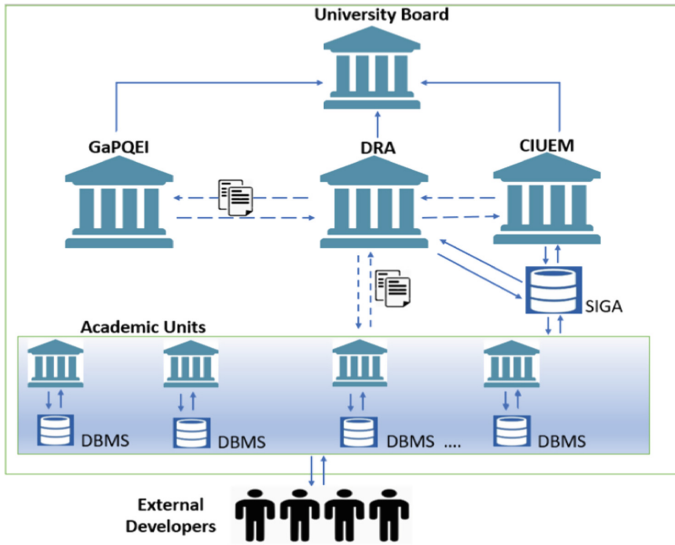
Fig. 1. Information flow at UEM

The number of systems mentioned above refers to the systems under the control of the central bodies of the UEM. However, there are more systems at the level of academic units. Furthermore, there are academic units that have more than one system.

The proliferation of systems is due to several factors, namely: recurring problems; dependence on data from disused systems, that is, complementarity between systems; improvement of functionalities and the system; isolated development of systems that respond to the local challenges of academic units; some systems developed or provided at the level of academic units, prove to be relatively better, compared to those provided by the central bodies.

Consequently, the proliferation of systems compromises their integration, undermining the implementation of robust and reliable decision support systems.

The proliferation of systems ends up compromising the generation of decision support information since there is no integration system for the different data sources and, to make matters worse, GaPQEI does not have access to any of these computer systems in the academic units.

The lack of access to the different systems ends up leaving GapQEI with no option but to request the data from the respective sources. According to GaPQEI, the data provided by the different organic units do not always have the proper quality. Hence, in her opinion, "The ideal would be for the system to be updated regularly and with the disaggregation of data obeying a range of standards and that could respond, via application, to the demands of the management, the Government and other partners".

GaPQEI has a computer system that helps them manage the data received, for subsequent presentation in the form of reports, yearbooks, and statistics.

It should be noted that the computer system that GaPQEI claims to have does not communicate with other systems and is not even a Business Intelligence tool, it is just a support system in data management.

5 Results

This section presents the results found for each participating entity, namely the Academic units, the DRA, the CIUEM, GaPQEI and the Developers of IT systems outside the UEM. In general, the results of the seven dimensions of the ITPOSMO framework were based on close-ended questions. Open-ended questions were specially used for GaPQEI and to obtain other possible results from all entities.

5.1 External Developers

Regarding the seven (7) dimensions of ITPOSMO framework, it was noticed that the dimensions of objectives and values, staffing and skills, management and other resources were above the average level three of the Likert scale, which means that they constitute a great challenge, as shown in Fig. 2.
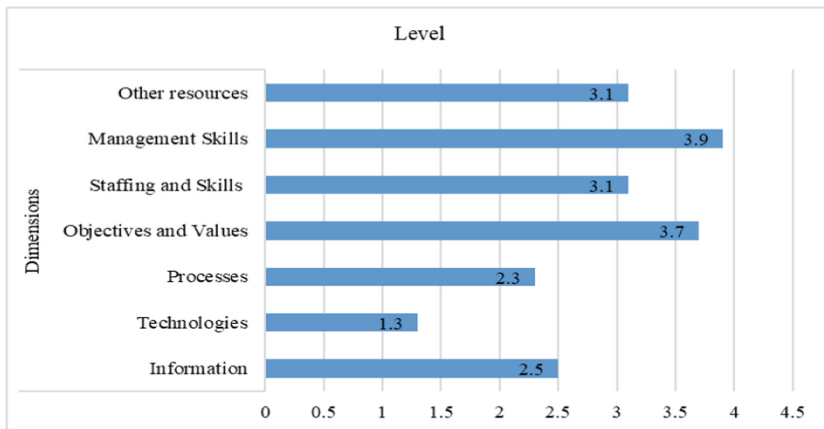
Fig. 2. Results – External developers

From the open-ended questions were possible to find the following conclusions and results:

The External developers were invited by directors of the Directorate of Finance, faculties, centers, and departments. Most of them provided systems at the level of academic units. The provided systems do not have communication or integration with the other systems at the university level because each academic unit manages it autonomously and, on the other hand, the integration proposal presented by external developers was rejected by the Finance and academic Directorates.

Some external developers understand that computer systems are not implemented across the entire university due to its size and the fact that academic units have financial autonomy, that way, they are free to work as they wish. Other developers list a series of challenges on the part of the administration, namely, the inability of the administration to evaluate programs that have already been implemented; not understanding that programming is a very complicated task and that it cannot compose its own team and that personal interests do not match with the interests of the university.

Interacting with external developers, none mentioned the CIUEM, the entity responsible for information technologies at the university level. The CIUEM was never involved.

5.2 Academic Units

Regarding the seven (7) dimensions, all were below the average level three (3) of the Likert scale, as shown in Fig. 3.
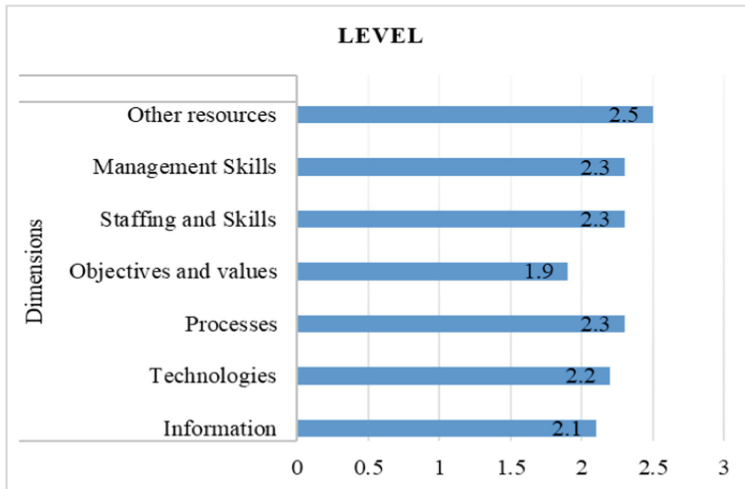
Fig. 3. Results - Academic Units

From the open-ended questions were possible to find the following conclusions and results:

Most academic units use more than one academic management system due to the attempts to improve a system, data dependency, migrations, and local developments at the academic unit level. The development of systems at the academic unit level was the initiative of the respective academic directors since the systems used at the level of the entire university do not respond to local challenges. The sharing of information with central bodies is mostly done through physical and electronic files.

The academic unit's responses were somewhat controversial, as in the closed-ended questions they showed some indifference and a good level of satisfaction, but in the open-ended questions they showed that they were facing several challenges in the systems proposed by the central bodies.

5.3 Directorate of Academic Registry

Regarding the seven (7) dimensions, it was possible to note that the dimensions of other resources were above the average level three (3) of the Likert scale, which means that they constituted a great challenge, as shown in Fig. 4.
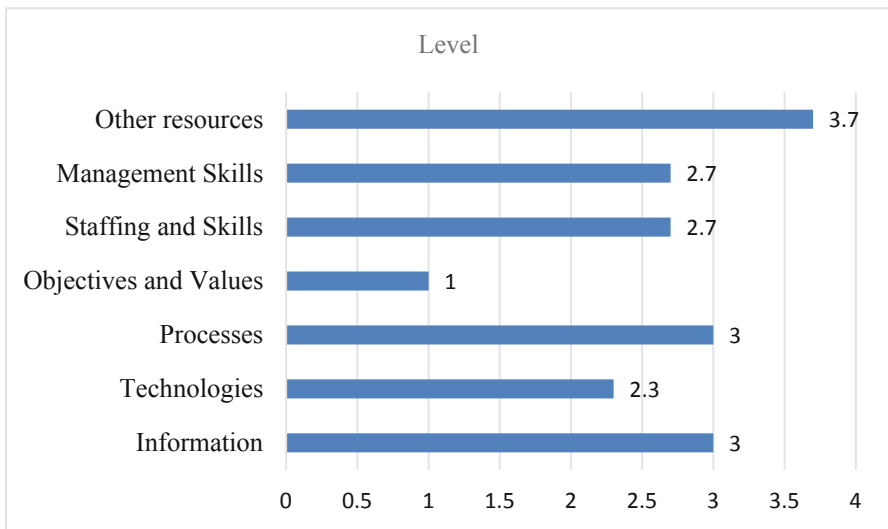
Fig. 4. Results - Directorate of Academic Registry

Analyzing the answers to each question, it was possible to notice that the results gain a different analysis. The questions about interoperability, number of employees involved, financial resources immediately gain prominence for being above the level three (3) on the Likert scale, which means they constitute a challenge. Although most questions are characterized by indifference.

5.4 UEM Informatics Center

Regarding the seven (7) dimensions, all were below the average level three (3) of the Likert scale, as shown in Fig. 5.
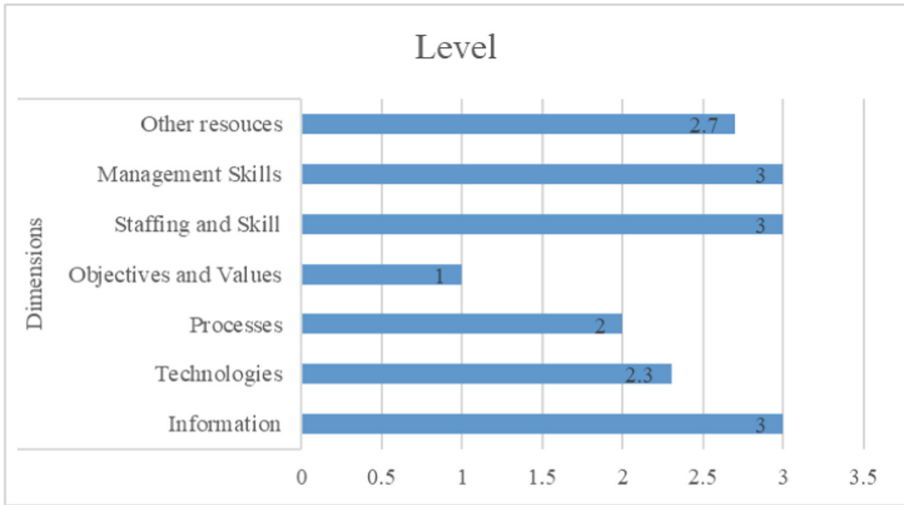
Fig. 5. Results - UEM Informatics Center

Analyzing the answers to each question, it was possible to note that the results gain a different analysis, where questions about the number of IT technicians, management skills, defense of personal rather than institutional interests and financial resources immediately stand out as they are above level three (3), which means they are a challenge.

5.5 Planning, Quality, and Institutional Studies Office

Faced with all the scenarios described by the four entities above, Planning, Quality, and Institutional Studies Office ends up finding limitations in carrying out its work in the most appropriate way, even having a computer system that supports it in management.

The data received without the desired quality and there is a lack of access to the different systems to be able to manipulate the data as desired.

6 Analysis

In this section, we introduce the analysis of the aspects described around the scenario experienced in the university on information systems. This process was conducted after collecting and analyzing all the entities participating in the present research, starting from the challenges.

6.1   Challenge Processing and Analysis Based on the ITPOSMO Framework

To have a diagnosis of the main constraints mentioned in the previous section in the national context, different questions were elaborated for each dimension and interview guides depending on the characteristics of the participants involved, namely, Academic Units, DRA, CIUEM, GaPQEI and External Developers.

   The quiz intended for Academic Units, DRA, CIUEM and external developers, contains questions that correspond to each of the seven (7) dimensions of the ITPOSMO framework. The questions contain predefined answers, obeying the Likert scale of five (5) levels, as shown in Table 3:

Table 3. Reading levels on the Likert Scale

Level	Correspondence	Meaning
5	Very high	The probability is very high then 80%
4	High	The probability is between 61%–80%
3	Not high, not low	The probability is between 41%–60%
2	Low	The probability is between 21%–40%
1	Very low	The probability is very low. Maximum 20%

   It should be noted that for each dimension there is more than one question and for some questionnaires there is more than one participant. Therefore, the intermediate level is determined from the average of the levels corresponding to the responses of the dimension for each participant and the global level determined by the average of the levels. This way, it can be assumed that if the challenge level exceeds three (3), it is a challenge to consider.

6.2   Analysis and Processing – External Developers

The participation of external developers/suppliers is 75%, that is, three (3) out of four (4) planned. The respective answers for each question and dimension are reflected in Table 4 through the respective levels. (Q = Question, L = Level, P = Participant, IL = Intermediate level, GL = Global Level).

Table 4. Analysis and processing – External developers

P	Dimensions													
	I		T		P		O		S		M		O	
	Q	L	Q	L	Q	L	Q	L	Q	L	Q	L	Q	L
P1	9	2	11	1	12	2	14	4	15	4	18	4	21	5
	10	1			13	2			16	2	19	5	22	3
									17	4	20	4	23	3
IL		1.5		1.0		2.0		4.0		3.3		4.3		3.7
P 2	9	1	11	2	12	2	14	2	15	2	18	2	21	3
	10	1			13	2			16	2	19	2	22	3
									17	4	20	3	23	3
IL		1.0		2.0		2.0		2.0		2.7		2.3		3.0
P 3	9	5	11	1	12	1	14	5	15	3	18	5	21	1
	10	5			13	5			16	5	19	5	22	4
									17	2	20	5	23	3
IL		5.0		1.0		3.0		5.0		3.3		5.0		2.7
GL	2.5		1.3		2.3		3.7		3.1		3.9		3.1	

Once the calculations are done, it is possible to notice that the dimensions of objectives and values, people and skills, management and other resources are high, that is, above level three (3). It is also possible to note that the overall level of the four dimensions results from the average of the intermediate levels with different extreme values on the Likert scale. However, higher values prevail, hence global levels are above average.

The levels of the dimensions of Objectives and values, people and skills, management and other resources are already clear. However, the dimensions of information and processes deserve attention due to the extreme levels of values on the Likert scale, although they are below three (3).

In a scenario where systems integration depends on the collaboration of different players, it is important that there be some harmony, not an environment in which some developers have a positive appreciation and others a completely opposite position, that is, very negative. The level of each question is presented below to allow a more detailed analysis, as shown in Table 5.

Table 5. Level by question and dimension

Question	Level	Dimension
9	2.7	Information
10	2.3	Information
11	1.3	Technologies
12	1.7	Processes
13	3.0	Processes
14	**3.7**	**Objectives and Values**
15	3.0	Staffing and Skills
16	3.0	Staffing and Skills
17	**3.3**	**Staffing and Skills**
18	**3.7**	**Management Skills**
19	**4.0**	**Management Skills**
20	**4.0**	**Management Skills**
21	3.0	Other resources
22	**3.3**	**Other resources**
23	3.0	Other resources

6.3   Analysis and Processing – Academic Units

For the Academic Units, 18 participants, corresponding to the number of faculties, were expected to participate. Their participation was 77.8%, that is, 14 of the 18 expected participants.

Based on their answers, it was possible to notice that all dimensions are configured as acceptable, that is, below level three (3). In part, this is since most dimensions are made up of more than one question. Therefore, it may happen that the questions are assuming values of different extremes on the Likert scale, and because of this, the average of the dimensions results in a value below or close to the average of three (3). The way found to dispel any kind of doubt is to scrutinize the impact of each question.

The results for each question showed that the questions 19 (about number of technicians) and 25 (about financial resources) are highlighted. The level of question 19 is 3.1, which means that there is a shortage of information technicians, question 25 has a level of 2.7, which means that there is no lack of financial resources, but this question deserves a different treatment, since in the existence of financial resources, it was supposed to not have the shortage of computer technicians.

6.4   Analysis and Processing – Directorate of Academic Registry

The participation of Directorate of Academic Registry was of 100%, that is, one of one expected. For this entity, the dimension of Other Resources was the unique high then three (3).

After the analysis of each question, it was concluded that the 17 (about interoperability), 19 (about the number of employees involved), 25 (about financial resources) are immediately highlighted for being above level three on the Likert scale. Although most questions are characterized by indifference.

6.5   Analysis and Processing – UEM Informatics Center

The participation of UEM Informatics Center was 100%, that is, one of one expected. For this entity, all dimensions were acceptable, that is, were under three (3) on the Likert Scale. In part, this is because most dimensions are made up of more than one question. Therefore, it may happen that the questions are assuming values of different extremes on the Likert scale, and because of this, the average of the dimensions results in a value below or close to the average of three (3).

After the analysis of each question, it was possible to note that the results gain a different analysis, where questions 16 (about number of IT technicians), 19 (about management skills), 22 (about defense of personal rather than institutional interests) and 24 (about financial resources) are immediately highlighted for being above level three (3).

6.6   Analysis - Planning, Quality, and Institutional Studies Office

The Planning, Quality, and Institutional Studies Office was not included in the analysis and processing using the ITPOSMO framework because only open-ended questions were administered. The unique purpose for this entity was to understand the reality of the flow of information and current practices.

Faced with all the scenarios described by the four entities above, the Planning, Quality and Institutional Studies Office ends up finding limitations in carrying out its work in the most appropriate way, even having a computer system that supports it in management.

The limitations found by the Planning, Quality and Institutional Studies Office include the reception of data without desired quality and lack of access to the different systems to be able to manipulate the data with confidence and as desired.

6.7   General Analysis and Processing

Up to this stage, analyzes and processing of each entity were carried out. Now, Table 6 summarizes all entities and dimensions simultaneously to find outstanding elements.

Table 6. General Analysis and processing

	Dimensions						
	I	T	P	O	S	M	O
Participant	Level	Level	Level	Level	Level	Level	Level
CIUEM	3	2.3	2	1	3	3	2.7
DRA	3	2.3	3	1	2.7	2.7	**3.7**
RA	2.1	2.2	2.3	1.9	2.3	2.3	2.5
External developers	2.5	1.3	2.3	**3.7**	**3.1**	**3.9**	**3.1**
Global level	**2.7**	**2.0**	**2.4**	**1.9**	**2.8**	**3.0**	**3.0**

Observing the global level for each dimension, it is possible to notice that no level is above the average level three (3) on the Likert scale, that is, on the part resulting from values that are around the average level, making the average calculation of them coincide with the mean value and, on the other hand, resulting from values all below the mean level on the Likert scale. Despite the global level being equal or below three (3), we cannot ignore the four (4) dimensions highlighted from different participants, that is, Objectives and values, Staffing and Skills, Management Skills and Other Resources.

As mentioned above, almost all dimensions are made up of more than one question and of all entities or Participants, external developers were the most expressive, with values above the mean level on the Likert scale.

The other entities have average values in certain dimensions, the result of calculating the average of extreme values in the Likert scale in the questions of the same dimension. Therefore, it is possible to find questions in which the answers are unanimous in some entities and different ones. Below are some highlights:

Managers, that is, DRA and CIUEM, state that they do not have financial resources to meet current IT challenges. RA and external developers say that there are financial resources.

The DRA, RA and CIUEM assume that the technicians involved in the implementation of computer systems are few, although competent. While external developers have it in sufficient numbers.

A part of the external developers and the RAs refer that the sharing of information is good and the other and the DRA refer that it is bad.

Most external developers mention that there is resistance from system users.

Most external developers say that the mobilization of stakeholders for the adoption of new systems is ineffective.

Most external developers say that managers are more interested in defending personal interests than institutional ones.

Not all external developers and the UEM managers have good personal relationships, some are terrible.

Most external developers refer that IT systems managers at UEM are not very committed to goals and strategies.

All entities are unanimous about the availability of time, that is, they say that there is enough time to develop systems from scratch, without the need to buy.

Having identified in this work the main challenges of each Participant entity (DRA, RA, CIUEM, GaPQEI and external developers), it makes perfect sense that future works assess these challenges and propose solutions. Evaluate, for example, the mechanisms for awarding systems development and hiring technicians and propose more appropriate award models and other aspects.

7 Discussion

The success of an educational system depends on the effectiveness of its information system. The system's ability to support the sharing, storage, classification, and use of Information. It therefore means that various education information management systems must be integrated to holistically address the challenges and effectively manage the education system [10].

There are several integration challenges, including systemic, logical, or social and administrative reasons [11, 14].

According to [14], the main challenges for the integration of information are directly related to storage systems, forms of access, types of communication and security. Regardless of the technological solution used, the main concern of IS integration focused on information is to ensure that it is always available, correct, and valid for the applications or people who need it.

According to [29] proposed the definition of challenges in seven (7) dimensions, namely, information, technology, processes, objectives and values, personnel and skills, management skills and structures and other resources such as time and money.

During the implementation of a prototype for service-oriented integration of the information systems of the educational institution called CEFAT-AL in Brazil using Service Oriented Architecture (SOA), challenges related to the dimensions of management and people were encountered [8]. In India, failures of information systems were found due to people, namely politicians and managers, more because of the conception they had about information systems [30] the failures were found using questionnaire surveys, discussions and consultation of documents [20]. In South Africa, the introduction of an INTRANET and touch-screen kiosks failed due to overemphasis on technology, ignoring people and their skills, information needs and communication preferences. In Ecuador, systems failed because of structural and process dimensions [30].

Analyzing the reasons for failures in Brazil, India, Ecuador and South Africa, it's noticeable that there are reduced and different challenges using different approaches. Using ITPOSMO in the UK, during the introduction of an expert health system for computerized colonoscopy, gaps were found in all seven dimensions [20]. In the present case study, after the use of ITPOSMO framework it was concluded that the integration fails because of challenges related to objectives and values, staffing and skills, management kills and other resources. These four challenges are important for the success of integration of information systems within the context of UEM. Indeed, information is dispersed with little standards on design and dissemination; there is high dependency on external resources for information systems design, maintenance, and management.

8 Conclusions

The main objective of this research work was to analyze the challenges of integration from the perspective of Business Intelligence in public universities since data integration is the prerequisite for establishing a business intelligence system. To achieve this objective, it was necessary to identify the information needs at different levels of the organization, from which it was possible to conclude that all levels need information for different purposes, that is, at the AR level for better local management and proportion of quality information to GaPQEI for subsequent production and sending of decision support information to top managers and the government.

Information without the desirable quality is on the one hand due to technical reasons such as routine changes in computer systems trying to improve some functionalities and/or adoption of modern technologies, as well as the adoption of ad hoc solutions at the level of academic or administrative units, without due harmonization with the other units.

Something curious observed is that the managers, that is, the CIUEM and the DRA say that there are no financial resources for the proper implementation of systems, but the RA and external developers say the opposite. There are those who claim that the emergence of several isolated systems is a result of the financial autonomy that the units have and, on the other hand, there are those who claim that the computer systems do not adequately respond to the wishes of the UEM because the administration does not understand that programming is a very complicated task and you cannot choose your own team, personal interests do not coincide with the interests of UEM.

From the present research, it was possible to learn that not only the observations of the majority must be considered, but also the observations of the minority must be considered when their actions involve the majority.

The use of the ITPOSMO framework made it possible to analyze all the indicated dimensions, since it allows asking questions of each dimension and using the Likert scale to make the questionnaire very easy and quick to answer. However, close-ended questions easily make room for Participants afraid of reprisals to be very moderate in their responses. As a precaution, close-ended and open-ended questions were elaborated with some prior information, which made it possible to obtain the real challenges and consequently the main objective of the present research work.

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The Role of EMIS in Improving Equitable Service Delivery in Education: A Case Study from the Gambia

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Abstract. Public services are a core responsibility of governments to its citizens, and their purpose is to ensure that every individual receives the basic services necessary to survive which includes primary health care, basic education, and social security. However, many developing countries struggle to provide these basic services to their citizens due to limited resources and inefficiencies in delivering the services.

The Gambia Ministry of Basic and Secondary Education (MoBSE) is concerned with the trend of resource distribution in the provision of education that is disproportionately benefiting the wealthiest group and is leveraging its Education Management Information system (EMIS), underpinned by digital technologies, to monitor and reverse this trend.

This study employs a case study methodology that dives into the issues affecting education service delivery at the regional level where service providers are closest to the people. Interviews were the primary form of data used in this study in addition to meetings, and observations of regional officers and teachers as secondary sources of data. Thematic content analysis method is used, interviews were transcribed, and coded using inductive strategies.

The paper follows the case of the implementation of a daily teacher attendance system at the school level and the designing of EMIS dashboards targeting sub-national level managers to understand the opportunities presented by digital technologies in the delivery of education at the regional level.

The research discovers that challenges in education service delivery in the Gambian are because of organisational, institutional, capacity, infrastructural and resource challenges. But the one that interests us the most in these interviews and has the potential to illuminate the above challenges, is the lack of access to and capacity to use data—an information challenge. Solving these information challenges is key to improving service delivery in terms of efficiency, effectiveness, and equity. We then discuss challenges infrastructure and policy gaps facing the country and conclude with research limitations.

Keywords: EMIS · Service Delivery · Education · Equity · Gambia

1 Introduction

1.1 Background

Public services are a core responsibility of governments to its citizens, and their purpose is to ensure that every individual receives the basic services necessary to survive which includes primary health care, basic education, and social security. This is perceived to create productive citizens to grow the economy of the country. However, many developing countries struggle to provide these basic services to their citizens due to limited resources, inefficiencies in delivering these services due to poor infrastructure, inadequate planning, and leakages (Besley and Ghatak 2007).

The effects of this government struggles to deliver these services affect the poor, minority groups, and other disadvantaged groups disproportionately as they predominantly depend on public services. These disadvantaged groups are challenged primarily because of poverty barriers, physical barriers including remoteness and infrastructure, and a mismatch between what they need and what is supplied (Ramakrishnan 2013).

Public services are delivered by public servants and can be categorised according to the services they provide. Policies and laws are delivered by politicians and policymakers at the national level, and resources are demanded—from the national budget—and managed by administrators at subnational levels where these providers are closest to the people. Civil servants like teachers and doctors give their time, effort, and skill in addition to the resources provided as input and the policy framework as a guide to effectively deliver the services people desire (Jackson 1993; Khrykov et al. 2023).

Public service delivery is measured by service delivery indicators that seek to spot gaps in service delivery and track progress over time to measure the effectiveness and quality of the services (World Bank 2023). These indicators should be used to hold governments accountable for the failings in service delivery especially when they have a negative impact on disadvantaged populations. This adds to the equity challenges already faced by these groups (Jackson 1993).

MoBSE expresses concern over the current pattern of education-related public spending, which primarily benefits "higher income groups" and exacerbates disparities. This issue was highlighted in the government's public expenditure review conducted for the education sector and continues to persist (World Bank Group 2017). Moreover, household expenditure on education reveals that the burden of payment disproportionately falls on the poor, leading to higher dropout rates in economically disadvantaged areas. Consequently, the efficiency of the education system is compromised, resulting in a decline in the standard and quality of education. These challenges persisted despite the enactment of free public education policy in the country starting in 2013 (MoBSE 2016). Thus, it is evident that to achieve the goal of equitable, inclusive, and quality education for all as stated in the education policy, government subsidies and interventions must be targeted to ensure equal educational opportunities. To do this, one of the education sector's priorities is the improvement of its service delivery mechanism, as engraved in its education policy spanning 2016–30. In the same breath, EMIS was accorded "priority status," aiming to provide valuable insights for planning purposes and informed decision-making.

Considering the education sector's recognition of the significance of information and communication technologies (ICTs) in achieving its policy goals and EMIS, entrusted with monitoring the evolving demands of local education policies and fulfilling the data requirements of SDG4, we examine in this research project the following research question:

– What are the challenges and what opportunities does digital EMIS provide decision-makers to improve service delivery in education in the Gambia?

Availability and management of resources, both financial and material, have been found to have a positive relationship with improving service delivery (Hodgson, Farrell, and Connolly 2007)). This implies that ensuring equitable distribution of resources ensures schools get just what they need thereby improving the general efficiency of the education system. We focus this research on the management of resources at the regional level to improve education service delivery.

2 Education Information Challenge

2.1 Data Challenge

Education systems have been producing a lot of data that has been underutilised and has had little impact. Two reasons have been given for this: firstly, the data collected is beneficial to policymakers and planners at the national level and does not satisfy the needs of lower-level managers and school administrators (World Bank Group 2018). This is because most education systems have been configured to drive policy formulation and planning for increased enrolment, which was the major objective in the Millennium Development Goals (MDG) period (Benavot and UNESCO 2015; United Nations 2015). This was a time when countries were struggling to ensure children have access to schools with gross enrolment rates generally below 50% in most developing countries.

The second reason is that most of the data that is produced is inaccessible to lower-level managers and school administrators. The lower-level managers are responsible for implementing policy objectives and have the most impact on the everyday activities in the school and consequently the quality of services provided to students. This is why the sustainable development goals (SDGs) call for a shift in the design of the education management information system (EMIS) to address these data challenges (United Nations 2015).

2.2 EMIS

"a system for the collection, integration, processing, maintenance and dissemination of data and information to support decision making, policy-analysis and formulation, planning, monitoring and management at all levels of an education system. It is a system of people, technology, models, methods, processes, procedures, rules and regulations that function together to provide education leaders, decision makers and managers at all levels with a comprehensive, integrated set of relevant, reliable, unambiguous, and timely data and information to support them in completion of their responsibilities." - (Cassidy 2006)

Cassidy's definition provides the most comprehensive definition of EMIS, which explicates its inputs, functions, and outputs. Education data can be used to monitor progress at individual schools and an entire national education system (Hua and Herstein 2003; Sajjad Ahmad Bhatti and Adnan 2010; Wako 2003). EMIS data is useful for the allocation of education staff, school supplies, and other resources (Chapman 1991; Hua and Herstein 2003; Wako 2003); management strengthening (Chapman 1991); and policy planning and formulation (Hua & Herstein, 2003; Wako, 2003). There is an acknowledgement of the importance of an enhanced education management information system (EMIS) in facilitating data-driven decision-making and the delivery of education services. Considering the growing need to produce high-quality data for monitoring progress towards Sustainable Development Goals (SDGs), we examine the challenges of providing education to the Gambian population and the obstacles and possibilities associated with implementing a digital platform supported EMIS at the regional level.

3   Method

This research project is part of a larger project by the ministry of basic and secondary education in the Gambia to leverage DHIS2, a digital platform, to improve its education management information system.

This first author is a full-time employee of MoBSE under the EMIS unit that is in charge of designing and implementing education information systems for the ministry. This gives the primary author easy access to the field, data sources, a deep understanding of the context, and experience in implementing information systems for education which have all being leveraged in this research. This paper is borne out of the primary author's interactions with teachers and regional officers during the implementation of the EMIS project. The primary author also assumes the position of the embedded researcher, closely following the project as it took shape, attended (and facilitated – in his capacity as MoBSE staff) training sessions and took advantage of opportunities to interview participants and document observations and feedback from the use of the technologies. This embeddedness of the primary author presents drawbacks from positional ambiguities to outright ethical challenges such as influencing participants. However, with his withdrawn nature, the second author provides an outsider's perspective and insights, ensures that primary authors biases are recognised and acknowledged and safeguard the methodological soundness of the research.

This study employs a case study methodology, which allows us to deep dive into the issues affecting education service delivery at the regional level (Walsham 2006, 1995; Yin 2018). This study targeted the service providers at the regional level and the service beneficiaries at the school level to understand the perspective of education service delivery from the regional level. The study participants were chosen based on availability and on the perceived remoteness of the regions and schools they manage. This, we believe, presents unique angles to the delivering and benefiting from services in education.

Interviews were the primary form of data used. The first author travelled to the offices of the participants ranging from regional directors (heads of institutions) and principal education officers to other staff in the regions, for data collection. Interviews were also

held at the schools, with the head teachers the targeted participants. Seven in-depth interviews were conducted in total, with an average of 60 min per interview. All the interviews were recorded after receiving consent from the participants and explaining the ethical procedures for recording sessions. Meetings with headteachers, training of regional officers and teachers during the implementation of the platform, and observations of the use of these platforms and their innovations by the regional officers and teachers are other sources of data used in this study (Hennink, Hutter, and Bailey 2020; Walsham 1995; Yin 2018).

Adopting the thematic content analysis method, the interviews were transcribed manually, anonymized, and then coded using inductive strategies. The codes were grouped into categories, which were then arranged into themes. (Hennink et al. 2020; Miles and Huberman 1994; Miles, Huberman, and Saldaña 2013).

4   Case

The Gambia is a geographically small country in sub-Saharan Africa with very few resources and is comparatively poorer than all its neighbouring countries. The Gambia has a decentralised governance structure, with regional administrators responsible for planning, managing, and delivering education services to the population in their region. However, the resources are still centralised at the national level, and the regional administrators must demand and negotiate for resources, sometimes under very competitive conditions.

In early 2019, the ministry of education in the Gambia entered a partnership with the Health Information Systems Programmes Centre from the University of Oslo, Norway (HISP Centre) to support its EMIS strengthening efforts. Among the agreements was the use of DHIS2 as the backbone of the country's EMIS to aid the decentralisation of EMIS to the regional and school levels to fulfil the objectives of the national decentralisation plan. DHIS2 is a widely used platform for health in several African countries and is increasingly adopted in education. The Gambia Ministry of Health has adopted DHIS2 as the backbone for the national health management information system (HMIS) since 2009. HISP West and Central Africa (HISP-WCA), a regional organisation and a partner of HISP-UiO, is responsible for coordinating and supporting implementations. HISPWCA trained the core EMIS staff of the ministry on the DHIS2 platform, from the creation of EMIS forms to the design and sharing of dashboards. As part of the project, they are continually supporting the development of locally relevant innovations on the platform. Using the training of trainers approach, the EMIS staff also conducts step-down training for regional officers and head teachers on the use of the DHIS2 platform as a decision-making tool. The initiatives under the DHIS2 for EMIS project in the Gambia are preceded by advocacy meetings with administrative leaders at each level to get buy-in, followed by capacity-building training during the implementation targeting users and technical staff.

Two initiatives from the project that are relevant to this study are explained below.

4.1   EMIS Dashboard Design

Previously, the pinnacle of the EMIS data collection cycle was the publication of the annual yearbook, which is shared with the wider education stakeholder group through the ministry's website in pdf format. Understandably, this format wasn't ideal as input for further analyses. In addition, the document is bulky and includes many indicators because of its wide audience. Even though the ministry produces Excel tables of the data in addition to the report for more specific requests, it is most suitable to the technical people. Non-technical people send their requests directly to the EMIS unit and is becoming an increasing burden for the statisticians, who can't respond to all requests on time.

Using the DHIS2 platform, the ministry decided to create dashboards that are relevant for both policy monitoring and subnational-level operations. They convened representatives from all regional offices to compile relevant indicators for the sub-national levels in addition to the policy-level indicators in the annual yearbook and to design visualisations and dashboards. These dashboards will be accessible and useful to all the education stakeholder groups.

Since its rolling out in late 2022, several use cases have been reported from all levels, especially the regional levels including.

1. Transitional arrange of students moving from one level to the other in terms of spaces available.
2. School Mapping including catchment area determination.
3. School Profiles including enrolment, resources, infrastructure, and sanitation facilities.

4.2   Daily Attendance System App

With teachers being the single biggest service provider in education, their absences from lessons have more of a consequence for students' performance than any other. As a result, monitoring teacher attendance is crucial to improving the contact time and performance of students in any country. The Gambia is challenged in doing this, as since 2011, many initiatives to monitor attendance have been introduced with little success.

In 2019, leveraging the DHIS2 platform, the ministry, with the support of HISP-WCA, developed a teacher attendance app for schools. This presented school administrators with an easier means to report teacher attendance, which is then instantly aggregated and analysed at the regional level. The teacher attendance system leveraged the ubiquitous nature of smart phones at school levels. An application was designed to support schools quickly record attendance daily and shared via SMS at no cost to the school because of a national infrastructure connecting all the public schools.

The COVID pandemic presented a reality check to the attendance system with the abrupt closure of schools. After the reopening of schools, attendance reporting wasn't at the levels expected. Two issues were highlighted: 1) the headteachers didn't see the use of the system for themselves, and 2) there was no monitoring mechanism for attendance reporting at the regional level to support schools that weren't able to report. Another version of the app was released in late 2022, which resolved the above concerns. As a result, the uptake was even bigger than before, as the school administrators are now able to analyse and use the attendance data they are reporting to the regions.

5   Finding

Our analysis shows a myriad of challenges facing the education sector in delivering quality education at the regional level. Based on the service delivery framework, we synthesise the challenges into three areas: identifying education service delivery issues and appropriate beneficiaries of services; planning and delivering services; and monitoring and evaluating the quality of services.

5.1   Challenges in Education Service Delivery

Identifying Issues and Appropriate Beneficiaries

> "In School X… enrolment last year compared to this year dropped and the reason is best known to them, but what we can do is to go to them, talk to them, sensitise them so that they can move on "- A Regional Director

Understanding the needs of the schools to effectively react and improve the situation is very important for the regional office. This ensures that they can act quickly, demand resources from the national level, and even be able to forecast to prevent such situations in the future. As this regional director explains, it's difficult for the regional offices to be aware of the situations unfolding in the schools. And usually, before these situations come to light, they have grown out of control enough to warrant heads turning. These situations usually warrant additional resources to investigate the problem, or, as exemplified in the above quote, blindly intervening without fully understanding the problem.

> "... I think two years back, school feeding (was) stopped in this region but thank God towards the (end of) last academic year towards June (it resumed). And some schools, especially the old schools were supplied (when) they (WFP) started it again. 23 new schools that have been established, have been identified and now we are working with them (the schools) to establish food management committees so that they (WFP) have started supplying food to all those schools." - A Regional Director

The school feeding programme is a collaboration between the Ministry of Education and the World Food Programme (WFP). The goal of the programme is to provide food to children in schools to drive enrolment and attendance by, at least theoretically, targeting poor communities where many can't afford to send their children to school with lunch money.

However, practically, these school feeding programmes are more blanket in nature, and as a result, funding issues resulted in their current stop-start nature. This is affecting its effectiveness as the children and their parents can no longer rely on it. This is important because household expenditures make up the biggest share of national spending on education.

Regional offices, under the decentralised public administration structure, are responsible for identifying the needs of their schools and negotiating for the provision of the resources they need. Determining what the schools need and who the beneficiaries of each programme should be are the first challenges.

Planning and Delivering Services

> "... even this year just now our team went to School B just to stabilise, and they advise that School B is a multi-grade school… they only have two classrooms. And the enrolment given now means School B would need more classrooms because if more children have been enrolled in the school, it means they need more classrooms." - A Regional Director

When designing and planning interventions, evidence in terms of numbers and scale is important in negotiating resources from the national basket. It's important to note that this basket is the same one all the other regions are dipping their hands into, and it's sometimes the same basket where all programmes of the ministry are resourced from. So, it's not only sufficient to say that you need it more than the other regions, but also that your specific issue will yield more benefit to the sector, or that its impact, if it's not resourced, will outweigh the benefits of its competitors. And for this, timing is important.

Normally, regions and schools need to demand resources before the beginning of the academic year to ensure all the resources are available at the start of the academic year. This is to ensure that effective teaching and learning begin in earnest by reducing the amount of time lost at the beginning of the academic year. However, what the regional director in the above quote shows is that regions can only begin to understand the issues in schools during "stabilisation," which ironically is meant to ensure all schools are using the resources they are supplied with effectively, and in the event of a gap or surplus in a specific resource, that resource is sourced from or transferred to another school, respectively.

When these issues are identified at the beginning of the school year, it's often too late to plan any intervention, and the children suffer as a result.

> "what we were using maybe during our trekking with a motorbike maybe for example if it is School A to School B if I'm to depart I just set the mileage from School A to School B when I reach at School B I read the mileage if it was from 110 now it is 120 I'll for that yes it is 10 kilometres" - Regional officer

This planning officer at the region narrates the methods they apply to measure one of the criteria to establish schools. Distance, catchment area, and feeder schools are some of

the primary criteria for establishing schools in communities. Physically riding a motor-cycle to establish distance between locations is time-consuming, resource-inefficient, and risky for the personnel involved.

Monitoring and Evaluating the Quality of Services

> "This … monitoring is continuous, whether at the beginning or at the middle of the term. We are always monitoring because, when I came in, I found that they have not been monitoring for a while. The advice I did was I dispatched the vehicles to go to all the schools to ensure that they monitored they know what is happening so that that information can help us to intervene." - Regional Director

After the service is delivered, it is important to track the usage and management of these resources. This ensures the school administrators are accountable for the resources supplied to minimise loss due to negligence, misappropriation, or malpractice. It is also important to measure the effectiveness of the resource in relation to other indicators, e.g., teacher attendance or student performance, and in terms of efficiency and fairness. Monitoring, currently in the Gambian context, is resource-intensive, time-consuming, and mainly for gathering information for the regions, with little or no support at the school level.

5.2   Information Challenge

These service delivery challenges identified are because of organisational, institutional, capacity, infrastructural and resource challenges. But the one that interests us the most in these interviews and has the potential to illuminate the above challenges, is the lack of access to and capacity to use data—an information challenge. For all these challenges in the educational service delivery chain, the lack of access to or ability to use data is implicitly embedded.

Identifying Issues and Appropriate Beneficiaries
On how these intervention criteria are determined, one regional director replied:

> "... they use that criterium where schools with good gardens and farms to select some schools. at most, some of these (selected) schools' communities … are in a rural settlement" - A regional director

The lack of information leaves the regional offices at the mercy of the philanthropists and other project partners, as they are unable to negotiate or direct the interventions without information. As shown in the quote above, some of these criteria set by partners are not always necessarily aligned with the goals of regional offices.

If the goal of the school feeding program is to increase participation of children in schools, there are better indicators to determine that than schools with gardens and

farms. Chances are these schools are in farming communities that can provide for their children meals most days in the year.

For school feeding, a lack of reliable information for planning results in blanket interventions, which lead to sustainability issues due to the low resources available. As a result, the interventions are intermittent, which nullifies the impact and progress they make. It also reduces the trust and confidence of people in the programme. This is also a case of misplaced priorities, targeting "old" schools instead of schools in "poor" communities.

Limited information on why these schools' enrolment dropped leads to intervention without planning, blind interventions, which are not efficient in terms of resources and time. Triangulation of already available EMIS data could have pointed to reasons for the drop (e.g., classrooms), which could have saved resources and time by focusing on solving the problem.

Planning and Delivering Services

"We are not involved in the selection, but they will do their own survey, the SAFMU together with world food programme and they would identify… madrassas are involved. I think we will need to be part of the team; they have the focal point for school feeding, and if we are part of the team, it will be helpful because certain communities (that we know of) would need school feeding more than others." – A regional director

Exclusion of regional and school administrators from the school selection process disempowers them. Organisations planning and intervening alone can conflict with the interests of the regional offices, which are the institutions responsible for increasing and maintaining enrolment in schools. The inclusion criteria for the beneficiaries might be counterproductive to increasing and retaining children in school, e.g., "existence of a school garden and/or farm, kitchen, and stores". Even though all these are likely to be found in rural areas, it is not sufficient as a proxy to target poor communities, which is the whole point of school feedings. The communities that can't afford to send their kids to school with lunch money, low enrolment and retention rates could provide better proxy indicators for school feeding, even though poverty is not the only major barrier to accessing education in the country.

Monitoring and Evaluating the Quality of Services
Lack of access to information increases monitoring costs, which could be more strategic and efficient with information systems to inform decisions, and the cluster monitors can go back to supporting teachers' pedagogy instead of collecting information.

6   Discussion

How digital technology can help resolve these information challenges in education? Our analysis shows the information challenges can be synthesised into four broad areas according to Cassidy's description of the purpose of a well-functioning EMIS. Using

the two initiatives from the case studies above, we show how the introduction of digital technology has improved the planning and delivery of educational services at the regional level in the Gambia.

6.1   Resolving the Information Challenges

Collecting Data

The school is the primary source of data for many activities and programmes in education. Despite this, data is still collected from schools in paper forms, and this goes for all forms of data collection at the school level, from the annual school census to teacher attendance and appraisal. This places a lot of burden on the teachers, who, in addition to preparing for lessons, marking attendance, and grading results, must also collate this information on a termly, monthly, weekly, and even daily basis for reporting to the regional and national stakeholders. This steals teacher contact time from students and affects the yearly instructional hours target and the quality of teaching and learning. Collecting data this way extends the processing time, as data needs to be entered, cleaned, and verified before analysis can be done.

With Digital EMIS

> "(Updating the charts and graphs in schools) every year sometimes every term because you have the monitoring schedule that every term you need to change it you have also the teachers profile the staff profile which is very huge but if you have these things it is easily if you have if you have the system" - A regional officer

The attendance app at the school level provides data quality tools in the form of validation and completeness checks of the data, automatically aggregates the data based on the period specified by the users. But above all, it provides instant analysis for school level users. Education systems generally do not send feedback to schools, where most of the data is generated.

At the regional level, the internet-based web dashboards with preconfigured analytics provide instant analysis of the data received from schools. This greatly improved the processing of the data; there is less focus now on aggregating and managing data quality and more on interpreting, acting on, and sharing the data with partners and stakeholders. These dashboards also allow for remote monitoring through continuous updates as data is reported and monitoring progress using trend analysis.

Accessing Data

Because of the separate data collections and analyses for individual programmes and activities, these systems exist in silos with different data management and storage formats. And since no one can collect all the data, accessing and sharing it is very difficult. Sometimes, even within the same office, the data is only accessible to the data managers, and everyone else must place a request for data, which the officers will fulfil at their own pace. The same is seen with the routine EMIS school census at the school level, as

the data processing and dissemination are centralised at the ministry level. The school census is the most comprehensive dataset about the school, which the regional officers need when planning, distributing, or managing resources in schools. Traditionally, it has been difficult to access and use the data shared in the pdf report, as a result, many regions revert to collecting the data again from the schools to make use of it, wasting time and duplicating effort.

With Digital EMIS

> "When you need data you need not to call Banjul, EMIS Headquarters and say I need the enrolment of this (school), go straight to the dashboard click where you want to the organisational (list) and you filter the school that you need the enrolment you can have everything there even the number of physical facilities ranging from toilets number of utilities that are present whether they are using electricity or solar, or the number of water points, whether it is a borehole, open well, or handpump, you can, and there you can make a decision, and the number of quarters that are using solar or the number of water points whether it is a borehole open well or handpump you can and there you can make decision and the number of quarters that are available" - A regional officer

This quote from the regional officer nicely underscores the change witnessed at the regional level in terms of accessing EMIS data. At the school level, while it is possible to access the data in the same way as at the regional level, infrastructure is the biggest obstacle at present.

Using Data

In addition to having limited access to the data, only a few people at the regional offices and schools could independently analyse and synthesise the data to be able to make decisions from it. At the school level, there is no facility/opportunity for the school administrators to utilise the data they are reporting to regional and national stakeholders. Firstly, the data collected targets the needs of the stakeholders, and secondly, usually there is limited feedback to schools, or when there is, it comes too late to address the needs of the school.

With Digital EMIS

> "the directors and this thing they are yet to be given their password but I think work is in progress but nonetheless we normally have any problem that comes in we just come here in the hall project it and use the dashboard either I use my password or Ida use her password then we what we whatever we want to do we do it and advise the director rightly yeah" - A regional officer

While the daily teacher attendance application at the school level has instant analysis to motivate school administrators to get into the habit of using data in their daily routines,

the bigger impact is witnessed at the regional level. Whereas before, data was accessible to only a few individuals on private computers, these EMIS dashboards have allowed for collaboration between the regional officers and the directors in decision making. This builds the capacity of the officers, who could be used to strengthen their capacity for using data for decision making at the school level.

Innovation

It must be said that this new property of innovation only exists in digital systems, as EMIS in principle can be underpinned by any technology. This presents huge opportunities for the ministry, regional offices, and schools to explore and improve the delivery of education.

> "Since you guys are very good at designing apps to monitor us and our teachers' attendances, why not design apps to help us get our payslips. This is one of the biggest reasons why teachers are absent from school. As a teacher, I cannot stop any teacher from resolving their issues if they have problems with their salaries." - A head teacher in school

This is an acknowledgement from a head teacher of the potential of this new EMIS, underpinned by a digital platform, to create innovations to address issues in the education system. In reference to this, they cite the issue of teacher salary transfer and access to payslips as a major factor affecting teacher accreditation and reference the capacity this digital EMIS has in resolving these issues. Teachers collect these documents for themselves at the regional offices, which could be as far away as 100 miles with no regular transportation means, especially for rural schools. And this is in addition to trekking at least a couple of miles to the highway in remote communities.

6.2 Improving Service Delivery

In this case, we have discovered three areas where the use of digital EMIS has improved service delivery.

Equity

> "the issue surrounding the posting of female teachers to such communities to serve as a role model … they are encouraging MRC Holland to construct staff quarters. Also encourage female teachers to take up postings. … communities really will be sensitised even by physically seeing female teachers will encourage them to send their girl child to school." - A regional director

Examples have been shared of how when planners use data to inform their decision-making and interventions, it builds trust and confidence in partners to contribute to achieving the goals of education. Discovering gaps in female teacher postings in rural

schools led to an investigation and enticed partners to support programmes that, in this case, have a reverberating effect in terms of equity.

Effectiveness

> "the cash transfer was a really very good intervention by MoBSE given to marabouts so that they allow their children to go to school Or even if they are in the daaras a teacher is appointed to take them for classes" - A regional director

Knowing the problem before intervening increases the chances of success for intervention programmes. Upon realising that the areas with the lowest school enrolment rates are where faith-based schools (daaras) are dominant, the ministry supplied teachers to these schools and supported them through cash transfers in exchange for including mainstream subjects in their curriculum. This is both effective and efficient, as opposed to building white elephants that no one would use and starting an enrolment war.

Efficiency

Across the educational service delivery chain, less time is spent now on collecting, processing, and analysing data. Many of these tasks are automated, requiring minimal input from users, and coupled with increased access to data, officers can now focus on planning action. However, the biggest wins are in terms of monitoring at the regional level as well as teaching and learning at the school level. Cluster monitors can revert to focusing on monitoring schools progress towards education performance targets and providing support to schools. Teachers can now spend less time compiling reports and analysing data to adequately prepare for lessons. Both cases have direct consequences for improving students' performance.

7 Conclusion

This paper focuses only on the use of digital technology for service delivery at the regional level. Our methodology focused on the rural regions, as they generally perform poorly on many education performance indicators. This is not to say that the urban regions are not facing any challenges, but that understanding the service delivery challenges in rural areas, where conditions are at their most extreme, can help us devise strategies to help them catch up with other regions. In addition, all outcomes and innovations are openly shared with everyone.

We have discovered that digital technologies in education have the potential to improve service delivery in the sector in terms of equity, efficiency, and effectiveness. Despite the importance of the availability and use of information in planning, delivering, and monitoring educational services, the sector is faced with many challenges that need to be addressed for effective service delivery in education. This includes too few resources available to act on the issues identified, poor ICT infrastructure that includes heavy reliance on officers and staff's personal resources, which has ethical implications, and institutional issues that could nullify the effect of any information system. These

need to be addressed to realise the opportunities presented by digital technologies in improving service delivery in other poor developing countries with low resources.

In addition, there is a big increase in demand for data in the education sector, which unfortunately is also a result of the increased capacity of digital technology to process larger amounts of data. This has the risk of increasing the burden on teachers and needs to be explored further to understand how this could be avoided. Despite the important role digital technologies are playing in education, the teacher's most important task is still to provide teaching and learning.

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Taking a Leaf from Health: Implementation of a Decentralized Education Management Information System in Uganda

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Abstract. Education management information systems (EMIS) play a critical role in providing quality data for effective decision making and design of appropriate interventions. Over the last two decades, the health sector in low and middle-income countries (LMICs) has seen the emergence of robust and responsive health management information systems (HMIS). On the contrary, the education sector lacks comprehensive and flexible information systems for reporting and management of key education data, resulting in fragmentation and limited education data use above the school level. Against this backdrop, this paper presents key lessons from the implementation of a standardized HMIS in the health sector in Uganda, which has informed the implementation of a decentralized EMIS. Drawing from an action research approach to EMIS strengthening in Uganda, we provide guidance to education managers and policy makers in LMICs seeking to enhance education data standardization, management and use.

Keywords: EMIS · education · information systems · data standardization

1 Introduction

There has been a marked improvement in access to education in low and middle-income countries (LMICs) with a net enrolment rate of 91% in 2015 up from 83% in 2000 (United Nations, 2015). Despite the large increase in access to schooling, learning outcomes still remain poor, with inequalities and a large number of marginalized populations left behind. It was reported that over 600 children and adolescents globally are not achieving the minimum proficiency levels in literacy and numeracy (UNESCO, 2017). These gaps have been exacerbated by the challenges in timely availability and use of education data for education sector management and policy formulation.

In order to ensure inclusive and equitable quality education for all, in line with Sustainable Development Goal (SDG) 4, and fulfill the principle of leaving no one behind, there is a need to increase the quality and range of data to meet the demands of the changing education landscape. However, the Education Management Information Systems (EMIS) in most developing countries have been standalone, fragmented, difficult

to access and unable to adjust to the evolving data needs (Powell, 2006). This is further worsened by limited technical capacity, low data literacy and shortage of resources within the public sector (UNESCO/GPE, 2020).

Between 2010 and 2018, only 35% of countries in sub-Saharan Africa were able to report on the most important SDG 4 global indicators (UNESCO, 2019). In addition, the recent COVID-19 global pandemic revealed the need to develop more resilient education data systems that have the ability to respond to new and emergent data needs (Sparkes, 2021). Earlier research found that failures in education data systems were also attributed to; 1) poor data collection and analysis processes due to unstandardized data collection tools, indicators, and duplicate reporting by partners; 2) low utilization of EMIS data at decentralized levels to inform response to local needs; and 3) lack of appropriate strategies and formats for dissemination of EMIS outputs further limiting demand for EMIS outputs (Powell, 2006).

Although several efforts have been made by education development partners, donor agencies and countries to address these education data challenges and strengthen coordination, improve availability and use of education data at both country and global levels, when compared to the health sector, the education sector is still lagging behind. Most traditional EMIS are still centrally managed and only support upward reporting with limited feedback and use of data to support local action and education service delivery. Moreso, sub-national level actors, who are key enablers in implementation of education policies, have largely been omitted from the discourse of strengthening education data systems (De Grauwe & Lugaz, 2011; GPE, 2019).

In the health sector, there has emerged, over the last 20 years, a general-purpose health management information system (HMIS) that has provided an opportunity for developing countries to build dynamic low-cost, innovative solutions with modern data analysis and visualization tools for decentralized routine health management (Msiska & Nielsen, 2017). Built with open-source software, this solution has shown a great potential to move from unreliable and fragmented health information systems to increased demand and use of health data in decentralized units (Karuri et al., 2018; Manya et al., 2018). Although it has been shown that flexible and responsive EMIS improved timely and decentralized decision making for multiple users, there has been limited investment in an easy-to-implement data system, adaptable to different contexts and responsive to various data needs within the education sector (Bernbaum & Kurt, 2011; Ommundsen, 2017).

It is against this backdrop that this paper draws on key lessons from the implementation of a general purpose HMIS in the Global South, to inform the adoption and implementation of a similar system for the education sector. Drawing on an action research project based in Uganda, where a nascent EMIS is drawing on the experience gained with a long-standing HMIS, we ask the following question: *What key learnings from health can inform the implementation of decentralized education information systems in developing countries?*

The paper proceeds as follows. We first provide an overview of the ICT for Development (ICT4D) literature on the use of ICTs in relation to educational goals, with a focus on EMIS and its potential for development. We then describe our action research

methodology, as well as the EMIS Uganda context to which it is applied. Our findings draw four overarching lessons for EMIS: leverage an enabling legal and policy framework; work towards the alignment of key stakeholders; harmonize data collection instruments and routines; and appoint dedicated data managers at the district level. We conclude by positioning such lessons in the nascent literature on EMIS in information systems and ICT4D research.

2 Theoretical Foundations

In this section, we first provide an overview of how the ICT4D literature has engaged with educational goals. We then explore existing applications of HMIS to education, illuminating the importance for education data management systems to learn from the knowledge built by HMIS over time.

2.1 EMIS in the ICT4D Landscape

The ICT4D literature is displaying an increasing focus on unpacking, describing and problematizing the link between ICTs and the SDGs (Andersson & Hatakka, 2023). This is true both for the ICT4D agenda at large, and for specific goals within it. Digital connectivity – with its affordance to develop systems of data management in areas directly connected to the SDG – emerges as the "hidden hero" of the SDG discourse, one in which SDG 4 is inscribed (Brown et al., 2023). At halfway to the 2030 targets and with most developing countries off track, there is a much greater need to leverage and harness the potential of ICTs in accelerating progress towards achievement of the SDGs (ITU & UNDP, 2023).

Centered on the idea of inclusive innovation for development, one stream of literature has focused on how ICTs can be involved in imparting education: enabled by information-based means, distance learning has been looked at as a means to overcome physical barriers preventing schooling from taking place (Andersson & Hatakka, 2010; Grönlund et al., 2008). Following the wave of knowledge-for-development approaches developed in the late 1990s, especially in correspondence with the World Bank's (1999) landmark report Knowledge for Development, such approaches leverage the potential of distance education as capability-expanding, specifically for communities constrained in terms of access to learning opportunities (Hatakka et al., 2013).

A second stream develops around the effective provision of ICT-based means to learners (Thapa & Sein, 2018). Differently from approaches centered on distance learning, such works impinge on the materiality of ICTs, as artifacts that – inscribed in a learning context – can support the learner in multiple crucial ways. Notwithstanding the critique and implementation issues associated with the OLPC project, Srinivasan (2022) notes how information remains at the heart of such approaches: digital artifacts, she suggests, enter the ICT4D discourse by directly participating in learners' experience on the ground.

A third stream which has seen some popularity in ICT4D studies in LMICs are school and/or learner management systems. Such studies often report on the implementation of some sort of "best of breed" system at a higher education institution in one or more

LMICs, often employing a technology acceptance or adoption perspective. These systems usually have a dual perspective of use by providing the institution with necessary information for making strategic decisions and monitoring student learning processes (Martins et al., 2019; Denizhan et al., 2020).

In contrast to the learner-oriented edtech research streams, surprisingly limited attention has been given to technologies capable of datafying learner populations, with the goal of mapping educational resources and organizing them in ways effective to combating the "learning crisis" (UNESCO, 2020). Essentially, education management information systems in LMICs have been overlooked by academia, despite their critical role in enabling decentralized and data driven decision making regarding school construction, posting of qualified teachers, and distribution of desks, books, and finances (Amuha & Masiero, 2022). There is little awareness of the critical role of EMIS in the ICT4D space, despite its major role in employing ICTs to enable and monitor progress towards SDGs. It is in relation to this knowledge gap that lessons from health, examined through a socio-technical information systems lens, can be leveraged.

2.2 HMIS and Education

Over the last three decades and following the 1978 Alma-Ata declaration on universal health for all, there has been a gradual increase in digitalization of the health sector. This led to a focus on a decentralized approach of strengthening national health information systems (HIS) to generate reliable, timely and accurate health data to inform public health interventions, planning and policy formulation in developing countries (WHO, 2008). For example, in Sierra Leone, involvement of all relevant stakeholders in review and integration of data collection tools, coupled with training of all relevant stakeholders led to the successful scale of the HIS which in the long run improved the quality and use of the data at district level (Braa et al., 2010). In Kenya, the devolution of powers to subnational levels increased the demand for health data for planning and implementation of programs which positively enhanced the culture of information use by the devolved units (Manya et al., 2018). In Zanzibar, regular data use workshops with active engagement of the data users improved coverage and quality of data collected and enhanced staff capacity for information use, presentation, and analysis for decision-making (Braa et al., 2012).

In the education sector, EMIS data has been largely used at national level to inform planning and budgeting, monitoring, allocation of resources, and policy formulation ((Hua & Herstein, 2003). However, gaps in the current education data systems limit response to the growing demand for data beyond enrolment rates, to data on learning processes, equity, inclusion and learning outcomes. As such, many countries are struggling to keep up with the shifting reporting requirements. A 2019 assessment by the Association for the Development of Education in Africa (ADEA) noted that several African countries lack institutionalized frameworks for reporting on SDG4 and continental indicators (ADEA, 2019). With limited feedback on data collected, the high reporting burden on school administrators has not been translated into local action (Custer et al., 2018). Little has been done to strengthen the capacities of sub-national actors in data management and use for effective education service delivery (De Grauwe & Lugaz, 2011). In addition, existence of multiple, parallel, unharmonized data collection systems often not linked to national systems has limited response to education in emergencies further

leaving learners from these emergency and conflict situations behind (Sparkes, 2021; UNESCO, 2020).

With both health and education sectors, critical to human capital development and relevant for the social-economic development of countries, it is paramount that we draw on lessons learnt in implementation of HMIS to mitigate the current gaps in EMIS and accelerate progress to the SDGs.

3   Research Methodology

3.1   Research Approach

This research is based on the action research methodology proposed by Braa et al. (2004) for development and implementation of HMIS in developing countries based on the principles of "the networks of action". This argument is based on the global collaboration of the Health Information Systems Programme (HISP) networks, that have supported the design, development and implementation of a free and open-source software called District Health Information Software (DHIS2[1]) in over 80 developing countries. Action research aims at generating new knowledge while solving real world problems thus bridging the gap between research and practice (Braa et al., 2007; Braa & Nielsen, 2015). This study is part of the ongoing research on EMIS in Uganda, The Gambia, and Togo. Braa et al. (2004) argue that action research carried out in networks provides the potential for multiple sites to learn from each other, share experiences and knowledge, and plan and implement actions in a context-specific manner.

Baskerville (1999) argues that the ideal domain of action research is characterized by settings where the researcher is actively involved, the research is a cyclical process and knowledge obtained is used to solve the real-world problems. One of the authors has been actively engaged in the implementation activities since project inception. This has enabled us to obtain valuable insights on the project whereas the iterative process of action research has given us the opportunity to reflect on the implementation, identify what is working well and areas that can be improved.

3.2   Data Collection Methods

Data was collected using various methods during the various stages of the project. In-depth key informant interviews using semi structured questionnaires were conducted with key education stakeholders at national, district and school level to understand the current education data system, its challenges, information needs, information flows, information use culture, existing capacity, and support. Walsham (2006) indicates that interviews are an important data source, as they enable researchers to assess the interpretations of informants in the field.

Focus group discussions were also held with head teachers from schools in the pilot districts to understand their reporting routines, data use practices and challenges. Email communications and WhatsApp group discussions with the education teams provided valuable insights into the different data needs and challenges. Several documents such

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[1] https://dhis2.org/hisp-network/.

as the Ministry of Education and Sports draft EMIS Policy, Uganda Bureau of Statistics Act (1998) Education Act (2008) and the Local Government Act 1997 were reviewed to further understand the institutional framework and existing enabling environment or lack thereof, in which the EMIS operates. Table 1 below provides a summary of the data collection methods used.

Table 1. Summary of Data Collection Methods

Method	Description	When
Presentations	4 at national; MoES – Basic education department, M&E Technical working group, Permanent Secretary, Minister of state for Primary Education 3 at district; leadership, education teams, planners	Inception Inception
Interviews	6 at national (Commissioner, Assistant commissioner, 2 principal Education officers, 2 M&E officers) 8 at district (3 DEOs, 2 planners, 2 school inspectors, 1 data entrant) 4 at school (school administrators) 1 Education Partner	Pilot evaluation
Focus group discussions	2 at district level (district team & headteachers)	Pilot evaluation
Workshops	3 project orientation meetings 2 national trainings 5 end user trainings	Inception Implementation Implementation
Participant observations	Several during support supervisions visits	Implementation, ongoing
Document review	Review of existing pre-primary and primary level data collection tools EMIS policy, Education Act, UBOS Act, Local government Act, Past EMIS review reports (ADEA & EMIS task force)	Inception, action planning Inception & Pilot evaluation
Emails and social media	Email communications with district teams, WhatsApp groups (DEO forum, implementation support group)	Ongoing
Informal discussions	Several discussions with MoES, district and project teams	Ongoing

3.3 Data Analysis

Analysis of the data followed an interpretive lens (Walsham, 2006). Transcriptions from interviews and field notes made during workshops, observations and information conversations were reviewed and analyzed to identify the emerging themes. In addition to the empirical data collected, the authors also draw on reflections from their long-standing involvement and learnings from the implementation of DHIS2 in the health sector for which the HISP network group in Uganda has supported since 2013.

4 The EMIS Landscape in Uganda

Like most developing countries, the EMIS is a key source of data for the education sector. EMIS has been defined by several scholars, with the most comprehensive definition by Cassidy (2006). EMIS is defined as a system for the collection, integration, processing, maintenance and dissemination of data and information to support decision making, policy-analysis and formulation, planning, monitoring, and management at all levels of an education system. EMIS is a system of people, technology, models, methods, processes, procedures, rules, and regulations that function together to provide education leaders, decision makers and managers at all levels with a comprehensive, integrated set of relevant, reliable, unambiguous, and timely data and information to support them in completion of their responsibilities. (Cassidy, 2006: 27). Although this definition provides a comprehensive description of EMIS, traditionally, EMIS strengthening efforts have largely been focused on the technology pillar and less focus on the other components thus limiting successful adoption and implementation of EMIS.

In Uganda, EMIS was conceptualized in 1993 as part of the Primary Education Reform Program to enhance the management capacity of the sector in the areas of Planning, Budgeting, Policy development, Monitoring and Evaluation (MoES, 2017). In March 1997, the Local Government Act allowed for the decentralization and devolution of functions, powers, and services to district local governments. Unlike in the health sector where management of health data was devolved to sub-national level, the management of data in the education sector is still largely centralized at the MoES. The annual school census (ASC) which is the key source of EMIS data from schools, is largely paper based. Data is captured on paper tools at school level and relayed through the district education office to the MoES headquarters for capture and analysis in a standalone database.

Between 2000 and 2014, EMIS evolved over four phases that largely focused on strengthening the technology pillar. These phases were characterized by adoption of computer-based systems that were standalone, vendor-locked and of single-year design. This created multiple challenges including failure to link to existing examination and population data systems for comprehensive analysis, inability for longitudinal data analyses and reliance on donor/vendor support for system update and support.

Reviews of EMIS identified the challenges above, in addition to limited quality and comprehensiveness of data, unpunctuality in data management and dissemination, weak policy and legal framework, and limited sustainable investment in EMIS activities (ADEA, 2016; MoES, 2017). Recommendations from the reviews led to the constitution of an EMIS task force, in 2017, to oversee the development of a new and robust EMIS.

Furthermore, due to the decline in the quality and comprehensiveness of the EMIS data, coupled with shortage of funds, the annual school census has not been conducted since 2017 (Sparkes, 2021). With the robust EMIS yet to be operationalized, the MoES has since 2017 relied on ad hoc data calls to districts and schools to inform education sector budgeting and planning and no statistical report highlighting performance on key indicators has been generated. Based on these gaps and drawing on the successful implementation of DHIS2 in the health sector supported by the in-country HISP group, Uganda was selected as one of the countries to explore the use of DHIS2 to support education data management.

4.1   The Project Background

This research is part of a broader ongoing data use innovations research currently implemented in three African countries (The Gambia, Uganda and Togo) by the University of Oslo and the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX) Project. The project has taken different approaches across the three countries; The Gambia is exploring the use of DHIS2 to operationalize a new education policy on the shift from aggregate to individual level data management and use; Togo's main project objective is to leverage the DHIS2 functionalities to support data integration and exchange with an existing data system (State Duc) enhancing data analysis and visualization of education data. In Uganda, the main project objective is to explore the use of DHIS2 as a decentralized EMIS (DHIS2-DEMIS), and enhance availability, feedback, and the use of education data by district level managers.

The DHIS2-DEMIS project in Uganda commenced in early 2019 and is implemented through the Ministry of Education and Sports (MoES) basic education department, in partnership with HISP Uganda and Save the Children Uganda. HISP Uganda draws from experience gained over more than (10) years of supporting the implementation of DHIS2 in the health sector, while Save the Children has been working and supporting the education sector in Uganda for over 60 years. The project is currently implemented in four (4) out of 135 districts of Uganda.

During the project initiation phase, several stakeholder engagements for buy-in and support were held with the central and district level leadership. This phase was followed by a requirements gathering phase where field visits were conducted to understand the existing data management and data use practices at district and school level. This process informed the initial customization in DHIS2 of the annual school census form and later of the integrated termly data collection tool in 2021, to support routine data capture, analysis, and visualization of key education indicators. The districts were also set up with both hardware (laptops, desktops, uninterrupted power supply) and software to support online data capture and analysis.

Several capacity building workshops on a) system design and customization b) data capture c) data analysis, presentation and use have been held for both the MoES central level and district teams. Statistical data for 2018–2023 (excluding 2020 when schools were closed due to the COVID-19 pandemic) from both pre-primary and primary schools was collected onto hard copies and captured into the DHIS2-DEMIS. In addition, 2016 and 2017 EMIS data from the previously conducted annual school censuses was also captured into the system to allow for longitudinal data analysis.

Dashboards, visualized at both district and central level, were created with key performance indicators such as gross enrolments, reporting rates, teacher to pupil ratio, pupil to classroom ratio, pupil to latrine stance ratio etc. Primary leaving examination results from 2016–2019 from the Uganda national examination board (UNEB) were imported into the system and used to calculate the performance index and pass rate indicators.

An assessment of the pilot project was conducted in February 2020, and findings indicated that the DHIS2-EMIS pilot has had a positive outcome with buy-in from the MoES central level and improved management and use of education data at district level. The training and support supervision conducted during the project has empowered the districts to collect, enter, validate, present, and use data from DHIS2-EMIS to inform decision making. Data from DHIS2-EMIS has been used by the districts as a basis for decision making and allocation of resources such as distribution of desks, allocation of teachers, allocation of school capitation grants, building new latrine stances and classroom blocks. Data from DHIS2-DEMIS has also enabled cross-sector synergies between health and education by improving joint planning for cross-sector interventions such as vaccination, HIV and deworming programs in schools.

In response to the COVID-19, the DHIS2-DEMIS was further customized in April 2020, to support school-based surveillance and reporting on diseases of public health concern. In addition, the system was configured to support a national data call which provided data to inform distribution of self-study materials during the extended national lockdown as well as inform reopening of schools.

Whereas the ongoing implementation of DHIS2-DEMIS has improved availability of timely and reliable data for planning and decision making across all education levels and strengthened cross-sectoral synergies, it has also generated key learnings described below that are relevant for successful and sustainable implementation of EMIS in developing countries.

5   Lessons Learnt from Health

"[…..] but the good thing is that you have borrowed a leaf from DHIS2 (in health), even this one (in education) if you could adopt how they are doing it […] so even the ministry of education could borrow a leaf on how the ministry of health is doing it; Frequent updates, trainings, stakeholders and biostats […]. I think health has regional review meetings, where you can collect data from the system, pick out those key things that are standing out and have meetings with the health facilities and the districts. […] and that's how I think it has helped them to keep going and their system is vibrant. So, the Ministry of Education should borrow a leaf and continue borrowing from them. I know at one point in time we will also be there."
- R002

The above quote is from a district planner responsible for overall planning and budgeting in one of the implementation districts, who has over time, witnessed the differences between the health and education sectors in terms of management and use of data. Below we provide a description of the key learnings from health that can inform the education sector in adoption and implementation of a sustainable education management information system.

5.1 Enabling Legal and Policy Framework

An enabling legal and policy framework is the anchor on which the EMIS stands and is critical for supporting full functioning of the system. The framework allows for institutionalization of EMIS and should be dynamic enough to enable technological advancements while providing a clear and comprehensive strategy on enforcement, management and dissemination of data (Abdul-Hamid, 2014). Assessment findings from EMIS norms and Standards in Uganda highlighted lack of legal and policy framework as one of the key challenges in education data management (ADEA, 2016). Recommendations from this report informed drafting of the EMIS policy by the MoES planning department. However, the draft EMIS policy which clearly highlights the policy objectives, implementation framework and roles and responsibilities of the various stakeholders is yet to be approved and operationalized.

During the DHIS2-DEMIS project implementation, data collection tools were distributed to both public and private schools. However, the private schools were less compliant to submit filled forms to the district office. For the private schools that submitted their forms, the enrolment numbers declared were less than expected because they wanted to evade tax.

> *"…..And the attitude of the people towards the submission of the forms is still very poor. That still remains a gap. Especially with the private schools. The moment you give them this form, they think that even if they give the right information, it will be used to tax them or for any other thing that is really unknown. That kind of assumption is the one that is troubling them alot." - R004*

The lack of a policy has led to complacency in reporting especially for private since there are no sanctions and punishments tagged to non-adherence to reporting requirements.

> *"We find that even when the DEO calls them for a meeting, they don't appear. Now in one of our review meetings, we were trying to understand why these people of the private sector don't adhere and one of them boldly told us that; "this is my school, and I can choose to report or not." So, if one can say that, that means most of them are thinking that this is a private arrangement, there is no need for the government to interfere." - R001*

In the health sector, during early adoption of the DHIS2 for health data management in Uganda, the Ministry of Health Division of Health Informatics drafted a 5-year eHealth strategy (2017–2021) to guide adoption and implementation of digital health innovations in the country. This was followed by the 2021/25 health information and digital health strategy (HIDHS) developed within the broader strategy of the National Health policy and National Development Plan (NDP) III on digital transformation for social economic development. This strategy was developed to *"provide strategic guidance on development and implementation of sustainable information and digital health initiatives, ensure equitable access to quality health data and information and promote continuous learning and evidence-based decision making"* (MoH, 2021).

Development of these policy frameworks in the health sector have enabled the MoH division of health informatics to provide coordinated stewardship and alignment of stakeholders towards the one digital health strategy. Based on the policy, both private and public health facilities are mandated to provide timely health data to inform national planning and programming for different health interventions. The Planning Department at the MoES will need to expedite the review, update, approval, and operationalization of the EMIS policy to provide an enabling legal and policy framework for the reporting, management and use of EMIS in the country. With the policy in place, both private and government institutions will be mandated to provide data relevant for education sector budgeting, planning and policy formulation. Whereas, private institutions may not directly benefit from government grants, they benefit from other government services such as road construction, borehole construction that enhance their education service delivery.

5.2   Harmonization of Stakeholders

Donors, development partners and bilateral agencies play a critical role in supporting governments in developing countries to improve provision of essential services such as health and education and monitor progress towards the United Nations' SDGs. However, governments need to ensure that partners are well coordinated and their implementations are well aligned to government priorities and not fragmented which cripples progress to overall national development.

The health sector in Uganda has several multilateral and bilateral health development partners supporting implementation of different health programs. These health programs require reliable and quality data to inform implementation and monitoring progress towards attainment of health development goals. Prior to the adoption of DHIS2 as a national health management information system, data management was fragmented. Each partner maintained separate databases for collection and management of data from supported districts/regions. This data informed their programming and enabled them to fulfil donor reporting requirements. These individual databases were not linked to the national system and as such limited availability, at national level, of comprehensive data to support health sector programming. The MoH in return, relied on "partner data" to inform sector planning.

With the introduction of the national electronic health management information system (eHMIS) based on DHIS2, the MoH constituted the Health Information, Innovation and Research (HIIRE) technical working group composed of representatives from both government and development partners. The technical working is responsible for providing technical oversight and ensuring that all stakeholders' health data needs are aligned to national priorities. Both government and partner resources are leveraged to strengthen data management processes, reporting, and use of data within the national eHMIS. Partners used their resources to strengthen reporting into the eHMIS for supported health facilities (MoH, 2021).

Similarly, the education sector has various education development partners (EDPs) supporting implementation of various education programs at national and sub-national levels. The EDPs require EMIS data to inform interventions in supported districts and learning institutions. However, given the challenges of obtaining reliable and timely data

from the national EMIS, most partners opt for collection and management of data from supported districts using project-specific databases which are not linked to the national system (Sparkes, 2021). This further weakens the country's EMIS structure, creating reliance by MoES, on data collected through ad hoc data calls and partners and a gap in availability of complete data for the education sector. A dedicated working group is required to streamline both government and partner data needs and optimize use of resources to strengthen the national EMIS.

5.3   Harmonization of Data Collection Instruments and Routine Data Collection

Data collection tools are a key element of data production procedures that affects data reliability. It is therefore very important that data collection instruments are well designed, tested and data collectors trained to collect the desired data (Hua & Herstein, 2003).

In the Health sector, between 2000–2001, the MoH together with different stakeholders undertook a review and update of all HMIS data collection and reporting tools. This aimed to integrate the key health data and indicators within standard reporting tools, lessen data capture errors and improve consistency in reporting and reduce the burden in compilation of health data (Kintu et al., 2005). Prior to this, different MoH user departments and partners collected separate department/project specific data from health facilities and districts. This in the long run compromised the quality of reporting on routine HMIS and limited availability of data for national level planning. The harmonization of data collection tools in the health sector also streamlined the frequency of reporting. Health facilities submit routine data on a monthly and quarterly basis while additional data is submitted on a semi-annual and annual basis. Collection of routine data informs timely response to key interventions such as prevention and management of disease out-breaks and distribution of health commodities to prevent drug stock outs.

With the introduction of DHIS2, all stakeholders were required to obtain from the national eHMIS. The MoH Division of Health Informatics has since coordinated periodic workshops, with different user departments and partners, to review and update all the HMIS data collection tools to include new data requirements and indicators based on emerging data needs and changes in epidemiological trends. The partners support printing and distribution of approved HMIS tools to health facilities and coordinate district data quality and review workshops. This has eliminated parallel reporting and reduced the reporting burden on facilities and districts. As such, resources from both the MoH and stakeholders are optimized to improve timeliness, completeness, and accuracy of the data, making it more reliable for use by all stakeholders (Kiberu et al., 2014).

In the education sector, the annual school census tools are the main source of statistical data for the MoES. Additional data such as population statistics is obtained from the Uganda Bureau of Statistics (UBOS) and national examination board to allow calculation of key education indicators such as gross and net enrolment, pass rate and performance index. In addition to the annual school census tools, different user departments within the MoES and Partners collect data from learning institutions using department/partner specific data collection instruments. Since the annual EMIS census was last conducted in 2017, the MoES has relied on ad hoc data calls to districts and schools to provide

updated data for planning and resource allocation. These different requests and mechanisms for data collection are a source of data duplication and heavy workload on schools and districts which in the long run compromises the quality of data collected.

> *"…and sometimes the government expects us to have minds that grasp everything like our learners. Before we master one system, they introduce another, now we have the one recording daily attendance, then we have EMIS, then there is DEMIS. All these collect more or less the same data. Why doesn't the government harmonize at the top and just bring us one system?" – R005*

During the implementation of the DHIS2-DEMIS, the project team supported a workshop to harmonize the data needs from seven different MoES departments. This led to the design of one integrated termly data collection tool that provides more routine data from the pilot districts on a termly basis. Department specific dashboards were designed within the system to allow for visualization of department specific indicators such as Special Needs Learners, Gender, school health, human resources.

Harmonization of data collection tools eliminates the duplication in data collected, improves quality of data collected and reduces the data collection burden on schools and districts. Besides reducing the data burden from ad hoc data calls, the districts are able to easily respond to data requests from different MoES departments and partners. In addition, more focus has been put on improving the timeliness and quality of the data as well as using the data to inform routine decision making in the districts. For example, routine termly data on learner enrolment has informed termly allocation of capitation grants to schools, while indicators such as pupil-teacher has informed the redistribution of teachers.

5.4   Dedicated District Data Manager

Human resources are one of the critical building blocks in the successful implementation of an information system. While implementing these information systems, it is critical that emphasis is not only put on recruitment of qualified human resources at the central level, but also at the subnational level.

Prior to the introduction of DHIS2 in health, data management at health facility and district level was mainly carried out by health records assistants, th majority of whom lacked formal training in health data management. This deficiency in data management skills contributed to the poor quality of data collected due to delayed reports, incomplete and inaccurate submission of monthly routine reports to districts and later to national level (Kintu et al., 2005).

The roll out of the DHIS2 in health, created the need for a recruitment of qualified data managers to support the capture, analysis and presentation of health data at district level. Initially, these district biostatisticians were supported by the implementing partners operating within the various districts, however, with continuous advocacy, the position of a district biostatistician was institutionalized within the government human resource structure. The biostatistician is responsible for management of all health data and coordination of data quality and review workshops to improve quality and use of data within the district.

In the education sector, there is no similar position within the current structure of the district education office. The data management role has been delegated to the district education officer or the inspector of schools who are most of the time engaged in administrative and inspection duties and often lack the expertise and time to support data management within the district. During the DHIS2-DEMIS project implementation, although a multi-disciplinary team of district education officers, inspectors of schools, planners, and IT officers, was trained, a dedicated data manager is required for sustainable management of EMIS activities at district level. Oftentimes, the district education officers have bridged this gap by assigning at least one person within their office responsibility for EMIS related activities. However, this has not been sustainable in situations where the delegated staff are either volunteers or interns available for only a short period of time.

> *"For us in education, we don't have a data officer, so because I am busy with other work at district, the inspector of schools is the one responsible for following up reporting and analyzing the data in the system. If I need any statistics for a meeting, he provides. But then, he also has his other work. So, if we had a data officer like our colleagues in health do, we would be more organized."- R001*

The position of a district statistician has been included in the proposed human resource structure within the draft EMIS policy, which is a step in the right direction (MoES, 2018). Once the EMIS policy is approved and operationalized the district education statistician will play a vital role in supporting EMIS activities at district level. Since operationalization of such a policy requires significant budgetary commitments from the government, this position may not be realized in the short term and may require continuous advocacy for inclusion within the government structure. In the interim, support for this position can be initially provided by the education development partners as was the case in the health sector.

5.5   Capacity Building Strategy

During the implementation of DHIS2 in the health sector, several trainings were conducted to build capacity of the human resources at both national and subnational levels in management and use of the system. At the central level, the training focused on equipping system administrators with skills in system customization, maintenance, and end user support. Program M&E managers at the MoH and the district data managers were trained in analysis, presentation, and use of data in the system as well as basic troubleshooting skills. These trainings which were conducted in a cascade model ensured that all staff obtained skills in use of the system. In addition, online and in person regional academies have been conducted and a master's degree course in health informatics with modules on DHIS2 was introduced at one of the universities. The staff are also encouraged to join the global DHIS2 community of practice, a forum where participants engaged in implementation and use of DHIS2 share different use case stories and offer peer to peer support. These strategies have provided an opportunity for long term capacity building for staff involved in health data management.

In the education sector, during the implementation of DHIS2-DEMIS, the project team conducted several capacity building training exercises on system design and customization, data capture, data analysis, presentation and use for both the MoES central level and district teams. To promote peer to peer learning, the training included the district health biostatisticians who shared their long-term learnings and experience in using the DHIS2 with the education teams. At district level, the biostatisticians have continued to provide mentorship and support to their education counterparts thus improving their knowledge and skills in use of the system. This has further strengthened the cross-sector collaboration and use of the system at district level.

> *"We have learnt a lot from the district biostatisticians. For instance, for the last training we had, yes, our facilitators were very good, but naturally the brain forgets some things, then you go to him [biostatistician] and say, we studied this thing but I have forgotten. How can I go about it? Then he comes in and says do this" - R002*

With continuous updates of the system and staff turnover in the public sector, a long-term capacity building strategy is necessary to support re-training and training of new staff involved in data management. This could be in the form of short videos, self-paced online modules, academies, and introduction of EMIS modules in pre-service teacher training institutions.

6   Discussion

The ongoing implementation of DHIS2-DEMIS in Uganda has highlighted key learnings from health that could be adopted for the effective implementation of a sustainable education management information system in the education sector. These learning affirm the policy areas underscored in the World Bank framework paper on "what matters most for an education management information system," which include: an enabling environment, system soundness, quality data and utilization of data for decision making (Abdul-Hamid, 2014).

Legal and policy frameworks governing EMIS significantly influence the Ministry of Education's effectiveness and credibility to produce and disseminate education statistics (ADEA, 2016). As it is in the health sector, the Ministry of Education requires a clear mandate to collect information from all education and training institutions and bodies to inform efficient and effective education management. This will support reporting from both government and private institutions and enhance planning and allocation of resources such as roads, boreholes that enhance education service delivery for all. The legal and policy framework should also be aligned to the broader education sector plans and the national policy which allows for better coordination across different government agencies and facilitates cross sectoral analysis and planning. For example, implementation of school-based surveillance as part of the project demonstrated the need for strengthening cross sectoral collaboration between health and education. Surveillance data was shared across the ministries to inform COVID-19 response in schools while enrollment data informed health programs on immunization and support for teenage mothers in schools.

Alignment of stakeholders within one coordination body is essential to support management and relay of data into one integrated national EMIS. It is important to recognize the needs of the various stakeholders and ensure that their support is not parallel to the national priorities. This in turn improves completeness and quality of the data, optimizes use of scarce resources and reduces the cost of monitoring for both government and development partners (Yuki & Kameyama, 2014). This alignment of stakeholders should be coupled with standardization and integration of the many parallel and fragmented data collection tools and systems introduced to meet the demands of the different stakeholders. In the health sector, all partner needs, data collection tools and systems have been aligned to the national DHIS2 through coordination of the health information, innovations and research technical working group eliminating parallel and duplicate reporting.

In the DHIS2-DEMIS project, introduction of the termly data collection tool that integrates reporting needs for the different ministry departments and partners has demonstrated the potential to eliminate parallel and duplicate data collection tools and hence reduce the reporting burden on schools. The national EMIS should also be comprehensive enough to meet the needs of the different stakeholders. This in turn will ensure that all stakeholder efforts aim to improve the quality and use of the education data. The EMIS can also be linked to other sectors for national development such as employment, health, poverty alleviation which are related to education outcomes and contribute to the achievement of the SDGs (UNESCO, 2018). For example, in the ongoing research project, additional data such as population statistics and examination data from other existing systems has been integrated into the DHIS2-DEMIS to provide a comprehensive analysis of relevant indicators for different stakeholders to act on.

Although emphasis is usually put on staffing the EMIS unit at the central level, competencies should not only be built at central level but also extend to staff at subnational levels such as region, district, and school level (UNESCO, 2018). The research study shows improved management and data driven decision making in districts with dedicated data staff. Usually, when Ministries of Education are budgeting for EMIS, the recurrent costs for training of EMIS staff are usually overlooked or underestimated, which in the long run negatively impacts on the effectiveness of the EMIS (Abdul-Hamid, 2014). Capacity building has been identified as one of the key factors for the successful implementation of health information systems (Braa et al., 2012; Karuri et al., 2014; Manya et al., 2018). As such, Ministries of Education and partners need to ensure that capacity strengthening costs are prioritized in their annual budgets if they are to achieve a sustainable and effective EMIS. In the research project capacity has been built for the; central ministry staff to manage the system and provide end-user support use; the districts and schools to manage and use their data to inform local action. However, with staff transfers there is a need for ministries to budget for continuous capacity building as well as support peer to peer learning between health and education sectors.

It is important to address these learnings concurrently for successful implementation of EMIS. As investments are being channeled to the design and development of the EMIS, similar efforts should be placed on fast tracking approval and operationalization of the EMIS policy. It would be counter-productive to have a robust EMIS without a sound operational legal framework or an adequate budget allocated for recruitment and

training of staff. The sector would still suffer the same challenges such as inadequate human resource, low reporting rates, poor quality data and fragmented data systems which would negatively impact on availability of comprehensive education data to inform policy and data-driven decisions at multiple levels.

7 Conclusion

In order for countries to successfully implement an efficient EMIS, there is a need to draw more attention to the key lessons illustrated in this paper. Previously, most EMIS implementations have focused on strengthening the technology component, ignoring the need to streamline stakeholders, harmonize data needs and allocate qualified human resources at subnational level. However, we argue that while the increased use of ICTs is useful to improve the efficiency of an EMIS, organizational and other factors are critical for an effective and comprehensive EMIS that informs and supports a quality education system.

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Even More Work for Mother? Online Schooling and Asymmetric Parental Involvement during the Pandemic in Indonesia

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Abstract. In this paper, we investigate accounts of what online schools meant for the paid and unpaid work done by women during Covid-19. When schools closed, and online schools started in Indonesia, parents were faced with restructuring the activities their children had earlier carried out at school and that were now centered at home. They also dealt with the introduction of digital technology in households. How did women (mothers specifically) negotiate these changes and what were the implications of these changes for their work burden? To understand this, we carried out a study in Batu, Indonesia, with heterosexual families that had multiple primary school-age children dealing with the transition from in-person to online schooling between March and May 2021.

Rather than a silver bullet for freeing up time, the introduction of information systems and digital technology into schooling merely added another task to the list of unpaid work that women perform. We use an Actor-Network lens but bring in the role of ideology to understand how networks are configured in times of change. How did mothers cope with the disproportionate burden of tasks related to online schooling that fell on them? Throughout, we found that mothers remained the dominant actors organizing their children's online schooling, regardless of which parent earned more, had more free time from paid work, or was more digitally literate. We argue that since a gendered ideology underpins this reality, interventions such as online schooling cannot be designed in a gender-blind or gender-neutral manner.

Keywords: parenting involvement · online school · division of household labor · Covid-19 · actor network theory

1 Introduction

In March 2020, the WHO recommended that countries implement policies to close public spaces to reduce the spread of the COVID-19 virus [42]. The Indonesian government implemented this policy, resulting in the closure of offices, schools, childcare facilities, and other public spaces and also leading to the implementation of protocols for working

and studying from home [22]. While working and studying from home became the new norm for families in Indonesia and globally in recent years, situated cultural practices, gender ideologies, and income levels fundamentally shaped its consequences for different populations in varied geographies. At the very least, since digital devices and internet access became critical actors in families to connect with work and education [30], digital inequality and adoption (themselves dependent on economic, social, geographic, and generational gaps [25, 39] was one such differentiating factor. According to the ITU data, women are 6% less likely to access the Internet and 12% less likely to own a smartphone [23]. Specifically, when we look at Indonesian data, the gender gap in mobile Internet use is 20%. Only 40% of Indonesian women access the Internet via mobile phones, compared to 60% of Indonesian men [9]. A second dimension to consider in the context of schooling from home is the increased involvement of parents in their children's (online) education; furthermore, the younger the school-age children, the greater the involvement of parents.

Additionally, the involvement now required skills related to digital technology [30, 33] and became a new responsibility held by mothers. However, it cannot be denied that women face more "obstacles to access, affordability, lack of education, and inherent cultural, social norms" that can be further exacerbated during crises. It should be noted that a mother's role in online education is accompanied by other household chores such as cooking or cleaning, which also increases as children and adults spend more time at home [7]. Finally, juggling children's education and housework had always proved especially challenging for families where parents also carried out paid work [17]: the pandemic further complicated this scenario.

Our interest is in how mothers and fathers in heterosexual families divided unpaid, household work once the home became the center of all family activities during the pandemic. Did the inclusion of other actors, working from home, and having more time at home increase the participation of both parents in household chores? What factors shaped who took on additional tasks, such as the ones on online schooling and the associated use of digital technologies? To what extent did factors such as the incomes earned by the two partners or their relative digital literacy shape who played these new roles? We examine these questions using an actor-network lens to examine parents' involvement in their children's online schooling in Batu, Indonesia in 2020. We examine how the introduction of online schooling during Covid-19 and the need for increased parental involvement builds on or disrupts existing patterns of how household work is divided between parents. Even as the celebratory narrative around online schooling (and working from home) suggests that this introduction of digital technologies adds convenience and flexibility to people's lives, we investigate how it works in practice, especially for women.

2   Theoretical Approach and Lens

Digital technology has become the leading actor in facilitating information communication between groups, especially in the era of COVID-19. The pandemic strengthens dependence on digital technology as a new actor affecting family reality [11]. The role of the use of technology - including digital technology and information systems - cannot

be separated from the social content contained therein [5, 6, 8, 26]. More specifically, the role of gender in shaping technology design and use has been an object of study for the past several decades by those studying the social life of technologies [12, 40]. More recently, this gendered analysis has been carried out in the context of digital technologies and information systems as well.[1] Much of this research emphasizes the different mechanisms through which the patriarchal organization of work and life is manifested and fundamentally shapes how women can leverage technology in their lives. Our paper adds to this growing (but arguably still small) body of literature by examining how the celebratory rhetoric around digital technologies and their capacity to empower women – whether by freeing up time, offering them opportunities to do remote work or join the workforce, earn a living etc. -- translates in practice to the lives of women. Here, we consider specifically the case of women who are parents in Batu, Indonesia, and in the context of the shift to online schooling in the midst of the COVID-19 pandemic.

At the heart of this paper is the division of household tasks or domestic work between the male and female adults in heterosexual families into which the technologies and tasks of online schooling were inserted during the pandemic. By household tasks or domestic work, we refer to activities such as cooking; sweeping, mopping and tidying the house; washing dishes; washing, folding and ironing clothes; repairing electronics; watering plants; care work and new tasks including assistance in their children's online education – basically, activities that fall within the ILO's definition of "Unpaid work" as *"all work activities that are not paid, and it is safe to say…has no social recognition"* [3]. Research finds that, historically, the burden of such unpaid domestic work lies disproportionately on women globally, though the exact proportion varies by country. OECD data suggests that women were spending, on average, twice as much time on unpaid work as men [27]. Since the pandemic, this gap has only increased, with mothers of children under 12 years old carrying out up to three times more unpaid work than fathers in 2020 [28].

In this paper, we examine the asymmetric division of unpaid work using the ideology of gendered roles approach. This approach explains the unequal division of domestic work on the basis of the gender values embedded in society. It proposes that even if both partners hold economically lucrative jobs outside the home, since social norms dictate that women should be responsible for household chores, domestic work is always seen as "women's work" regardless of what other work they might take on [34] or how that work may compare to their male partners. Thus, the gendered roles approach proposes that the weight and influence of tradition in all areas of social life impels women to take responsibility for unpaid domestic work and perform most household activities regardless of their resources or time availability. For a while now, scholars have highlighted that this results in women bearing a "double burden" of paid work outside the home and unpaid domestic work within [21, 32]. Furthermore, studies in the context of the pandemic and changed work schedules reveal the continued prevalence of the double burden in the UK [35], Canada [36], Australia [13], Spain [16], and India [10].

Applying the ideology of gendered roles approach to the Indonesian case, we find that in Javanese culture, the gendered division of household work is reinforced by a range

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[1] See Maseiro (2020) and Oreglia and Srinivasan (2016) for a review of this literature and the range of themes covered.

of traditional values and beliefs. For instance, the identity of a woman is supposed to revolve around *Masak* (cooking)*, Macak* (dressing up), and *Manak* (giving birth) [18].[2] *Masak* is related to the role of women in the kitchen and in performing household chores. The kitchen – located typically at the back of the house – is considered the domain of women and the place where they possess authority [15]. The term *konco wing* (which translates roughly to "friend at the back") is often applied to the wife, implicitly also implying that her role and domain are in the kitchen rather than in public [15]. The second value of *Macak* suggests that an ideal Javanese woman works to maintain her health and beauty and dress up to attract the spirit of her husband [14]. The final value is *Manak*. According to Serat Darmagandul, this value means a woman must carry out her role in the *Paturon* (bed) [19]. However, other than that, this term emphasizes that an ideal woman must continue the husband's lineage and bear him children. A woman who cannot bear offspring is considered a failure and a disgrace to the family [43]. Furthermore, beyond giving birth, an ideal wife is expected to devote her energy to caring for and educating her children and be primarily responsible for nurturing them in these ways. While these traditional adages, terms and values may not tell us about life in contemporary Java in and of themselves, we evoke them to the extent that we see some alignment between them and practice: men are still perceived as heads of households and as the primary breadwinners who hold jobs outside their homes in the region [24]; while women continue to be held responsible for nurturing their children in contemporary Javanese society [31]. One of our respondents also conveyed the relevance of some of these values in her life when she told the first author:

> "*I have a life principle: not to demand, not to ask others for more. What is in me, I use. So even if there is no money in my hands, I will not ask. If anything makes me think about myself, like I want to buy lipstick, I think it's not important; Father's happiness is the most important. Children's happiness is above all. The family must come first. So I can't be selfish thinking about it.*"

How did such deeply held values in combination with the economic realities of families shape how men and women negotiated domestic work, including their involvement in children's online schooling, in contemporary Batu? Furthermore, not only did the unpaid workload of parents rise during online schooling at this time, but this shift also brought in ICTs – and relatedly, digital divides and digital literacy gaps along income or

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[2] The possession of *benggol* (money) and *bonggol* (sexual virility) are seen as desirable masculine attributes [15] with *Lelananging Jagad* (or the most masculine man in the entire universe) being one that's powerful, handsome and has many wives [44]. Women and the attributes associated with them, on the other hand, are considered subordinate [15]. The very term "Wanita," which stands for "Women" in Javanese comes from the words wani (brave) and tapa (suffering). Wanita means someone who dares to suffer for others [18]. The widely used adage "*Suwarga nunut neraka katut*" – that the husband decides whether his wife will go to heaven or hell – indicates how a woman/wife is expected to fit into the family of the man, and the extent to which a wife's life should depend on her husband's. Thus, when a husband goes to heaven or hell, so does his wife. This happens even where a wife's own actions may have earned her paradise but her husband's would lead her to hell – the wife's position is in hell merely because that is where her husband is headed, and her fate depends on her husband's [24].

gender - as significant actors/factors in the process. Socio-ecological approaches, such as the layered burden framework which views ICT proficiency within the cultural norms of existing social practices [4, 38] offers one way to think about ICT use within the context of a gendered division of labor. Actor-Network theory (ANT) offers another and is the one we use given its focus on the stabilization of networks of actors in people's lives as an "accomplishment" rather than as a given. Further, ANT views the world as networks of humans and non-human actors that can include objects, ideas, and concepts, which is useful in this scenario where our interest lies at the nexus of ideologies of gendered division of labor, schooling and digital technologies. Before the pandemic, families relied on relatively stable networks at school and at work. However, when access to these networks was cut off during a pandemic, families had to work with human and non-human (digital) actors alike to create new stable networks leveraging the resources they had access to [11]. Because an ANT analysis focuses on the relationships between actors, it allows for an investigation into how networks arise, how they move, how new actors join, how a new actor (such as an online school at home) affects the whole network and how networks achieve temporary stability. We lay out next our methods and findings that we subsequently analyze using an ANT framing.

3 Method

Interested as we were in studying family interactions during the COVID-19 pandemic, we chose to use an ethnographic approach that would allow us to build "thick" descriptions of the social phenomena we were studying and of the people, places, actions, and reactions involved in answering our research questions. We conducted our study from March–May 2021 with seven families in Batu, East Java, Indonesia. The families had to meet several criteria. They had to have children in grades 1–3 of elementary school, at which they required higher parental assistance while attending school. The second criterion was that both parents held jobs and were willing to be interviewed during the pandemic. We included both families whose children attended public school and those who went to private school since we wanted to understand how the economic condition of families (as reflected by their decisions to send their children to subsidized public schools or expensive private schools) affected their domestic division of labor, and also wanted to understand the varied ways in which different schools implemented online schooling itself. According to Hill and Taylor, poverty becomes a barrier in the form of parental involvement, with parents' work schedules, difficulty accessing digital infrastructure, and the lack of caregivers to support parents getting in the way [20]. Evidence from the pandemic, more specifically, indicates that the closure of schools made it difficult for children of low-income households to access online education [2].

These families could not provide good resources for children or assist them in their studies, resulting in these children not accessing good education compared to children from high-income households. The Principals of schools helped find respondents using these criteria and reached out to them. Seven of the families approached agreed to take part in this study. They all had children in grades 1–3 (elementary school). Appendix A provides a breakdown of these families and their members.

This research was conducted using observation, interviews, and diary studies while following all the region's COVID-related safety protocols. The interview was the first

stage of this research. These interviews were conducted by the first author in Bahasa at the families' homes at a time convenient to the respondents. Finally, seven mothers, three fathers, and ten children agreed to be interviewed. These interviews were semi-structured, followed a rough interview guide with questions concerning family activities before and after the pandemic, related to paid work, housework, and parental involvement in school, and were conducted after obtaining verbal informed consent. Interviewing one family took 2–4 h, depending on the number of family members. For the children, methods were somewhat different in order to keep them engaged: in addition to an interview, this included drawing a daily clock to explain their activities and a house map to show the location of these activities (Annexure 1).

In addition to interviews, the first author spent time observing family activities. To capture details that the family might have forgotten to mention during the interview. Observations also helped us understand a family's daily activities and build a more complete contextual picture. We also asked three families to maintain study diaries to understand the family's activities in a 24-h cycle. This allowed us to access family time usage data and learn about family activities throughout the day [1]. The character families can be seen in Annexure 2. The data collected through interviews and observation was translated by the first author and iteratively analysed collaboratively by both authors.

4 Findings

This study explores the impact of online schooling on parental involvement and division of household chores. Parental involvement has increased while household chores have become more demanding during COVID-19. A family with a seven-year-old child, Mischa, is used to illustrate the shift in task allocation. Gendered patterns persist in parental involvement and household work. We then summarize how all aspects of these shifts remain gendered before moving on to discussing these findings using an ANT lens.

4.1 Parenting Involvement in Online Schooling

The shift to online schooling required greater parental involvement than before COVID-19. Inspired by Borup et al. (2014), Table 1 categorizes parental involvement in schooling into three categories and summarizes changes to each before and during online schooling: nurturing and organizing (which includes the provision of fees and infrastructure to support schooling and scheduling schooling-related activities); communicating with teachers; and learning and mentoring (which pertain to accessing and using the course material) [41]. As face-to-face education moved online, it demanded many changes along all these dimensions of involvement. For one, parents had to provide digital devices, internet connectivity and space for children to attend online classes. Furthermore, since they acted as intermediaries between teachers and their children, they needed to be adept at using digital devices and learning applications to provide an adequate environment. Given the dynamic situation, schools themselves made frequent changes to their schedules, and how they communicated with parents about assignment submissions and classes. This was also something that parents now needed to keep up with, including picking up and dropping off assignments in many cases where online submissions were not possible.

Some of these shifts depended on the type of school that the children attended. Thus, private schools used not only WhatsApp groups (WAG) to communicate with students and parents, but also other applications such as Telegram, Google Classroom or direct delivery based on students' preferences. In addition, because parents in private schools had better finances and education, they could access and master new educational applications faster. At the other end, public schools discontinued their trial with online class meetings after facing several obstacles, ranging from the unavailability of affordable internet packages that could support the demands of online classes and the difficulties of using different software applications to the absence of smartphones which became the main problem in scheduling classes at times that would work for students' families. These challenges caused teachers to switch to WAG for task distribution.

Table 1. Parental Involvement in schooling before and during COVID-19

Activity	Before	During
Nurturing and organising	1. Parents paid tuition 2. Parents provided supplies and snacks while at school 3. Parents procured learning materials: • Textbooks • Stationery • Notebook 4. Mothers ensured children arrived at school on time, made sure they took part in extracurricular activities, reminded them to do their homework etc 5. Mothers dropped and picked up children from school	1. Parents paid tuition 2. Parents arranged space at home for online schools 3. Parents also had to arrange for • Exclusive use of digital devices during online school hours • Use of messaging and conferencing apps • Internet connection and data quota for daily online meetings, uploading assignments on google classroom, and messaging teachers 4. Parents (mostly mothers) delivered and picked up the completed worksheets (in public schools)
Communication	1. Teachers and students communicated directly at school about lessons and assignments 2. Teachers and parents (mostly mothers) had a WAG for announcements on report cards, meetings, activities, or money collection	1. Increased communication between parents (mostly mothers) and teachers on WA, Telegram, and Google Classroom to deliver assignments, lessons and teaching; and to resolve difficulties in accessing any of these 2. In addition, in public schools, mothers also communicated directly when collecting/submitting worksheets at school
Learning and mentoring	1. Parents left the children's mastering of course material entirely to the teacher	1. Parents (mostly mothers) had to learn subject matter (using Google) to accompany and teach children during online schooling 2. Parents had to learn how to use messaging and classroom apps (with support from teachers in private schools and without in public schools)

We found that these shifts in parental involvement because of online schooling had different implications for fathers and mothers, with mothers taking up a lot of the additional burden. For instance, as existing WAGs started being used for additional functions such as delivering assignments, conveying the day's lesson links, collecting assignments, or ensuring that learning was going well, mothers told us they had to actively monitor these groups before online school to get a link to the meeting. Some of them also faced difficulties in using new applications. Moreover, when this happened, rather than asking their spouses for help, mothers preferred to seek the guidance of teachers (who guided them using a screen recording or video which they then sent via the WAG).

There were several reasons for this asymmetric burden that left women responsible for the three main categories of parental involvement in schooling. The consequences of these added responsibilities, too, varied. In general, mothers crafted several strategies to ensure their children could participate in online education despite individual and family-level constraints. For one, the ownership of digital devices and access to internet connectivity were lower among women than men. We found in our study that some women did not have digital devices they could provide their children to attend online classes. Often, even though the father might have had a smartphone, he would not share that device for online schooling needs. Socio-economic considerations also influenced this gap, with high-income families providing digital devices and unlimited internet access to all their children for online schooling, while mothers from low-income families borrowed money to procure a smartphone or worked out a sharing schedule of smartphone use among their children for their online classes. Where families were simply unable to provide smartphones, paper-based tasks were undertaken and submitted offline. The increased parental involvement in online classes was also strongly associated with technological proficiency. Those with higher education and with better incomes were able quickly learn to use the internet effectively, sometimes through Google. However, low-income families and mothers who had only completed elementary school struggled and found alternative means such as seeking help from teachers or older children to master digital devices. Further, the mothers' mastery of technology also influenced whether schools continued with remote schooling or found alternatives. Here too, there was a difference between how private and public schools dealt with challenges related to the availability of devices, connectivity, and technological know-how. When the student did not have a digital device, the private schools provided an assignment pick-up and drop-off schedule, as one of the mothers, Rina, described: *"Parents of these students came to the school. First, I came. Then, the parents picked up their assignments from school. I made worksheets, assignments to work on for one week. Then on Friday, they returned the work that had been done, take on a new assignment for the next week."*

Where students had digital devices but faced difficulties with their internet connection, the school provided additional time for students. A teacher mentioned such cases: *"They've run out of internet connection. They will chat with WhatsApp first. 'Ma'am, if I don't do my assignment tomorrow, then I don't have credit.' So often. I say, 'Never mind. Submit it later if you want to go to school or when you have an internet connection. Just do it.'"* For students with access to digital devices and stable internet access, teachers supported the use of Google Classroom for parents. *"There are also parents who ask, 'Mom, can we just do Google Classroom?'. However, the school has very*

limited resources for teachers. So in one batch, there are 2 classes, A and B. We will combine them. Like for my session, of a total of two classes and fifty-six children. Twenty children can access it on Google Classroom. For the other thirty, we also share via WA." Using Google Classroom as a real-time learning tool made it easier for mothers as Susi outlined: "*I also accompany them so I can listen to the teacher's explanation. So later I can teach the children if they don't understand."*

Unlike private schools, public schools tried an online meeting for 1 h for students. These meetings lasted for two weeks and were then stopped without any explanation to the parents. The teacher conveyed how difficult it was to build an online meeting education system in the public-school context where many children neither had their own digital devices to use, nor could they access their parents' devices because their parents took their digital devices to work outside the home. Sometimes, teachers held meetings at 10 p.m. because it was only then that parents and digital devices were available. The lack of a stable internet access was another big obstacle to online meetings: online meetings required a stable internet connection and digital devices that support these connections also cost much more than what families with limited economic means could afford. For all these reasons, public school teachers decided to stop online meetings and change the education system to suit the family conditions of their students better. They created a paper-based education system using Student Worksheets (LKS), communication and work orders on WAG. They provided instructions for assignments on WAG, and made it possible for students to submit their assignments physically at the school premises. According to Yogi, a public-school teacher, this system was the most suitable and could be used by all students in the school: "*There are many considerations that we have made; it is difficult to determine the schedule because parents work as traders, farmers, mobile vendors, hotel officers. Parents have to get up early to work out of the house and take their cell phones away. Children cannot carry out online schools."*

Mischa

To illustrate some of the general findings described so far, we use the case of Mischa, a seven-year-old girl (in 2021, when the first author met her.) Her father, Thomas, a high school graduate, worked as a driver at an amusement park in Batu. However, due to the pandemic, Thomas was laid off by his company. Initially, he could earn up to IDR. 2,200,000/month, but now only received IDR. 800,000/month. Seeing Thomas's reduced income and considering their costs, his wife, Sarmi, switched to selling drinks and food at tourist attractions near their home after her laundry business closed due to the pandemic. She worked from around 4 pm till even 11 pm sometimes. She also had to work on holidays because most tourists visited then. By April 2021, Sarmi was earning up to IDR. 800,000/month.

Mischa was the youngest child in her family in the 1st grade of a public elementary school. She had three older sisters: Grace, who was in the 5th grade of elementary school; Hana, who was in the 2nd grade of junior high school; and Agnes, who was in the 2nd grade of high school. Mischa also had an older brother, Gilang, who was 20 years old and worked as a hotel broker. He had graduated from middle school. When the pandemic hit, Mischa started her first class at an online school. Mischa was lucky because her family's house had Wi-Fi access near a government office. Families had been using this Wi-Fi access for a long time, so when families needed to access online schools, they had no

trouble connecting to the internet. However, although there were five smartphones in Mischa's house, belonging to Mischa's father, her brother, and three to her sisters, no smartphone could be used for her online schooling. The most significant cause was the low memory and older models of most smartphones in the house, making it very difficult to access online meetings. Mischa could have used her father's smartphone for school, but Grace said, "Father is afraid his boss will call him for work, so we cannot use it for online schooling."

Therefore, Sarmi tried to buy a smartphone for Agnes. Thomas had a friend at a smartphone kiosk, and she had bought the phone from him on credit. However, this meant they had to pay eight installments in addition to the down payment. Sarmi borrowed money from neighbors to pay off the down payment and smartphone installments. This phone was now the main device for the family to attend online school. The eldest sister, Agnes, kept this new smartphone; every time there was an online school meeting, Agnes would hand this phone over to her younger siblings. Also, because Sarmi did not have a smartphone, she borrowed Agnes's smartphone to communicate with Mischa's teacher because it had the parent-teacher WAG.

Sarmi had a weekly cycle to organize Mischa's educational activities. Every Monday, she would pick up the LKS provided by the teacher. This worksheet contains assignments for one week. The teacher would send daily instructions via the WAG at different times, sometimes in the morning, on other days in the afternoon, or even at night. Upon receiving the assignment, Sarmi would read the instructions from the WAG message and ask Mischa to follow them. Sarmi said that Mischa did not always do her homework every day; it depended on Mischa's mood and Sarmi's time availability to help her complete the assignment. Most often, Mischa did her homework one day before the weekly submission deadline. Then, every Friday, Sarmi would collect all daily assignments from the week and drop them off at school. Between Friday and Sunday, teachers would assess their students' schoolwork. Other families also did something similar to enable schoolwork by their children.

4.2 Parental Involvement in Household Work

A daily log of Mischa's family (as an example) shows how this intensive involvement in schooling had to take place alongside Sarmi's existing domestic work, which had also increased during the pandemic.

Sarmi wakes up at 06.00 in the morning. She cleans the whole house and cooks food for breakfast: eggs and tofu. Thomas, her husband, has to start work at 8:00.am. Therefore, she must prepare breakfast before he leaves. Thomas gets up by 7 o'clock, and gets ready for work. After Thomas leaves, Sarmi wakes up Hana and Agnes and hurries them to take a shower and get ready to attend online school. In addition to the weekly organisation for Mischa and Grace's school, Sarmi also had to oversee Hana's school which took place daily on Google Meet. For this, they relied on the internet network from the government buildings not far from their home. Ananta, Hana's neighbor, and school friend, would also study online at Hana's house because they could get free internet access. Meanwhile, Agnes also relied on the same internet access to do her internship (Fig. 1). *In a different room, Sarmi dried clothes that had not been dried in a long time. She said: "Last night I worked late, now I have time to dry clothes."*

Fig. 1. Hana (centre) and Ananta (left) are doing online school while Agnes (right) is studying

When I asked how the housework she was doing at the moment was going, Sarmi said: "In the past, after taking the kids to school, I did all the housework. After that, I could take a break. Then, at 2 pm, they just got home. Currently, school is online; all the children are at home. I preferred it when they were in school and doing in-person learning. I had my own time that way; I'm now bored with all the kids in the house. I do everything. Tired."

Sarmi's log shows how she continued to play a big role in both online schooling and housework. The results of the diary study in Fig. 2 also support this finding (as do our findings from diaries maintained by other families and conversations with them). Figure 2 shows that Sarmi's role in unpaid work was increasing. Also, the amount of domestic work done by the father, Thomas, did not match how much Sarmi did.
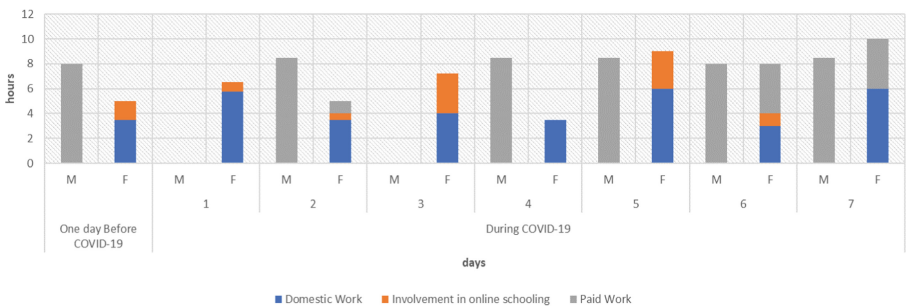
Fig. 2. Comparison of time spent on involvement in online school, domestic work, and paid work by men (M) and women (F) in Mischa's family

Findings from other families illuminate other dimensions of this asymmetry. Even in cases where the father was unemployed during the pandemic and the mother was the breadwinner, the father did not take over the domestic work. As a civil servant, Gina (34, f) had an income that was not affected by the pandemic, while Supratman (32, m), Gina's husband, was fired because the restaurant where he worked was closed.

But Gina continued to play the bigger role in her children's education. *"I must send my child's assignments and study materials to the school. So, I have to divide my time.*

Because I'm a working woman, I also have to carry out my duties as a mother. So, I still have to spend time teaching my son after work."

Case after case illustrated that even where fathers had more time at home, mothers still had to play the bigger role in domestic work. Where they had the resources, mothers used external assistance (from their family networks or paid help) to help them in domestic work rather than asking fathers to get involved. Elvira (42, f), a teacher, and mother of 3 children gave her example:

"My husband works from home and I have to go to school from 8 am-2 pm, but I still have to teach my daughter after school. He is busy working sometimes late into the night. So I call my mother to help cook and take care of the house while I am still at school. Sometimes the domestic worker comes every 2 or 3 days. In the past, she came every day, but now we reduce visits because we are afraid of COVID-19."

Assistance with household work depended on the socio-economic conditions of the family. Elvira came from a middle-income family. Thus, she was able to pay for domestic help. On the other hand, families with lower incomes had to find other ways to cope. In low-income families with many children, mothers would share household responsibilities with older children, including educating younger children. Girls in such households also had more household duties compared to boys. Sarmi says:

"Honestly, when I teach Mischa, I often get annoyed because she is so slow. So usually, the one who teaches her is Agnes or Hana. If she is with her sister, she is afraid the sister will be strict with her."

These families also adopted other ways if they could not share responsibilities with their children. For example, mothers sometimes prioritized the more pressing of their roles when facing a time crunch. So, sometimes the child would be allowed to play and not do an educational task that the mother would have had to supervise, when the mother had other tasks to complete at that time. For instance, Sarmi recollected how:

"Misha's teacher has given her assignments since last week. Mischa is still too lazy to do her assignments, I am also still busy with others. So when the teacher reminds us, we will do it later."

4.3   Gendered Division of Work

Thus, division of labor in our respondents' homes – in online schooling and beyond -- continued to burden women more. Moreover, the way our respondents (male and female) explained it, appeared to resonate closely with the values of *Masak, Macak, Manak* described earlier.

The last value -- and the most significant one for the purposes of this paper -- is *Manak,* which is associated with nurturing one's children. Our diary studies showed that even where mothers had experienced an increase in paid working hours of up to 4 h during the pandemic, they continued to feel it was largely their responsibility to ensure that their children's education remained unaffected (as inferred from the value

of *Manak*). This meant women had to undertake additional work to achieve these goals during the pandemic -, and the quantum of work associated with this was different based on their socioeconomic condition as described in Table 1. Families with better incomes had chosen to send their children to attend private schools and these provided online classes using Zoom or Google Meet during the pandemic as described earlier.

"I chose a private school because the education is good for my children. Currently, schools will carry out online activities using Google Meet for one hour. Teachers can give assignments and discuss learning materials," said Susi.[3]

However, families who sent their children to public schools faced many difficulties as we saw, with mothers taking on new assignments according to a predetermined schedule. Mothers played a more important role in this education because all teaching responsibilities were assigned to them, as experienced by Sarmi, Mischa's mother. Thus, mothers continued to carry out the *manak* function even after the increased burden of online schooling. Thomas meanwhile reasoned:

"Well, I'm the one who makes a living. So, my job is just to make a living and the mother bears the other tasks such as teaching the children, playing with the children, taking care of the house."

5   Discussion and Conclusion

This study aimed to understand how deeply gendered values within families and their economic realities shaped how mothers negotiated their involvement in children's online schooling in contemporary Batu. We use an Actor-Network lens to understand how mothers accomplished some stability in these tumultuous times. An advantage of using this approach at a time of change is that even interconnections and networks hidden in "normal" situations are laid bare in such transition periods. Second, because ANT treats the formation and temporary stabilization of new networks as an accomplishment rather than as routine, it allows us to highlight the labor that goes into making "stability" happen - this is especially significant in the context of women's unpaid labor which has long been rendered invisible. We bring to this approach the role of ideology (in this case, around the gendered involvement in children's schooling and household work) in how networks are configured in times of change.

When online schooling was introduced by schools in Batu during the pandemic, families had to craft new strategies. The teacher-student interaction at the heart of conventional schooling was in person, with parents interacting with teachers on specific occasions such as parent meetings, the distribution of report cards, and school outings. The entry of online schools meant families (largely led by mothers) had to change the form of this actor-network for schooling. School entered the physical space of the home, and information technology became an actor that had to be used. Younger children

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[3] The pandemic was challenging for Susi's family. At the pandemic's beginning, Ridho, Susi's husband, had a nervous breakdown. As a result, the family had to stop using cars because only Ridho could drive a car. In the end, Susi had to open a kiosk and sell her wares. However, she earned very little, and the family had to sell its car to make ends meet during the pandemic. Ridho often complained about the difficulty of even getting food for them.

(grades 1–3 in elementary school), especially, needed assistance from their parents to use this technology for school. For the parents, this was an addition to the family's other unpaid work. How did mothers reconfigure their actor-networks to cope with the asymmetric burden of household work they carried, including their involvement in online schooling?

At the home front, they encouraged various actors to get involved to ensure a more stable family network around unpaid household work, now including schooling-related activities. Those who were economically able sought assistance from paid domestic help. They also made available digital devices and connectivity by paying for it. Families that did not have the economic means relied on extended family (their mothers or in-laws, for instance). Elder children were also prevailed upon to help in various ways - with household work (if girls) and with their devices and technology skills to help their younger siblings' online school. Mothers also came up with other strategies, such as creating a sharing schedule for the phone so that children could attend online school. Other technological resources - such as an available public Wi-Fi network - were also pulled in to achieve stability.

Public schools and their teachers also adjusted their modalities (such as switching to assignment drop-offs and WAGs for communication) to make schooling during the pandemic more feasible. Regardless of their income levels, we found that mothers maintained the link with teachers to keep their children's schooling going daily. Moreover, mothers relied on teachers (rather than their spouses) as crucial supporting actors when they had difficulty using information technology. The father's role in achieving online schooling appeared minimal, even where he possessed a smartphone or a higher digital literacy than the mother. The father became the last resort, reaching out to ensure the stability of the family network only when no other option was available. More broadly, it was mothers who felt and were held responsible for their children's education, including the establishment and maintenance of these actor-networks that made it possible. Throughout, we found that the division of work around organizing for school (some of which spilt over into an increased volume of existing household chores such as cooking and cleaning) during the pandemic, was influenced by a gendered ideology around the division of household work (rather than by other factors such as who was doing more paid work or bringing in a higher income).

While individual mothers managed to create temporarily stable networks that allowed them to cope with the additional burdens brought on by online schooling, we recommend that longer-term structural changes are required to make it easier for women to accomplish these networks and their durability. While individual schools and teachers were already focused on reducing the burden on parents, broader education and schooling policy should tailor these strategies considering the mother who bears the burden. Additionally, there is a need for more in-depth policy analysis related to women's digital literacy and their access to connectivity. More accessible childcare services would be crucial in reducing the excessive burden on women at moments like this. Finally, since a gendered ideology underpinned every aspect of the maintenance of these networks, campaigns to bring about attitudinal shifts and enable conversations around household division of labour are essential to truly change the asymmetric burden of mothers in times of peace and crisis alike.

Annexure 1
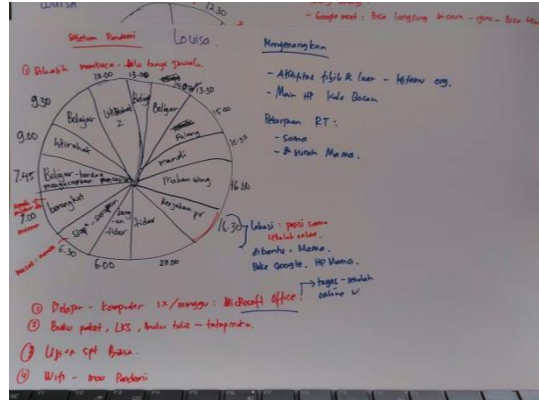
Olivia's Daily Clock

Annexure 2

Table of Respondent

Family members		Relationship	School	Job
Mischa	Sarmi	Mother		Food seller
	Thomas	Father		Driver
	Gilang	1st Son		hotel broker
	Agnes	1st daughter	Public	student
	Hana	2nd daughter	Private	student
	Grace	3rd daughter	Public	student
	Mischa	4th daughter	Public	student
Jio	Susi	Mother		Kiosk seller
	Ridho	Father		
	Aza	1st Daughter	Private	student
	Jio	2nd Son	Private	student
Olivia	Rina	Mother		Private School Teacher

(*continued*)

Family members		Relationship	School	Job
	John	Father		car/motorcycle repair worker
	Jevon	Son	Private	student
	Olivia	daughter	Private	student
Atta	Nina	Mother		Food seller
	Baro	Father		Food seller
	Atta	Son	Public	student
	Aro	Son	Public	student
Ipah	Sela	Mother		Village treasure and Villa caretaker
	Opik	Father		Hotel employee
	Ipah	Daughter	Public	student
Aloysius	Gina	Mother		Civil servant
	Supratman	Father		Cook
	Aloysius	Son	Public	student
Juni	Elvira	Mother		Public School Teacher
	Ari	Father		Private sector worker
	Juni	daughter	Private	student

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Empowering Children for Social Justice–Design Research in the Context of Children's Computing Education

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Abstract. In the contemporary digitalized society, it is pivotal to provide children with skills to ideate, design and develop digital technology and to critically reflect on it and its consequences. In the current world full of crises, it is also crucial to make visible for children that digital technology is never value-free and that it can be used for making the world a better place but also for discrimination, marginalization, and oppression. Information Systems (IS) scholars have not addressed these topics with children, while IS as a discipline would provide very suitable expertise for this. We, inspired by frameworks on empowerment and social justice, have invited children to tackle a wicked societal problem of bullying through design of digital technology as part of their computing education, and while doing so, aimed at empowering children to empower those suffering from bullying, i.e., advocating social justice. In this design research study, we analyze and showcase our empowering design process and outcomes. We contribute to IS literature by offering insights on how IS research can contribute to children's empowerment and social justice oriented computing education. These insights serve also IS researchers working with adults and pursuing social justice and empowerment agendas.

Keywords: Children · Empowerment · Social Justice · Computing Education

1 Introduction

There is an increasing pressure set for the computing education of children of today: such education should not only equip children with skills and competences to make meaningful use of digital technologies, but such education should encourage children to start shaping and making such technologies as well as approaching them critically (e.g., [1–10]). Overall, children should be educated to make informed decisions on digital technologies concerning their future everyday life and society [1].

Information Systems (IS) literature has remained quite silent about this important topic. There are few IS studies highlighting children as an important user group [11–13]

and few studies arguing we should consider also children's computing education, not only that of adults [14–16]. Some IS studies have concentrated on student marketing and recruitment for senior highschoolers, addressing their computing education (e.g.[16, 17])– but even these studies are rare as IS education is oftentimes targeting students already in higher education in their marketing and recruitment efforts [16, 17]. We argue that IS research should direct its gaze towards children. Overall, we feel there is a lot IS research could offer to children's computing education.

Among such issues is the critical research tradition and the critical approach towards societal consequences of digital technology. Those are becoming ever more significant, also for the younger generation and their computing education. We are currently living in a turbulent world, suffering from crises of several kinds, feeling anxiety regarding our own future as well as the future of humankind and the globe. We feel that addressing these global crises and associated collective anxiety should be on the agenda of computing education, too. Indeed, recent research on children's computing education has started integrating critical and social justice topics into the education [2, 3, 6–10, 18, 19]. This literature base argues that children should be empowered to address important societal problems relating, e.g., to oppression, inequality, injustice, marginalization or climate change through design of digital technology (for a review, see e.g., [20]). However, currently children's computing education, although being globally developed under the labels, e.g., of Science, Technology, Engineering and Mathematics, computer science, programming, computational thinking, or digital fabrication and making education, remains too technology focused and exclusive [1–10]. IS research, being inspired by the critical research tradition and having a strong background in approaching digital technologies and their consequences critically already for decades (e.g., [21–24]), offers interesting avenues for cross-fertilizing the emerging stream of research on children's critical and social justice oriented computing education.

We have experimented with children's computing education that critically addresses important societal problems through design of digital technology, contributing to the currently very limited knowledge base on children's computing education of this type. Particularly we have addressed together with children the problem of bullying, which is a wicked–serious, complex, and extremely difficult to solve–problem of the current society [25, 26]. Bullying refers to aggressive behavior deliberately and repeatedly causing harm to a peer by someone in a more powerful position [25]. In this study we report on a project in which we, inspired by the frameworks on empowerment and social justice, have invited children to tackle bullying and while doing so, aimed at empowering children to empower those suffering from bullying, i.e., we have invited children to advocate social justice. As our research question we ask: How can critical perspectives, particularly on empowerment and social justice, be introduced into children's computing education curriculum? For answering the question, we will scrutinize the design process and its design outcomes from the viewpoint of empowerment. Our design research study contributes to IS literature by offering yet missing but badly needed insights on how IS research can contribute to children's computing education with empowerment and social justice lenses. Our insights serve IS researchers interested in children's computing education but also those working with adults and pursuing social justice and empowerment agendas.

2   Social Justice and Empowerment Lenses

Social justice is a complex concept with many possible interpretations and traditions [18, 19, 27, 28]. Topics such as racism, sexism, and classism are addressed under this umbrella term [27]. A large number of IS studies can implicitly be seen to address the topic, but there are also some studies that explicitly address social justice. These studies have considered how digital technologies contribute to social justice or injustice [28–30] as well as how critical IS research can aim towards social justice [23, 31].

Fraser [32, 33] offers a widely cited framework to approach social justice, utilized also in IS (e.g., [28, 29]). According to her, social justice can be approached from three perspectives: resource redistribution, cultural recognition and political representation. According to her [32, 33] all are needed for social justice to happen. She advocates the norm of participatory parity, relating to which she maintains that social justice "requires social arrangements that permit all (adult) members of society to interact with one another as peers. For participatory parity to be possible, I claim, at least two conditions must be satisfied. First, the distribution of material resources must be such as to ensure participants' independence and "voice." Second, the institutionalized cultural patterns of interpretation and evaluation express equal respect for all participants and ensure equal opportunity for achieving social esteem. Both these conditions are necessary for participatory parity. Neither alone is sufficient." [33] Thus, her view focuses on the economic structure but also on the culturally defined status hierarchies of society. Moreover, she [32] adds political dimension of representation to her theory of justice, underscoring the questions of who are included, who are excluded, who has a voice: "If representation is the defining issue of the political, then the characteristic political injustice is misrepresentation. Misrepresentation occurs when political boundaries and/or decision rules function to wrongly deny some people the possibility of participating on a par with others in social interaction–including, but not only, in political arenas". Fraser [32] discusses misrepresentation and misframing, the former referring to those included being wrongly denied from participation while the latter referring to exclusion of some from participation at all in the contests over justice.

In the case of bullying and children, we interpret bullying as an example of social injustice and see that tackling of it is more of a question of cultural recognition and political representation than redistribution of material resources, at least in our context. We interpret the tackling of bullying to concern "equal respect for all participants and (…) equal opportunity for achieving social esteem" [33]. We also see there are issues relating to the political dimension at play, addressing the boundaries and rules over participation and decision-making: who are included, who are excluded, who are allowed to have voice (see [32]), among children. In our case, we invite children to tackle injustice with the means of design of digital technology.

In our work we derive inspiration from the literature addressing empowerment. In our case, we aim to empower children to empower their peers. Empowerment is a complex concept with many disciplines and traditions, most notably psychology and organizational and management studies, but has also been addressed in IS research (see e.g. [34]). We approach empowerment with three distinctions: mainstream vs. critical, individual vs. collective, and motivational vs. relational (e.g. [34–41]). Considering the

mainstream vs. critical distinction, within the former empowerment is seen to entail giving people some more power of decision for the purpose of motivating them to perform better, while within the latter this view is rejected and it is maintained that empowerment instead necessitates that the oppressed question the oppressing status quo and combat the oppression, in this way liberating themselves as well as the oppressors [34, 36, 37]. In the context of bullying and children, the former view maintains that the bullied should be provided some more power of decision to help to prevent or reduce bullying while the latter view necessitates that the bullied question the state of the affairs and liberate themselves and the bullies from bullying. Considering the individual vs. collective distinction, within the former empowerment is seen to concern only individuals, while within the latter, it is seen to concern entire collectives, empowerment of which and feeling of social responsibility among all are highlighted [37–39]. In the context of bullying and children, the former concentrates only on the bullied and bullies, while the latter sees that entire communities should be involved, approaching bullying as a collective problem requiring collective action taking. Finally, considering the relational vs. motivational distinction, within the former empowerment is seen as power over someone or something [35, 36], while within the latter, empowerment is seen as increased task motivation, which is strengthened by perceived choice, meaningfulness, impact, and self-efficacy [36, 40]. In the context of bullying and children, the former sees that those bullied should gain more power over the bullies, while the latter underscores everyone's increased motivation to prevent or reduce bullying, which is seen to be increased by perceived choice, meaningfulness, impact and self-efficacy.

3   Methods

Methodologically, this study represents design research. In IS, Design Science Research (DSR) has become very popular during the past decades (e.g., [42–45]), DSR in IS research connects heavily with the design science model proposed by Cross [46]. DSR can be characterized by a desire to scientize design [46]. Cross [46], instead, argues for viewing design as a discipline in itself: not trying to fit it into the scientific method, but instead aiming to understand it as a rigorous culture of its own.

Along these lines, this study carries out design research, which aims at changing the world through design [47] and it is about "proliferation of new realities" [48]. Such research generates design artefacts as outcomes, but also knowledge contributions [47, 48], for which characteristic is that the discipline itself is generative: it is changing the context in which it operates [48]. Therefore, the knowledge contributions also need to be seen as generative and suggestive [48]. Valuable is to place the interest on the design artefacts that are capturing and embedding our implicit theories [48].

This design research project has lasted for four years with the goal to explore critical design and critical making together with children. City of Oulu representatives suggested exploring critical design and critical making to tackle the problem of bullying at school. A steering group with representatives from the City of Oulu and youth research (with expertise on educational administration, computing education, antibullying interventions) was established. During the timespan, numerous design research interventions have been carried out with different classes of children and their teachers, ranging from

eight years old children to 15 years old. The steering group suggested the schools to work with. The different interventions have had somewhat different foci over the years as well as many practical factors shaping them. The design research project aimed to explore different approaches for critical design and critical making, due to which the approaches and methods have been changing and evolving over the years. The project aimed at exploring the approaches with different age groups, due to which the practical activities, task assignments and presentations had to be modified to meet the needs of the different age groups. Teachers were significant collaborators in this work. Finally, the project was executed in the middle of the pandemic, which heavily influenced how the work was carried out with different groups of children.

This analysis focuses on three interventions, in which participants envisioned future technological solutions to prevent or reduce bullying at school. In interventions A and B, the participants, relying on design fiction [49] and theater of the oppressed approach [50], created low-fi prototypes of their imagined solutions that they incorporated into theater performances to showcase their use and impact for their school community, while in intervention C the participants, relying on design activism approach [51] and building on the design ideas of the previous interventions to advocate for genuine impact for the children's design in the realm of digital technology development [52], conducted activism campaigns to raise awareness about the issues of bullying and the impact of their proposed solutions in their school community. Intervention A was conducted with a 2nd grade class in Fall 2020, intervention B with a 6th grade class in the academic year 2020–2021, and intervention C with a 7th grade class in Spring 2022. Before the study, information about the research, as well as research consent and assent forms were distributed to the students and their guardians. All students took part in the sessions as part of their schoolwork, but research data was only included from the students who had parental consent and gave their assent to research. Participant information is presented in Table 1.

Table 1. Participant information (data shown from those we had consent)

	Grade level	Number of participants	Age of participants	Number of sessions
A	Second	25	7–9	18–45 min
B	Sixth	23	11–13	10–90 min
C	Seventh	38	13–15	6–45 min

The data collected from the interventions includes various kinds of participant generated ideation, design, prototyping and evaluation data as well as pre- and post-interviews or questionnaires. The data also includes video recording of specific sessions as well as different kinds of process data (field notes, photos, memos, project management data). The first four authors took the main responsibility for the data analysis. The analysis process was iterative and required a lot of discussion and negotiation among the analysts. The analysis entailed critically scrutinizing the design artefacts generated during this design research project by adult researchers and participating children. We focused on design artefacts addressing the design process and the design outcomes: for the former,

we examined the methodological material created by us for guiding the design process, while for the latter, we inquired the prototypes created by the children. We acknowledged that various theories have been embedded in and are underlying and shaping these design artefacts, but more strongly those created by us, researchers, than those created by children. First, we analyzed our design process, which entailed a lot of local variation, but also a set of general features, and abstracted an outline of the design process. Afterwards, we explicated the theories on empowerment underlying the design process. The next section presents the various empowerment theories embedded within our design process. Thereafter, we paid attention to the design outcomes, while in this case instead of abstracting a general outline or locating the most representative cases, we intentionally searched for variety within: we identified children's prototypes that showcase different empowerment theories as featuring in them.

4   Research Ethics

Considering that the project centers around the delicate matter of bullying, which can result in significant and enduring psychological consequences for those involved, we approached this subject matter with great care. This was particularly important when dealing with children. In order to maintain the utmost ethical integrity, we fostered a close partnership with the teachers. Prior to activities with the students, we engaged in an interview with their teacher. This interview encompassed various subjects, including the topic of bullying within the class and the teacher's and school's established protocols and strategies for addressing bullying. The interview served to confirm that the class did not have significant problems with bullying and that the school had effective procedures in place to address bullying incidents when they did occur. In addition, we collaborated with the teacher prior to every activity to ascertain their suitability for the students. Following each session, we held discussions with the teacher to collect their input. Throughout all activities, the teacher was actively involved in offering guidance and support. Lastly, the teacher prearranged groups in a way that balanced the students' strengths, thereby reducing the potential for discrimination or bullying. Throughout the project, we maintained a keen awareness of the power dynamics within the classroom and took deliberate actions to ensure that participation was fair and just. We were committed to never pressuring children to share their thoughts and we stressed the importance of grounding the outcomes in imagination rather than reality.

5   Design Process

Figure 1 summarizes our design process from the viewpoint of empowerment theories integrated into it, aiming at empowering children in relation to 1) bullying and 2) design of digital technology, to strive for social justice.

We maintain that all the empowerment theories identified in the literature are featuring in the design process. We started by sensitizing the children with the problem of bullying (with scenario and persona creation and letter writing) and with the design of digital technology (with start interviews/questionnaires, creative reflection tasks on own
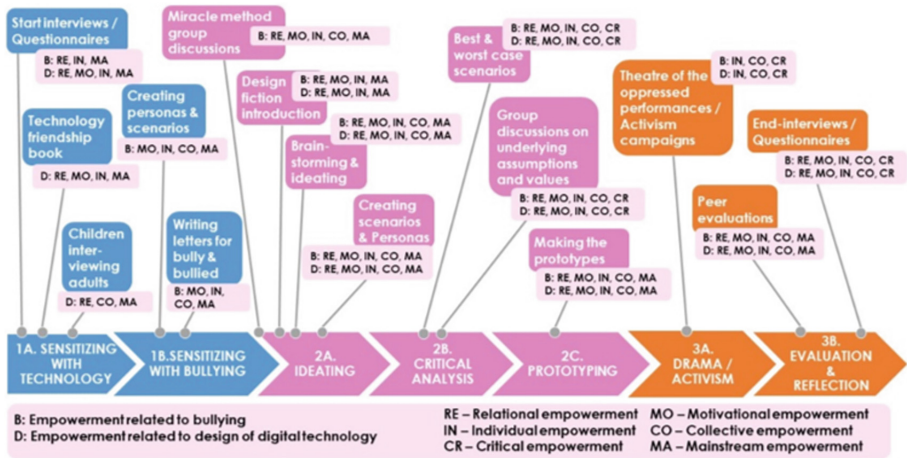
Fig. 1. Empowerment theories embedded in the design process.

relationship with digital technology and its design): making those visible for the children and inquiring their stances towards them, including their associated motivation and skills. We tried to make visible early on that children can make a difference regarding both bullying and digital technology (**relational empowerment**): they do not have to be accepted as they are, but instead one can take action and influence them. We also aimed at motivating children to work against bullying as well as at utilizing design of digital technology in that quest (**motivational empowerment**): the sensitizing tasks relating to bullying aimed at building empathy to motivate the children. The design process also aimed at developing children's competences as well as integrated choice and impact–we left many aspects open for children to decide and have an impact on.

We started by approaching the children as individuals (**individual empowerment**), but we soon introduced the idea of bullying as a collective problem through miracle method discussion on a world where a miracle had happened, and bullying had disappeared–addressing it from the perspective of different stakeholders. We asked the children to consider both bullying (with personas, scenarios and letter writing) and digital technology (with interview of an adult) from other persons' perspective, to design for solutions that address bullying as a collective problem (with brainstorming, design fiction, persona and scenario creation, prototyping), to evaluate those designs from other persons' perspectives (with peer evaluation) as well as to try to mobilize their broader school community for action taking against bullying (with theater of the oppressed performances, activism campaigns) (**collective empowerment**).

In the beginning, we approached empowerment in quite a mainstream sense: giving children some more power of decision regarding design of digital technology and tackling of bullying and motivating them for better performance (**mainstream empowerment**), while during the process we integrated critical concerns more and more strongly into the process: already during the sensitizing phase with personas, scenarios and letter writing, we invited children to critically analyze the status quo from the viewpoint of the bullying

problem and the bullied suffering from oppression. Later on, we encouraged the children to critically analyze their own designs from the viewpoint of best- and worst-case consequences, values and underlying assumptions. Thereafter, we asked the children to build theater of the oppressed performances or activism campaigns to mobilize broader collectives to tackle the oppression and to strive towards social justice. In the end interviews/questionnaires, we also asked children to critically evaluate and reflect on both the process and the outcomes, explicitly also discussing the goal of empowerment of the oppressed with them (**critical empowerment**).

6 Design Outcomes

The children's design outcomes are shown in Fig. 2.

Fig. 2. Empowerment theories embedded in the design outcomes.

A *super-girl to super-truck* (SGST) transformer was envisioned by a group of 2nd graders. The super-truck form of the design enables the super-girl to reach the bullying situation to address bullying as and when it occurs - by intervening and making the bully apologize using mind-control. The fidget spinner aids the super-girl in mind control, while the fire blades enable the super-truck to travel faster. This act of stopping the bullies and making them apologize includes the forms of **individual** and **relational empowerment** where the power dynamics between the bully and the bullied is changed and there is increased power over the bully, who is made to apologize. In this case the power is held by technology. This prototype also indicates a bit towards **critical empowerment** in the sense of questioning and combatting the oppressing status quo in the sense of mindset of the bully. However, we acknowledge that the idea of mind control poses many ethical challenges that do not align with the critical empowerment ideals.

The *PFB (Prevention for Bullying) robot* was designed by a group of 2nd graders. The robot is a friendly figure for preventing bullying (in the future) by motivating the bully

to change through reflection and discussions, asking them why they bully. We interpret the forms of **individual** and **motivational empowerment** to feature in this prototype: the bully is motivated to stop bullying, addressing the underlying issues through critical reflection, and to become friends with the person who was being bullied. Motivating the bully to change and become friendly can also be seen as a form of **critical empowerment** in the sense of radically changing the current state of affairs, more specifically the mindset of the bullies. In the actual bullying situation, the robot distracts the bully, moving their attention to the robot from the person being bullied to stop the bullying, another way **motivational empowerment** featuring in the design. The automated monitoring system to detect bullying enables the robot to arrive at the bullying scene, without human effort, to address the situation.

Magic headband was ideated by a 6th graders group. Magic headband's main idea was to change the world to a better place for us all by making bullying disappear, which can be seen to represent forms of **collective** and **critical empowerment**. The headband detects bullying, racism, and other kind of discrimination nearby and affects people's minds by changing bullies into nice people. The idea raises the same ethical questions than the first one. This idea clearly features **collective empowerment** as well: it is not concentrated on individuals but creates a positive atmosphere for all.

A tiger warrior robot was ideated by 6th graders. A tiger warrior robot monitors the school with its camera eyes, thus providing **collective empowerment** for the whole school community. It detects verbal bullying and sets punishments, but also rewards for good behaviour. We interpret that the idea engenders **relational empowerment** as it intervenes in bullying events and punishes the bullies, i.e., it introduces power over the bullies, while the punishment is seen to benefit the collective. In addition, the idea contains features of **motivational empowerment** by rewarding those who behave well.

BullyCounter mobile app was created by a group of 7th graders. Bullycounter can be seen to focus on **collective empowerment:** the users are children from all over the world who struggle with bullying and who can use the application to share their experiences and advice, helping each other out. The app can also be seen to include **individual empowerment:** while sharing experiences with others, children also receive help and insights to improve their own situation. If they require more help to solve the situation, they can choose to contact an adult. In addition, there are resources for self-help for those not comfortable discussing their situation on the platform–There they can find e.g., age-appropriate informational resources and helpline numbers. Users can also post to Bullycounter to raise awareness about the problem of bullying in general, which can be seen as a form of **critical empowerment.** The functionality to shame those who have been bullying others entails **relational empowerment** to those that have been affected by bullying, over the bullies.

7   Concluding Discussion

We reported on a design research project that engaged children to tackle a wicked societal problem of bullying through design of digital technology, inspired by theories on empowerment and social justice. IS research has so far remained ignorant of children's computing education, while having very suitable expertise to be utilized in that, especially in such that is having critical, empowerment and social justice orientation.

In this study, we analyzed and presented our design process and design outcomes with children, revealing how we–adult researchers and participating children–have integrated a variety of empowerment theories into the process and the outcomes. We pointed out that empowerment is a complex concept with multiple traditions and definitions. Through our analysis, we illustrated there are multiple ways by which one may address empowerment as part of the design process and design outcomes. We also pointed out that not all these ways are equally desirable. We underscore the value of collective and critical forms of empowerment (see [34, 36–39]), but we acknowledged all forms of empowerment featuring in the process and outcomes.

Our study also emphasized that social justice can be approached from multiple angles. Our empirical analysis did not yield equally rich insights into how social justice was embedded into and featuring in the design process and outcomes, while social justice acted as an important goal driving the entire project, particularly approached from the viewpoints of cultural recognition and political representation [32, 33]. The children's prototype descriptions were not detailed enough on this matter to decipher in detail which forms of injustice were particularly tackled. Our design process also remained on quite a general level regarding this matter. The design process documentation generated by children when sensitizing with the problem of bullying and their theater performances could provide more insights on this aspect and those will be analyzed in our future studies.

Our insights contribute to IS literature in several ways: we offer insights into how IS research can contribute to children's empowerment and social justice-oriented computing education as well as insights for critical IS research pursuing social justice and empowerment agendas. IS research has been inspired by critical research tradition for ages (see e.g., [21–24]). Adhering to the principles of critical IS research, we utilized concepts from the critical research tradition, were explicit about our value basis as well as asked children to do so and challenged the oppressive status quo and strived towards empowerment of individuals as well as collectives together with children (see [24]). In agreement with the prior IS literature, we have underscored socially responsible design and design research, critical design and design research, and the value of integrating criticality into those (see e.g., [22–24]). Our approach represents a participatory approach instead of an expert driven one (e.g., [22])–we invited local stakeholders, in our case children, to critically scrutinize the oppressing conditions of the status quo and to strive towards radical change.

Our approach enables renewing children's computing education. Even if critical, empowering and justice oriented aspects have already received some attention [1–3, 6–10, 18], these studies represent a small minority in the literature base and are very early attempts to introduce these concerns into children's computing education. Although this analysis mainly explicates the theories embedded in our design artefacts, our analysis also provides some evidence on the value of this work: our analysis showed that the children took the empowerment and social justice concerns seriously and took action for a better, more socially just, world. We already have some empirical evidence that our design process empowered the participating children (reported, e.g., in [49, 53]), indicating there is a lot of value in integrating this type of approach into children's computing education. However, we lack studies on whether the design outcomes are

really empowering other children, even if some empowerment theories were seen as picturing in them. Some of the design outcomes can even be seen as disempowering and even for the potentially empowering ones, future empirical studies are needed to understand whether they are actually empowering children.

As for the applicability of the findings in other contexts, we point out that these results have been gained in a particular country and with particular age groups, with many context specific aspects to be noted, such as the educational system. In different countries with different educational systems or with different age groups, changes may be needed for the approach. This is certainly the case for the individual activities, task assignments and materials used–even we had to modify them for the different age groups. Then again, the basic underlying approach worked well for all age groups. We actually think that this type of computing education approach could work also with adults, when properly modified. We claim that in IS education in universities, there is a lot to be learned from the approach discussed in this study. Critical IS scholars could utilize this approach in their educational activities and develop IS education to be more socially responsible, critical, empowering and justice oriented. This would enable their critical work to have a potentially wide-ranging real-world impact. We think our approach could also be used outside the context of education. IS researchers working with vulnerable or marginalized stakeholders or communities or with topics relating to equality and social justice may benefit from our approach to design and design research. By following our approach, IS researchers could integrate critical research tradition inspired theories into their design research processes as well as invite their participants to rely on those theories in their design.

In addition to the limitations and paths for future work already discussed, there are others worth mentioning. We provided deeper insights into how empowerment theories featured in our design process and design outcomes than into how social justice theories did so. In the future, more in-depth analysis of the design process and outcomes is needed from the social justice perspective. It is also important to note that we identified certain empowerment theories featuring in the design outcomes, but we did not educate children about these theories. Instead, we in different ways nudged them towards acknowledging these theories, while it was a surprise also for us to find such a variety of them in the outcomes. Future research could explore how to discuss these theories more explicitly with children as a basis for their design. We also point out that regarding motivational empowerment, we could have analyzed the different aspects influencing it in more detail; we mostly concentrated on the meaningfulness. We also wish to underscore that as design research is about "proliferation of new realities" and is generative, i.e., changing the context in which it operates, our knowledge contribution is generative and suggestive as well [48]. In this study we have been explicating some theories underlying and embedded in the design process and outcomes [48], while this does not represent a comprehensive account of theories or other drivers shaping the design process and outcomes. Rather, this represents an account that gives a way too neat of a picture of the messy reality involved in this work. Work in schools, with teachers and children in the middle of the pandemic, is a challenging endeavor with many moving parts and changes to the plan. Even without the pandemic, we remind IS researchers to prepare for the unexpected and, if working children, for their excitement and energy as well as for their lack thereof.

In the future we wish to continue exploring and probing this messy reality of 'doing design research' and invite also other IS researchers to do so. Additionally, we invite IS researchers to tackle the crucial topics of empowerment and social justice–by the means of design of digital technology, with children as well as with other stakeholder groups.

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
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Privacy, Trust, and Surveillance

Identity Platforms and Anti-LGBTQ+ Legislation: Implications for Safeguarding Personal Data

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Abstract. Little is known about how digital identity platforms can be managed and operated in countries where governments have introduced anti-LGBTQ+ legislation. This work-in-progress study explores the tensions associated with digital identity platforms in these contexts. It draws on concepts from actor network theory to analyze field data collected by the authors in the Health Information Systems (HISP) research programme around a digital platform (DHIS2) that is installed in 114 countries globally, primarily in the health sector. The study identifies contradictory interests among the human and non-human actors, and analyzes these according to (1) the operation of a digital identity platform in a legally gray area, (2) visibility and invisibilization of vulnerable populations, and (3) human rights vs neo-colonialism. In particular, the paper identifies the potential for enrollment of the identity platform technology from intended into realities of use in identifying LGBTQ+ individuals and groups, identifying risks of data-induced harm and routes to overcoming them.

Keywords: Digital identity · Digital platforms · LGBTQ+ · vulnerable populations · Actor Network Theory

1 Introduction

Digital identity platforms are digital platforms with the ability to convert individuals into machine-readable data [1]. Such systems have a fiduciary responsibility to safeguard personal data for these individuals. Challenges emerge in contexts where the exposure of such data risks the prosecution of individuals based on their sexual orientation or gender identity. Sixty-two countries have anti-LGBTQ+ (lesbian, gay, bisexual, transgender, queer/questioning, other) legislation that criminalizes people who have been identified to engage in same-sex relations. Little is known about how managers of digital identity platforms should respond to this challenge. Academic research is limited in offering

theory-informed knowledge and without this systematic knowledge, it is unclear how an identity platform can and should be managed in this context. This creates the risk of ad-hoc decision-making based on misconceptions about the concerns of members of the LGBTQ+ communities. To address this gap, our study is guided by the following research question:

RQ: How can digital identity platforms be managed where the exposure of the identity data could potentially be used to prosecute LGBTQ+ people?

To approach this question, this work-in-progress draws on actor-network theory (ANT) [2] to unpack the human and non-human stakeholders' interests in a case study and the potential for enrollment of the identity platform technology into alternative actor networks. Our empirical focus is on the Health Information Systems (HISP) research programme around a digital platform (DHIS2) installed as a national health management information system in 114 countries globally, including many of the countries where LGBTQ+ identities are criminalized.

The actor network analysis finds contradictory actor interests and analyzes them around three main areas: (1) operating in a legally gray area, (2) the processes that lead to visibility and invisibilization, and (3) human rights vs neo-colonialism. These issues are framed in opposition as 'digital colonialism', a practice where digital tools are plied to the systematic exploitation of structurally vulnerable populations [3, 4]. The paper presents work in progress towards future work on actor-network analysis of operating digital identity platforms. It seeks to understand the challenges and build systematic knowledge that can be used to develop operating policies and practices for platforms to prepare for and respond to such legislative changes in countries where they operate.

2 Background

2.1 Safeguarding Data

Managers of digital identity platforms have a fiduciary responsibility to safeguard personal data for all people represented within their databases [5]. The exposure of such data can have serious implications for the safety of individuals [6] and legislation mandates that managers maintain secure data practices to mitigate the risk of data breaches [7]. Little is known, however, about the management of extraordinary situations when governments demand data relating to people who are breaking the law. In the past decade, there has been an increase worldwide in government demands for access to data held by the private sector, a practice referred to as systematic government access [8]. The legal obligation to adhere to the law of the land, however, does not always synchronize with the moral obligation, and circumstances where laws are deemed to be unethical present challenges for ethical practices for digital identity platforms [9], as is the case where a country enacts anti-LGBTQ+ legislation.

2.2 Anti-LGBTQ+ Legislation Worldwide

Sixty-two countries have legislation in place that criminalize the lives of LGBTQ+ people [10], and there are many cases where LGBTQ+ people in these countries have

been convicted for engaging in same-sex relations. Gay couples have been arrested and imprisoned in many countries where the DHIS2 platform is utilized for national health surveillance [11–14]. Such anti-LGBTQ+ legislation has been widely condemned by the international community as a violation of human rights [15] which is 'contrary to … commitments on dignity and non-discrimination, and the prohibition of cruel, inhuman or degrading punishment' [16]. Such challenges point to hotly debated topics on the universality of human rights, particularly LGBTQ+ rights, with division ranging from the portrayal of such rights 'carrying hopes for freedom' and an aspiration for global connections, to the portrayal of them as 'a frightening new force of global coercion' [17]. Challenges around anti-LGBTQ+ laws have serious implications for organizations involved in the development and use of digital identity platforms for collecting, storing, and sharing personally identifiable data. While the security measures around data handling typically ensure that personal data does not fall into the wrong hands [7], in the countries that criminalize LGBTQ+ lives, the legislation dictates that they must be identified, and criminal proceedings be brought against them. The enforcement of such laws requires evidence to prove that an individual is engaging in these criminalized acts. Digital identity data and health data are potential sources of such evidence. Routine health data can potentially be used to infer whether a person is a member of the LGBTQ+ communities based on their behavior and practices. Such data can be derived from health records, from population census data, and from public health surveillance [18]. This creates a difficult management problem for digital platform designers and operators.

3   Theoretical Framework

Actor-network theory, or ANT [2] is a suitable frame for our inquiry because technology is viewed as much a product of social construction as of technical innovation. We draw on ANT as a sensitizing framework for storytelling about networks of actors - both human and non-human - and about the processes by which technology is established and entangled into the interests of actors and networks [19]. ANT enables focus on the stakeholders, or actors, within the socio-technical network and how they are shaping the forms of usage and social spread of the technology. The interests of the actors may vary widely and may encourage or constrain the technology. The process of alignment of actors' interests or shifts in alignment with the actor network occurs as actors enroll others into the network. ANT posits that aligning interests of actors in the network involves translation into common interests in using the technology achieved through inscriptions. Inscription may be used to support the translation of interests supporting the actor's interests and hence the aligning of the actor network. Table 1 below summarizes the main concepts of relevance to our inquiry.

Table 1. Summary of salient key concepts/ideas in actor network theory

Concept/idea	Definition/explanation
Actor	ANT focuses on stakeholders (actors) within a socio-technical network and how they are involved in shaping the form, adoption, innovation and geography of a technology. May include non-human stakeholders such as technology and texts [20, 21]
Actor network	Heterogeneous network of aligned interests, including people, organizations and standards [22]
Translation and inscription	The interests of the actors may vary widely and may encourage or constrain the technology. Actors' interests in the networks are translated into interests through common definitions, meanings and inscriptions attached to the technology [23, 24]
enrollment	The process of alignment of actors' interests with the actor network occurs as actors enroll others into the network [21]
Alignment	Alignment is concerned with the extent to which the agendas and interests inscribed into the practices, institutions, and strategies of the network pull in the same direction and serve the same purpose. Lack of alignment occurs when agendas and interests are diverging, in opposition, or competing. The political economy of competing agendas is concerned with the issue of whose network will dominate. [23, 25]

4   Methodology

This interpretive study [26, 27] draws on data from the authors' individual and collaborative activities concerning the safeguarding of personal data within implementations of DHIS2. The lead author conducted two months of ethnographic fieldwork and 15 interviews in India in 2023 with activists, health and welfare providers, and gender diverse people, analyzing how the transgender category is mobilized and understood in North India regarding health and welfare service provision. The third author's engaged scholarship [28] with DHIS2 implementation spans multiple country contexts over more than ten years. Participant observation has been undertaken during software development at HISP UiO, discussions with funders, and participation in or running training workshops, involving practical engagement in the discourses between various stakeholders regarding DHIS2 policies on privacy, security, confidentiality, and digital identity. The other two authors' have supervised DHIS2-related research projects for masters and PhD students.

For this study, the data was combined during intensive discussion and analyzed into themes derived from inductive analysis of the authors' respective fieldwork experiences and sensitized using actor-network theory concepts, producing the list of human and non-human actors. This enabled the study to make sense of the relevant influences, particularly networks, interests, translations, and inscriptions. Applying a case vignette approach allowed for the research to focus in depth on issues that were raised by the imposition of the strictest anti-LGBTQ+ laws across the experiences of the authors while keeping the specific country anonymous. This approach was taken because the

research topic raises serious concerns for the safety and security of individuals and thus is conducted with concern for privacy and ethical research practices.

5   Case Description

HISP is a network of North-South-South collaborations where the University of Oslo, Norway (UiO) has a key role in coordinating the network. The District Health Information System 2 (DHIS2) platform is a free and open-source platform used in 114 countries worldwide. It has a core database, a suite of generic applications that cover data entry, analysis, and system administration, and an application programming interface (API) [29]. Its core development is based at the HISP Centre at the University of Oslo (HISP UiO), Norway, and each individual implementation of the platform is independently owned and implemented by ministries of health.

In this study, *HISP Organization* is a local HISP team within the HISP network. It operates a DHIS2 implementation in an African country that is a former colony where the parliament has passed legislation that criminalizes same-sex relations. People known to be engaging in such relations face prosecution, including imprisonment or the death penalty.

The DHIS2 implementation is managed by the HISP Organization actor network, which includes the HISP employees in the Ministry, and the HISP Centre at UiO. HISP UiO acts as a conduit for financial and project support and capacity for the HISP Organization, responding to the needs with new features and technical solutions. In turn, HISP Organization champions the use of DHIS2, develops new implementations, and feeds back innovation and best practices to HISP UiO. To be officially recognized by HISP UiO, the HISP Organization has signed a memorandum of understanding (MoU) with UiO.

The DHIS2 technology is a non-human actant that contains the potential to be locally configured to capture data that could be used to identify LGBTQ+ individuals and their addresses. The implementation used by HISP Organization is inscribed with the design principles from UiO and operates in the Ministry of Health in the host country. This inscription is in the form of an open-source license. DHIS2 is also used by NGOs that target outreach and clinical services to key populations such as men who have sex with men and sex workers. These NGOs utilize DHIS2 to track their own program. The data remain independent and are not shared with the MoH or any other government organization.

The relevant actor networks are outlined in Fig. 1 below:
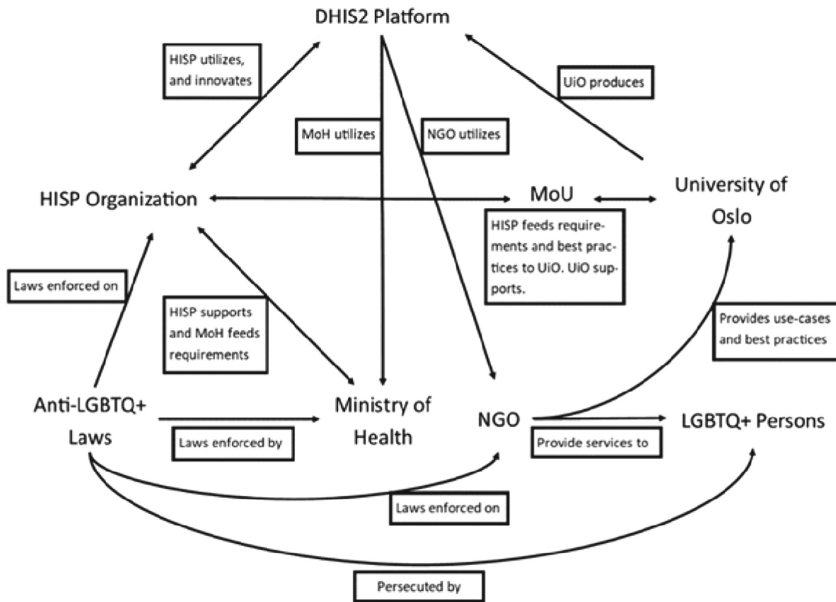
Fig. 1. Relevant actor networks

6 Analysis

6.1 Operating in a Legal Gray-Area

The HISP Organization actor network contains NGOs providing clinical services to LGBTQ+ and key populations. The DHIS2 Platform non-human actant negotiates the potential that the platform may be required to enforce the anti LGBTQ+ legislation. The actors in this network may decide collectively to safeguard LGBTQ+ identities while operating in a legal 'gray' area. Such a decision challenges the operating policies and governance of the UiO embedded in DHIS2 where the organization is operating against the law, even if the law is not being enforced.

6.2 Visibility vs Invisibilization

The collection of identity data risks the exposure of LGBTQ+ people to prosecution. However, the practices of hiding data that can identify LGBTQ+ people are translations that may lead to the long-term invisibilization of the LGBTQ+ communities, rendering them invisible to policy decisions. To carry out public health surveillance, data is needed to monitor disparities within the population over a long period of time. By halting the collection of this data, it becomes impossible to accurately recognize how determinants of health are affecting members of the LGBTQ+ communities. While HISP Organization or NGOs may choose to respond to the anti-LGBTQ+ law by halting the collection of all data that could make individual LGBTQ+ people identifiable, such a move would render the population invisible, amplifying existing inequities for the community in areas such as health and welfare.

6.3   Human Rights vs Neo-Colonialism

The HISP Organization actor network extends beyond the borders of the host nation to University of Oslo (UiO) Norway where the platform is produced. Tensions emerge between HISP Organization, the other human actors, and the perceived values inscribed within the non-human actants.

The host nation, whose government is within HISP Organization's actor network, is a former colony and, since gaining independence, has carried out efforts to build a national identity. As with many other nations who have enacted anti-LGBTQ+ legislation, the presence of LGBTQ+ identities is seen as an imposition of Western values, and the legislation in this study can be interpreted as part of a post-colonial project to reject the universality of Western values and a retaliation against a 'new force of global coercion' [17]. Concurrently, UiO, another actor in the HISP Organization actor network, upholds the Universal Declaration of Human Rights. However, the Memorandum of Understanding (MoU), a contract document between UiO and HISP Organization, is not explicitly inscribed with the promotion of the security and safety of LGBTQ+ people, and this giving space for interpretation by HISP Organization.

HISP Organization's response to this, through their practices and inscriptions in the DHIS2 implementations, influences how they are perceived by other actors in their actor network. On the one hand, a refusal to reveal the personal identity data of LGBTQ+ people on demand from law enforcement officers would be an alignment with the UiO actor network. On the other hand, it may be perceived by the host nation government's actor network as an imposition of Western values, and the inscription of values into the DHIS2 platform that contradicts their own. This could be perceived as an act of neo-colonialism in a country with a difficult history of occupation. Navigating this tension requires systematic knowledge and a clear pathway to address these tensions.

7   Conclusion and Anticipated Contribution

This research in progress study seeks to explore how digital identity platforms can be managed where the exposure of identity data could potentially be used to prosecute LGBTQ+ people. Thus far, using a case study and applying actor-network theory as an analytical tool, the study has exposed three areas where challenges arise.

We anticipate the study findings to have practical implications for digital identity platforms operating in countries where LGBTQ+ relationships are criminalized. We also anticipate a theoretical contribution to the fields of ICT4D, and to wider discourse in the data justice and surveillance studies fields by illuminating how data-induced harm plays out through the potential exposure of personally identifiable data.

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Privacy and Responsible Data in Civic Tech for Youth Sexual Reproductive Health Services

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Abstract. The growth of civic tech is significantly influencing public service delivery ecosystems in Southern Africa. Among the public services influenced is the delivery of youth sexual reproductive health (SRH) services. A number of civic tech initiatives aimed at addressing youth SRH challenges through civic participation in the service delivery ecosystem have been implemented. Given the volume and nature of data that these initiatives handle, there is a need to implement designs that safeguard citizens' data. By considering a case study of the MobiSAfAIDS initiative, this study explores Responsible Data (RD) considerations in the design, implementation, and use of the initiative. Exploring the initiative through the contextual integrity (CI) theory lens, the study aims to contribute to the body of knowledge and practice through laying a roadmap that seeks to guide responsible civic tech implementation. The study proposes to generate propositions that theorize RD use in the context of civic tech for youth SRH service access in Southern Africa.

Keywords: Privacy · Civic tech · Sexual reproductive health · responsible data · Southern Africa

1 Introduction and Background

Many societies have embraced digital technologies that provide alternative platforms for policy advocacy in areas historically characterized by lack a of citizen participation [1–4]. In Southern Africa, the advent of digital technologies have enabled the youth to engage with stakeholders on issues relating to SRH service delivery [5, 6]. The MobiSAfAIDS initiative was launched to connect young citizens, policy makers, and civic society organizations (CSOs) through the mediation of technology, promoting social accountability monitoring (SAM) for youth SRH service delivery [2, 5–7]. Using the platform, youth are able to report SRH service issues without fear of pejorative behavior from society. Even though civic tech initiatives like MobiSAfAIDS are impacting service delivery through fostering an active relationship between the youth and government (as service provider and policy maker), the fact that youth citizens' personal information is handled, cannot be overlooked.

Given the nature of data that MobiSAfAIDS captures, it is increasingly important to consider the responsible data concept and its implication in the design, implementation, and use of the initiative. As new ways of using data emerge, more ethical, legal, social, and privacy-related challenges also emerge, calling for more emphasis on approaches that respond to and prioritize these critical challenges in order to safeguard personal data from abuse and misuse [8, 9]. By exploring the MobiSAfAIDS case study, this study seeks to answer the question: How should responsible data be applied in civic tech for youth sexual reproductive health services?

This paper, which focuses on the privacy aspect of RD, is organized into six sections. The background section introduces civic tech, SRH, and RD concepts. Subsequently, the role of civic tech in healthcare services provision for SRH services, and the importance of RD is discussed. The fourth section proposes the theory suited for contextualizing the study, focusing on the theory constructs that bring understanding of both the context and the problem. The fifth section outlines the planned empirical study, followed by the conclusion that summarizes the paper.

2 Civic Tech in Healthcare

Several digital initiatives have been implemented throughout the world as they have exhibited great potential to improve healthcare delivery systems, accountability, efficiency, and service personalization [10]. These initiatives have been applied to, for example, provide critical information to pregnant women [11], chronic healthcare interventions [12–14], contact tracing to curb Ebola spread [15, 16], contact tracing interventions to curb the spread of the Covid-19 virus [17–19], and planning and budgeting in healthcare delivery [20]. Developments in digital technologies and the civic tech space have also influenced the SRH delivery ecosystems in Africa. Notable examples are Youth Empowerment Development Initiative (Nigeria), Tuseme Youth Development Program (Tanzania), HACEY Health Initiative (Nigeria), and SAUTIplus (Uganda). The advent of such digital platforms, has addressed some of the historic privacy, socio-cultural, and religious barriers that have characterized SRH delivery spaces [21]. In Southern Africa, MobiSAfAIDS is a typical example of how civic tech is being used to open up space for youth to report SRH issues [6].

Given the increased influence of civic tech initiatives in healthcare delivery, there is a need to consider how such initiatives are to be designed and implemented [13, 14, 22] to minimize privacy and ethical challenges. Importantly, most digital healthcare initiatives handle personal data of those that interact with them, and this should inform their design, implementation and use [3]. Mačiulienė and Skaržauskienė [23] argue that given the nature and volumes of data that these digital platforms generate, initiatives should be implemented in a responsible manner if their full potential is to be realised. The adoption of digital initiatives in mainstream service delivery requires stakeholders to deal with privacy-related issues decisively and to develop a roadmap to minimize the potential abuse of citizens' personal data [1]. It is against this background that Gevers [24] highlights the increasing need to explore the concept of responsible data and its implications for the design, implementation, and use of civic tech in SRH service delivery.

3 Responsible Data in Civic Tech

RD, a concept that originates from responsible innovation, prioritizes and responds to the ethical, legal, social, and privacy-related challenges resulting from new ways in which data is used, particularly in civic tech initiatives [9, 25]. McCreary et al. [26] and Solove [27] both argue that aspects of RD, for example, privacy, sensitivity, and their ethical implications are highly contextual in nature. Solove [27] also postulates that privacy is an evasive concept that is context dependent. Lau and Yuen [28] argue that ethics are influenced by the value system of the actors concerned, and that the behavior of actors is influenced by the general understanding of what is good and acceptable versus what is regarded as bad and unacceptable within the context. Therefore, to understand RD in the context of civic tech for SRH service delivery, there is a need to understand the context in terms of the social, legal, and ethical factors influencing data generation, the engagement processes, and data use. Apart from being private and confidential, health related data is highly sensitive. Questions regarding responsible generation and use of data need to be explored in order to understand how they influence civic tech initiatives, as well as how the initiatives are embraced [8].

4 Theoretical Framework

To understand the RD in the context of civic tech and SRH service delivery in Southern Africa, a framework for analyzing the contextual nature of data privacy is considered. The theory of Data Privacy as Contextual Integrity (CI) was developed by Helen Nissenbaum as a framework to contextualize the privacy concept and its implications in various discourses [29, 30]. Central to CI is the concept of *context* which defines the sphere of life from which privacy can be observed, which according to Nissenbaum [31] may range from political, educational, social, cultural, or the marketplace. It is argued that context, as it has always existed, plays an integral role in determining and defining confidentiality rules, with reference to data relating to people [29, 31]. Over the years, the definition of privacy has evolved, owing to technological advancements [32]. Privacy has historically been understood from a normative account of simple dichotomy, which simply made a distinction between private and public [31]. This limited view of data was only applicable and relevant in "small data", where privacy was more linked to individuals and small groups as opposed to "big data", where the privacy view is broad and extended to an international viewpoint, which involves multiple organizations, cultures, and societies [32]. Apart from unifying concepts that are privacy related, for example, confidentiality, control, and social practice [33], CI introduces new and holistic ways of looking at privacy by providing guidelines that respond to circumstances and stakeholders [29, 34].

CI defines four key constructs: informational norms, appropriateness, roles, and the principle of transmission [29, 31, 32]. Each *context* is therefore understood from the perspective of the four key constructs combined. Context and theory are central to knowledge construction [32, 35] and are critical in piecing together the general instances that relate to a concept. This is particularly important given that knowledge construction in the area of RD in civic tech can only be achieved by looking at the processes, and the

actors who are part of the SRH service delivery context. *Informational norms* govern the flow of information within a context norms [29, 31]. Getting in-depth understanding of the informational norms within the SRH service provision context in Southern Africa will help elucidate the related concepts of confidentiality and reciprocity. It will also help in determining where breaches take place. According to Benthall et al. [30], apart from governing information flows among stakeholders, informational norms also map into stakeholder privacy expectations. Informational norms are to be understood from the three parameters that they define, namely actors, attributes, and transmission principles. *Actors*, being the parties or stakeholders involved play one of the three roles, senders, receivers, or subjects [30, 36].

Actors within a context play particular *roles*, and the *roles* are the key variables that determine the sensitivity and susceptibility of information, as well as determining the privacy violations [29]. Therefore, it is important that the actors are carefully identified, and their roles carefully defined in order to understand a context. In circumstances where sensitive data is communicated, especially where some of the actors are minors, it is key that the informational norms are defined and understood to avoid ethical breaches. *Attributes* refer to the nature of data that flows between the actors within the informational norms' confines [31]. Attributes in the context of this study include any SRH-related data that is communicated between any two or more actors. *Transmission principles*, which are elements or rules that constrain the flow of information between actors have to be considered as well [36, 37]. Each context is subject to defined rules that constrain the flow of information, for example the healthcare-worker and patient confidentiality code, constrains the flow of information between the two. Figure 1 below illustrates the contextualization of CI. The SRH healthcare delivery context in Southern Africa can be comprehensively understood through the proper definition of contextual ends, purposes, and values. According to Benthall et al. [30], without proper definition of these teleological factors, the context cannot be comprehensively understood, and as a result, informational norms cannot be established.

5 Planned Empirical Study

This interpretive study makes use of primary and secondary empirical data to explore RD concept as it relates to MobiSAfAIDS. Semi-structured interviews are used to capture the sentiments of the purposively selected actors within the MobiSAfAIDS ecosystem from Zambia and Zimbabwe. These actors include the youth, staff from SAfAIDS, SAM champions, and youth representatives affiliated to SAfAIDS' implementation partners. Documents relating to previous research exercises on MobiSAfAIDS platform will be analyzed, including findings of a previously conducted youth survey. Some of the documents that are to be explored include the MobiSAfAIDS strategy report, requirements elicitation report and transcripts of the original fact gathering exercises, and the two countries' data protection acts.

Even though the data collection process is ongoing, preliminary results indicate that there is an inherent relationship between social and cultural structures, and privacy expectations. One participant (Country Office) said the following:

"… it would be very impossible to have a youth coming to talk about their sexuality in front of their parents. People want assurance that any information relating to their SRH is kept private and remains confidential…"

As work in progress, this study aims to contribute to theory and practice through propositions that act as guidelines for the continued implementation of MobiSAfAIDS, and other civic tech initiatives of similar magnitude.
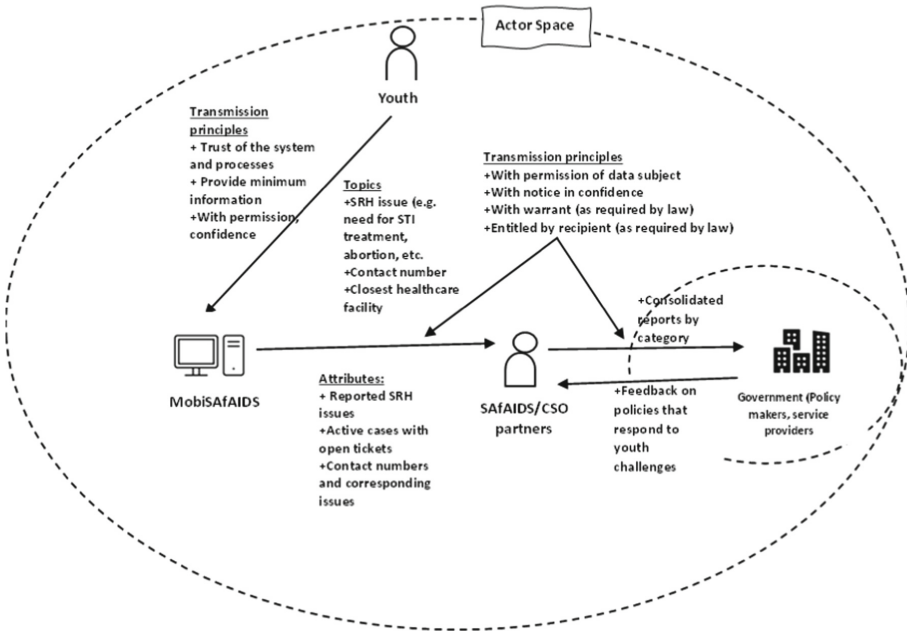
Fig. 1. Contextualization of CI (Source: Author)

6   Conclusion

As Hargittai et al. [36] and Guinchard [38] argue, CI provides a standard for examining the moral, ethical, and social implications of privacy, and privacy violations. Key to the understanding of RD implementation in the MobiSAfAIDS initiative is the careful consideration of context, data subjects, actors, and the information flows that take place among the actors. The complexities that exist in different context where MobiSAfAIDS is implemented are socially and culturally mediated and they determine how privacy and SRH issues are viewed and understood.

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Manifestations of Trust in the Implementation of Civic Tech in Southern Africa

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Abstract. The advent of civic tech on the African continent brought and enabled new imaginations of citizen engagement and democratic societies. Lessons learned since its inception framed key recommendations to structure and support the implementation of civic tech. Despite this, successful civic tech design and implementation is still limited and constrained in certain contexts. Using critical pragmatism and a qualitative ethnographic approach, this paper discusses how trust and power manifest and influence abstract actor systems associated with civic tech, and subsequently its success, sustainability, or failure. The MobiSAfAIDS project is explored as an interwoven discussion on power and trust theory, and empirical findings. Power 'over', and power 'to', can separate entities in their engagement towards implementing civic tech, influencing barriers to 'knowing' and access to 'act', in citizen engagement. Trust may be a key factor in enabling power 'with' (collaboration and learning), through access points associated with civic tech stakeholder systems – in the form of representatives, tasks, artefacts or objects, and governance/standards. Contexts will vary, and so will defined abstract systems in civic tech; nonetheless, conceptualizing these access points enable researchers and practitioners to explore how these exist in manifesting trust, and the gaps and barriers to their existence.

Keywords: Civic tech · trust · power · citizen engagement · sexual reproductive health

1 Questioning the Value of Civic Tech

The rise of civic technology (civic tech) on the African continent brought with it much enthusiasm on the possibilities that technology potentially contributes towards nurturing democratic societies and citizen participation [1–3]. The possibilities were explored through funded initiatives that enabled the emergence of a variety of civic tech projects throughout Africa [4]. Several lessons and key recommendations have emerged from these projects, with several opportunities applied in varied contexts. These lessons were and still are valuable in shaping civic tech today and in the future. However, why is it that we still find ourselves hitting a brick wall – with similar issues and challenges continuously present in civic tech implementations. Civic tech is defined as technology

and digital-enabled processes that support two-way communication between government and citizens on service delivery issues. It is purposed to enable and amplify citizen engagement through information access, enabled participation and collaboration by citizens with government, and empowered joint decision-making [5, 6]. A field that could be well positioned in the ICT4D field, and also learn from it – is also facing similar barriers that continuously result in what Toyama [7] calls *'pilotitis'*, where stringent realities emerge and continuously discourage progress in realizing the benefits of civic tech. Coupled with this, questions of governance, digital dictatorship, and digital ethics surrounding the use of civic tech are still insufficiently acknowledged and practiced in Africa, presenting potential negative implications associated with surveillance and data injustice [8–11]. The civic tech community of researchers and practitioners from both the public and private sector are questioning how civic tech can be scaled, and what form it should take if scaled. They are questioning the value of complex platforms (apps) over low-tech, and whether decisions to implement digital platforms in contexts with limited digital infrastructure, data governance, and socio-political barriers is an unrealistic approach. When faced with this dilemma as civic tech researchers and practitioners, we need to re-examine and re-orient the theories we have used to account for what we have missed or what we had not expected, so that we may reach the positive outcomes of civic tech, while accounting for any possible negative implications for populations that use this technology [12, 13].

The design and implementation of civic tech is a *relational* process, which is often undervalued or not understood sufficiently as such. According to Corbett and Le Dantec [10, p. 1], civic tech design needs to be reframed as a relational process building towards *"the wider pursuit of closing distance between the public and the government in civic relationships"*. At least that should be the goal among those stakeholders. However, literature has engaged in unearthing the social complexities of other influencing actors in civic tech, that have a role in shaping how it plays out in southern African contexts – which at times benefit the elite or privileged, more than vulnerable populations that truly need to benefit from such initiatives [3, 14–16]. Besides the key actors of government and citizens, other implementing actors are active in the implementation and use of civic tech, which typically include Non-government organizations (NGOs), civil society organizations (CSOs), internal/external funding bodies, and digital service providers (including big technology companies that continue to leverage off data from unaware populations). These actors also engage in the interplay of power over decisions that influence how civic tech will be designed, implemented, and used – and later influence data analytics that determine the direction of governance and democracy in society. Roberts and Zheng [7, p. 112] call for a shift in power in data-related programs like civic tech, *"as the centralisation of technical knowledge and the domination of techno-rationality take place at the expense of practical knowledge, resulting in the dehumanisation of development processes; and actively suppress emancipatory knowledge interests"*. In shifting power, the element of trust gauges the equality that exists between actors in civic tech design. Where the power differential is too great, then the interaction between actors *"is not necessarily trust but rather coercion"* [12, p. 53]. The different backgrounds and worldviews of civic tech actors, can challenge or support the direction of

such initiatives, determining their effect or impact. Like many tech innovation projects, civic tech is prone to the Collingridge dilemma [13, p. 3] where:

> *"technology in its early development phase can influence its development direction but not its impact on the society, and when the technology gets adapted into the society, it cannot alter its development".*

The interaction and responsible approaches applied to the initiative determine its long-term impact. Here, the practice of pluralism does not only consider the contribution of technologists, politicians, civil society, and activists – but the contribution and interpretations of diverse perspectives of community members and citizens influenced by the outcomes of civic tech [11, 19, 20]. The relational effects of technologies need to be uncovered, understanding the ethics of design, implementation, use, and data representation in civic tech (process as a whole), where the situations and trust of 'others' are put into perspective [18, 21]. This leads to the research question of this paper: How does trust manifest in the implementation of civic tech to enable/disable power for change.

As a researcher and implementer of civic tech, I approach this paper as a critical pragmatist, exploring the theories on power and trust in my experiential engagement in local and national civic tech projects. My aim is not to rediscover what we already know, in that power matters in civic tech spaces, but rather to *structure* the dynamics of power and identify access points (explore possibilities) to influence in the expert/domain systems that govern the working of civic tech in certain Southern African contexts. The structure of the paper begins with a presentation of the context of the study, and my methodological approach – to position the discussion. Subsequent sections are presented as interwoven discussions between literature, theory, and empirical findings. The paper first discusses how power typically unfolds in civic tech, and the forms it takes – which are not necessarily always negative but can have a positive influence for change to occur in society. Using Giddens theory of trust, I then explore how trust manifested in a civic tech project based on systems (of power) and their existing standards in the civic tech space, and the access points (through representatives, tasks, object/artefacts, and governance standards) between and within stakeholder systems, to evoke change.

2   Context and Methodological Approach

MobiSAfAIDS exists as a civic tech digital platform, that was one of the key outcomes of the Transforming Lives program, initiated by the NGO SAfAIDS from 2018–2020 [22]. Transforming Lives was a regional policy advocacy program across six countries in the Southern African Development Community (SADC) region, aimed at transforming the policy environment for accelerating access to sexual reproductive health rights by Adolescents and Young People within a SDG (Sustainable Development Goals) Framework. The program was premised around four pillars of intervention: 1) policy development; 2) policy advocacy; 3) social accountability monitoring; and 4) evidence and knowledge sharing. Although connected to other pillars of the program, the digital platform mainly supported pillar 3, on social accountability monitoring. MobiSAfAIDS continues to support other programs implemented by SAfAIDS, with varied experiences across the six

countries involved, including Zimbabwe, Zambia, South Africa, Malawi, Lesotho, and Eswatini.

The main functionality of the MobiSAfAIDS platform is to capture individual reports of SRH service delivery issues experienced by the youth. Once an account is created, users are able to log service delivery issues anonymously, based on the services they require. The report is sent to a designated health facility staff member, who assigns the report to the relevant service provider to address, correct or resolve. Once the issue has been resolved, the health staff records it as such, and the youth user is afforded the opportunity to either close the ticket or dispute the resolution and return the ticket to being open. The platform is valued as a mechanism that enables direct communication with local government, the youth, and civil society organizations. To date, data analyzed from reported issues has been used in advocacy process to engage government at local and national level, especially in Eswatini and Zambia. The success of the platform in various contexts, has been highly dependent on the political and civil society drive and influence.

The implementation of civic tech initiatives should exist as a collaborative effort between actors with defined roles in the process. Typically, this would include government (local and/or national), citizens, civil society, and digital service providers – these roles are defined differently, and most likely play out differently in civic tech initiatives in different regions [3, 6]. For the MobiSAfAIDS platform, the main actors and their roles are summarized in Table 1. Each actor had a level of influence that set the direction of the project. Key implementers of the project are the NGO and the digital service provider from the universities. The idea and conceptual development of the project started with these stakeholders, who later consulted with local community stakeholders to further design how the initiative would best work in their communities. Nonetheless, the power dynamics that drove the direction of the project influenced its success depending on how influential local stakeholders were in shaping the integration of the project in their communities and engaging most effectively with implementing stakeholders. For example, the pilot site in Zambia was more successful compared to the South African site, which demonstrated this.

As a researcher (Director of the Project) and digital service provider in the project, I needed to engage in continued dialogue and negotiation between actors, to enable shaping the project among all stakeholders. Even though our most direct contact was with the representatives of SAfAIDS, my team and I met with other stakeholders on several occasions to implement and strategize an effective operational model for continuity. Our aim was not only to implement the platform but engage in an iterative process of learning in the field, and learning from and with stakeholders. This resonates with the philosophical approach of critical pragmatism. Pragmatism is premised on enabling the establishment of a logical connection between theory and empirical data through abductive reasoning in an iterative manner [23, 24] – intending to create a balance between believe and *action*. In the action of pragmatism, *being critical* enables us to consider the influence of power and conflict, dealing with differences among stakeholders, and the circumstances of political engagement and learning – and to do all these in a more democratic way [12]. As much as civic tech aims to support democratic societies, the actual design and implementation of it needs to be more democratic. Through observing engagements,

Table 1. Roles in MobiSAfAIDS Design and Implementation

Role	Description
Youth Citizen	Youth who experience lack of access to sexual reproductive health services. They can report on this issue on the MobiSAfAIDS application. They also play the roles of Social Accountability Monitoring (SAM) Champion to support other youth in reporting on service delivery and advocating for better services
Youth-led CSO	The civil society organizations work closely with local youth on adolescent sexual reproductive health rights – and are mainly youth-led (often referred to as implementing partners). SAfAIDS works with these organizations, building their capacity for social accountability monitoring – they will cascade this training to the youth
Health Facility Administrator (Local Government)	These are individuals in charge of or who manage a public health facility. They receive and monitor reported issues on adolescent SRH services. Depending on the issue that needs to be addressed, they can also serve the role of a Service Provider
Health Service Provider (Local Government)	The service providers provide a SRH service to adolescent youth. When an issue is reported, they are assigned the report, and are required to address it and/or provide feedback on the reported issue. They are the only ones who can 'resolve' a reported issue, with the exception of the Health Facility Administrator, who can also be a service provider, depending on the issue reported e.g. staff conduct, resources, etc. Examples include a nurse, health counsellor, midwife, and doctor
SAfAIDS NGO	The NGO that was responsible for implementing and managing the various pillars of the Transforming Lives Program and facilitating the interplay and collaboration of these pillars to meet program goals. They also monitor issues (submitted and resolved) reported by the Youth or Youth-led CSOs, and attempt to support advocacy activities and government responsiveness
Digital Service Provider	This consists of researchers from a University in South Africa, Macau, and the UK, with background specializations in information systems and computer science. They implemented the MobiSAfAIDS application, in collaboration with the above stakeholders. All researchers were local and African, who also built on their experiences of implementing information and communication technology in marginalized rural contexts

and questioning (to understand) the move of stakeholders, including that of myself and my team – I situate my application of critical pragmatism based on Forester's [8, p. 18] premise: *"…critical pragmatism must be attentive not just to getting agreements or "getting things done!" but to the legitimacy and transparency and accountability of that pragmatic production of agreements, deals, and consequences. The critical pragmatist, we see, must attend to expertly informed outcomes and to equitably structured processes as well"*. Albeit this was always the most challenging process to apply, and in this paper, I discuss the negative and positive outcomes.

The Transforming Lives program ran from 2018–2021, but continues through other projects in SAfAIDS, which supported the continuity of MobiSAfAIDS. The analysis relies on qualitative ethnographic data collected through the following ways:

- *General Observation (2018–2022)*: Through engagements as a researcher and practitioner of the project, I reflect on my positionality and engagement with stakeholders in the project. It is not the only civic tech project I have been involved in, and so I bring in my experiences and acknowledge possible biases in relation to who I represent in the project, but also who I am as an African directly affected by the decisions around citizen engagement in my context. These in turn will be discussed in the findings in relation to how stakeholders engaged with me and my team, as outsiders and collaborators, and the resistance I experienced to become part of the project holistically.
- *Process Assessment conducted in 2020* – sample countries included Zambia and South Africa for comparison. Qualitative data is only analysed for this paper. Interviews were conducted with key informants of the project which included: Health Facility Administrators, SAfAIDS Country Staff, SAfAIDS Staff involved in other pillars of the Transforming Lives Program, SAfAIDS Staff directly involved in MobiSAfAIDS implementation, Youth SAM (Social Accountability Monitoring) Champions, and Youth-led CSOs.
- *A Strategy formulation process conducted in 2021/2022*: Workshops were held with each of the six countries, to elicit their experiences and develop integrated perspectives that highlight unique experiences, as well as lend a hand in informing other countries of key practices to apply, challenges to expect, and approaches to mitigate these challenges. Data was collected through recorded discussions, observations, and a reflection, in the engagement process – each stakeholder group was represented in the sessions.

Open and closed thematic analysis was applied to identify themes that emerged in relation to power and trust. The variables of power and trust are not comprehensively defined in civic tech, and in most cases these mainly point to power and trust between government and citizens. There is limited literature on how the dynamics around how these variables emerge with other implementing stakeholders in civic tech [14, 15].

3 Power Interplay in CivicTech

Using Giddens theory on Trust and the existence of abstract expert systems, I start the discussion by structuring these abstract systems in relation to civic tech. Giddens [25] postulates that trust in society is often that held in an individual or an institution

demonstrating a level of expertise that the one that trusts may rely on. These individuals or organizations exist or operate in systems, often considered as abstract to the external individual or organization, based on the expertise they can provide. In the MobiSAfAIDS initiative, the expert systems are based on the stakeholders summarized in Table 1 (although one acknowledges the possibility of other sub-systems under these categories). Typically in civic tech, we assume that expertise lies with the digital service provider, NGO, civil society organization, and local government, and tend to neglect the expert knowledge that exists in local citizens/communities [21, 26] – especially from vulnerable marginalized populations [27]. The voice of citizens is often not sufficiently considered or heard in the design of civic tech initiatives. We discovered this, when our digital service provider team could only *indirectly* engage with citizens in the early stages of the project – where all engagements had to pass directly through the NGO, and subsequently local youth CSOs. It was not immediately seen as limiting our full understanding of the needs and constraints of youth users as the NGOs and CSOs had worked with local actors for several years – but gradually became evident when other essential requirements emerged and the MobiSAfAIDS application was at times re-purposed by the youth and local clinic as an app for booking clinic appointments, rather than reporting service delivery issues. What also became apparent was that each stakeholder group had certain protocols or embedded practices (sometimes based on culture, traditions, codes of conduct, or governance structures) that determined how engagement could occur. This relates to what Giddens [25] refers to as faceless commitments or standards, to protect and trust the practice of experts in the systems – however, if used incorrectly, resulted in barriers to effective participation and collaboration across internal subsystems and external systems. These standards can also be essential in holding stakeholder experts accountable for how they practice, but in reality, this depends on how much one knows about their standards or governance frameworks – which can be hidden or invisible to institutions or individuals that rely on trusting the systems of civic tech players [11, 21, 28]. A necessary, if not sufficient component of democratic societies and politics, are knowledge practices within and across the expert systems of civic tech – where dominant knowledge practices or expert systems determine the direction of civic tech; towards success, or yet another tried, tested, and failed idea. As theorists in south contexts, we need to interrogate these knowledge systems, and re-structure the meaning of success, and visible knowledge practices that invite excluded knowledge systems and civic tech players at individual citizen or local community level. If not, Jasanoff [24, p. s6] argues that the growing development of expert knowledge can induce a sense of displacement and disempowerment where the *"…fragmentation and technical specificity of public problems and the ensuing distance between decision makers and the people undermine the appealing ideal of informed self-governance – the concern of experts taking over the task of political judgement"*. Escobar [25, p. 32] also postulates that these very dominant systems of expertise result in expert-driven processes, which are *"no longer generated by communities from within (ontonomy) nor through open political processes at the local level (autonomy)"*. In the initial stages of the MobiSAfAIDS project, the relationship between the digital service provider, and other internal systems of the program, was significantly linear. Figure 1 demonstrates this, in relation to how decisions were made, or how stakeholders engaged.
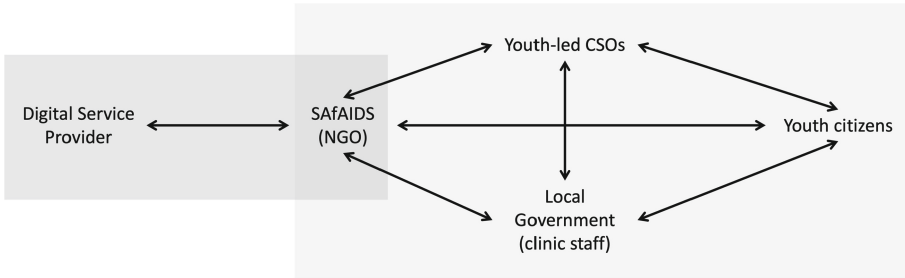
Fig. 1. In the Beginning – Communication and Relationship between MobiSAfAIDS Stakeholders

This illustration is not necessarily negative, as there were several operational successes in this model – partnering with an NGO and CSOs, limited the focus of the mobile app as a panacea for the Transforming Lives program intervention. MobiSAfAIDS, only supported one of the pillars of the program – social accountability monitoring. Furthermore, the mobile app was highly reliant on a human-centred social accountability monitoring toolkit that enabled the youth and youth-led CSOs, to exercise social accountability processes within their context. SAfAIDS had already established a working relationship between local stakeholders built over years of program interventions in Southern African countries – therefore the illustration demonstrates some existing interaction between local stakeholders. Nonetheless, even within those engagements, power dynamics influenced expert-driven processes that steered the civic tech and citizen engagement ship. The existence of bi-directional arrows does not imply the interaction process was purely positive in a sense – but rather signify the attempts of local experts to engage with each other, as needed in social accountability developments. Constructing the essence of power in this context becomes paramount, in identifying areas of influence, and transparency and accountability required in civic tech design, implementation, and use [31]. If we do not frame and structure these power and knowledge dynamics between civic tech players, civic tech in health (and other interventions), will be continue to exist in a space where *"Health system managers have little understanding of the technology sector; technology innovators have little understanding of the structure and the institutional arrangements in the health sector; and citizens have only a limited understanding of both sectors"* [22, p. 7].

Escobar [30] however points out that barriers that prevent equitable engagement between civic tech players do not necessarily emanate from a lack of knowledge, but rather the *conditions of existence of knowledge*. Conditions are shaped by power [32], which according to Avelino [31], can take the form of power 'to' (capacity or capability), power 'over' (relational), and what is often neglected, power 'with'. When **power 'to'** is a focus, the expected aim is to enable civic tech actors to have the capacity or capability to engage and evoke effective change in democratic societies. The Transforming Lives program was aimed at this, to enable evidence-based engagement on access to SRH services by the youth. However, power 'to' can also have negative implications as actors such as digital service providers, NGOs, CSOs and even government can push their own agendas at the expense of citizens – depending on the power they have, to control

the direction of the project. Power in this case exists as a relational process, where **power 'over'** is exercised by different actors. Digital service providers, who can also at times be corporate organizations [29], can obscure *"the links between means and ends, knowledge and power, or facts and value"*, which results in data or information injustice implications that other civic tech actors may be unaware of [9]. The NGO that may be constrained by funding agendas, may be limited in how much more they can support, and the knowledge to exercise this – where some NGOs have been left blindsided by digital service providers that implement pilot initiatives and do not train NGO staff or design platforms to be self-sustainable. Even though the digital implementers of MobiSAfAIDS collaborated with and trained the NGO IT staff, we discovered how learning the technical maintenance of the platform was challenging, and exercising user experience design was limited. We had to continuously collaborate, to a point where they could at least support the continuity of the platform. Coupled with these challenges, local government health staff were also constrained and frustrated with the limited resources available to them to be effectively responsive to reported service delivery issues. With a high staff turnover, new staff at a South African clinic begun to treat the mobile app and program with suspicion – ignoring reported SRH service issues and making it difficult for CSOs and the youth to engage on the evidence around lack of SRH services. The complexity of striking a balance, where power 'to', empowers rather than disempowers, and power 'over' nurtures true democracies rather than exerts dependence on other actors and manipulation, explains why we find ourselves re-inventing the same issues in civic tech in a spiral of repeated defeats. Avelino (2021) advises that we need to understand how these different types of power are intertwined in civic tech, exercising attentiveness to conflicting values and interests that can remain hidden or invisible among actors. Under these circumstances, Avelino [26, p. 428] calls for more transformative power where civic tech actors can *"challenge, alter and replace structures and institutions, by developing (re)new(ed) structures and institutions, be it a (re)new(ed) legal structure, physical infrastructure, economic paradigm or religious ideology"*. In this case, civic tech expert systems act in concert, emphasizing visibility and plurality as conditions of power – here Avelino [31] defines this as enacting **power 'with'**, which emphasizes cooperation and learning between abstract/expert systems in civic tech. The value of this was emphasized by the NGO program officer managing the MobiSAfAIDS and social accountability monitoring pillar of the program, where he identified the value in a different approach in engaging with a digital service provider (us), compared to previous experience working with consultants:

> *"Currently its formulated around a consultancy. But I believe that there is more that can be achieved…if we maybe span the scope of the relationship…maybe a collaboration…maybe to actually implement a collaborative project as partners. I think we can definitely benefit from that. But however just speaking on that the design of the Transforming Lives, and the interest at this moment was more on a consultancy, just focusing on the development of the technology. But I believe we still have more to offer, and…I would definitely like to see a collaboration and expand in a different setting altogether."*

He assumed consultants often removed themselves from engaging with other local actors in civic tech, to exercise the given task – the MobiSAM team, as critical pragmatists saw the need to engage more holistically with the intervention to enable the achievement of its intended outcomes, and its sustainability. Power is known to be relationally constituted and resides in the social context – when the social context changes between civic tech actors and partners, power relations change as well. The desire and willingness to enact that change are dependent on trust between civic tech actors.

4   On the Role of Trust and Partnership

Power 'over', and power 'to', can separate entities in their engagement towards implementing civic tech. This is based on a socio-political system that enable barriers to 'knowing' and access to 'act', in citizen engagement [3, 15]. Trust may be a key factor in enabling power 'with'. According to Giddens [20, p. 34], trust is defined as: *"confidence in the reliability of a person or systems, regarding a given set of outcomes of events, where that confidence expresses a faith in the probity or love of another, or in the correctness or abstract principles"*. In civic tech, trust is often associated with institutional trust, where institutions of expertise organize areas of the material and social environments we reside in. I want to re-emphasize here that expertise does not only lie in implementing actors (DSP, NGO, CSOs, and local government), but also expertise in the local 'knowledge systems' of citizens and the youth. Understanding the values of local youth, and how they individually or collectively practice in their systems, is vital to developing programs of relevance and effectiveness in sexual reproductive health rights. They should not simply be seen as receivers of services, but active designers and partners in accessing the services they need in SRH.

Trust without *intimacy* between abstract systems, potentially harbours the negative implications of disempowerment and coercion in civic tech design and implementation. When intimacy is practiced, it is not limited to trust in an individual person, but one has sufficient knowledge of the practice of the expert systems [28, p. 22]. It is the individual experts/representatives (what Giddens [25] refers to as *'facework commitments'*) within the layers that provide access points to knowledge and practices within the expert/abstract system. From a study on expertise and transparency in science, Smith [28, p. 1465] showed that it was trust in a person *"that persuaded the public to persevere with the knowledge produced by a particular scientist even though their immediate needs did not appear met"*, or what Meyer et al. [29, p. 180] refer to as trust in the demeanor of the 'expert': *"their level of professionalism, mannerisms, and other aspects of their personality affect our impressions and expectations"*. We observed the value of intimacy and learning in the following engagement circumstances between:

1. **Ourselves as the digital service providers and the implementing NGO** – the NGO program officer indicated: "I think what was critical was the cross-learning…from our end as SAfAIDS, moving into that territory, was new for us and umm…partnership allowed for MobiSAM to bring in their expertise, and their experiences in [their previous] Municipality. So it's not like…we did not have to invest in starting from scratch in time to generate new lessons. But rather we also learned from the MobiSAM team, how we can easily do that, how the technology can be adapted, and the process

that we need to follow. And I assume from our end as well, we also shared lessons around the operations of civil society, specifically looking at how programming is happening around SRH service and rights. So we have actually also shared lessons on how MobiSAM can actually be adapted for different developmental contexts."

2. **Local government and youth** – a health facility administrator in Zambia indicated: "…and also what we may need is also continuous sensitisation to the community. We need sensitisation to the community such that they will know, even up to the end of this program, they will know that they can still come to the facility and we are going to offer those services to them. It won't be the end of the program and the end of the services….no! What we need is the continuous sensitisation so that they continue flowing the way they are flowing at the health facility. We are really being encouraged, and even us, it's a plus, where we can see that we are really working and are delivering health services to the people of [the local community] here, in Lusaka."

Understanding the knowledge systems and incentives among youth is still not forthright, from the perspective of myself, as part of the digital service provider team. The NGO and CSOs continued to communicate use requests, values and frustrations by the youth, when using the application but we only had a direct understanding when conducting a user experience study – examples included delays on confirming anonymous registrations to access the app igniting suspicions around the purpose of the app, the request for a social interactive discussion forum on the app, and notifications and reminders of when issues have been addressed, *etc.* These examples may seem basic, but these emanated from how youth practiced effectively in their systems on SRH [35].

According to Giddens [20, p. 88], *"access points are points of connection between lay individuals or collectives and the representatives of abstract systems. They are places of vulnerability for abstract systems, but also junctions at which trust can be maintained or built up"*. Although trust is based on the abstract system itself, it is the individual representatives/experts that are the access points and its operators (who can also potentially be fallible) – fallible in the sense that experts can also get things wrong misinterpreting the expertise they are expected to possess. This is where trust in individuals should depend highly on trust in a variety of social systems, and not just one abstract system – people need to trust the holistic system of civic tech – and ensure it is not narrowly defined in relation to social systems of expertise. Although Giddens [25] indicates that representatives of abstract systems have the role of maintaining control over access points and trust in the abstract system, Luhmann [36] on the other hand indicates that it is actually that people need to trust the *whole* system, before they can trust the system's representative. Trust is a medium of interaction between social systems and individuals in civic tech and citizen engagement – these interactions between systems is not necessarily in a one-way unidirectional manner as Giddens [25] postulates, but should rather be *multidimensional* [36], where trust in one system is highly dependent on trust in other systems and individuals in civic tech. Nonetheless, theorists agree that trust is needed where information asymmetries affect the rational judgement on the consequences of a choice, and that the decision to trust has an emotional or affective weight [34]. Power 'with' becomes very important here. Even if the individual or institution may struggle to trust, the point at which they choose to trust or the reason behind it may be based on the need to uphold his self-respect and justify themselves socially [29, 33, 34, 36]. This is particularly a

turning point for government officials that had no choice in Zambia and Eswatini, but to trust and respond to citizens demands, that are especially backed up by evidence-based data generated from the MobiSAfAIDS app.

If trust is characterized as complex interactions/relationships between government officials, local government systems, citizens, and broader social systems that influence citizen engagement, then trust at all levels/systems needs to be explored and addressed when determining how to improve trust in civic tech [14, 34]. Building on the concept of 'access points' that maintain and build trust between abstract systems in civic tech, I identify the shape and form this can take using the example of MobiSAfAIDS – which I summarize in Table 2. Access points can be categorized in relation to its *representatives*, *tasks* exercised, *artefacts or objects* that enable access points, *governance/standards* that determine the perceived legitimacy, technical competence and ability of the abstract system. Contexts will vary, and so will defined abstract systems in civic tech; nonetheless, conceptualizing these access points enable researchers and practitioners to explore how these exist in manifesting trust, and the gaps and barriers to their existence.

Table 2. Abstract Systems and Access Points in Civic Tech

Abstract System	Access Point Category	Examples from MobiSAfAIDS
Youth Citizen	*Representative/s*	SAM champions, youth activists
	Tasks	Communicate the needs and frustrations of the youth, and enable/incentivize youth in their systems to engage with other actors in civic tech
	Artefacts or Objects	The MobiSAfAIDS app, mobile phone, social media
	Governance/Standards	Local culture, peer pressure, trends and communication ecologies, active citizenship
Civil Society Organization (Youth-led)	*Representative/s*	Youth activists, SAM champions, program officers
	Tasks	Training on advocacy processes and rights, recruiting youth into their knowledge systems, developing tools of engagement, information development and sharing
	Artefacts or Objects	MobiSAfAIDS app, social media, shared reports/documents
	Governance/Standards	CSO policies, government policies
Local Government	*Representative/s*	Health facility administrators, health service providers, ward councilors, national government

<div align="right">(continued)</div>

Table 2. (*continued*)

Abstract System	Access Point Category	Examples from MobiSAfAIDS
	Tasks	Community sensitization to SRH services, citizen awareness and engagement processes
	Artefacts or Objects	Scorecards, MobiSAfAIDS app
	Governance/Standards	Local, regional, and international policy and regulation
NGO	*Representative/s*	Program officers, IT staff, MobiSAfAIDS NGO representatives
	Tasks	Advocacy training, recruitment, and engagement with local CSOs, regional CSO coalition formations for joint country efforts, knowledge exchange (especially with the digital service provider)
	Artefacts or Objects	MobiSAfAIDS app, SAM toolkit
	Governance/Standards	Data governance policy, moderation policy (*still a work in progress…*), NGO policies
Digital Service Provider	*Representative/s*	Researchers, development team, consultants
	Tasks	Joint design and implementation of the app with civic tech actors, evaluation to guide the process, knowledge exchange, panel discussions at local workshops
	Artefacts or Objects	MobiSAfAIDS app, published reports and papers
	Governance/Standards	Research ethics, intellectual property agreements, research design and methodology, data policy, data governance policy, moderation policy

The listed forms of access points in Table 2, point to several aspects that exist in some initiatives, either in practice, or still being discussed as lacking – although not necessarily structured to identify areas to influence. The access point forms require further research and interrogation to identify their workings and interactions in MobiSAfAIDS and other empirical contexts, and barriers to their operation. This is what we call for in future research, exploring the environment of civic tech and digital development, in efforts to design spaces of deliberation in the implementation of digital innovation.

5 Concluding Remarks

Faced with lessons and defeats from previous interventions, we need to continue to question the relational process of design and implementation of civic tech, as frontier technologies, neo-liberalism, and authoritarian influence and impinge on realizing the true benefit of democratic societies. This paper sought to explore how trust manifests in the design and implementation of civic tech, in its specific relation to shaping power in the abstract expert/stakeholder systems associated with it. Using a critical pragmatist approach, as one involved in the implementation of the MobiSAfAIDS platform, I explore the theories on power and trust in my experiential engagement in local and national civic tech projects. In exploring the interplay of power in civic tech, the three types of power are explored in how stakeholders from expert systems engage enabling or disabling democratic change through civic tech. Power 'to' and power 'over' are essential in empowering and enabling actors to advocate for change but can also disempower civic tech actors (especially local citizens) depending on the conditions of existence of the power. One may possess the power 'to' enable citizen engagement, but where the conditions and relations are not right, may choose not to exercise that power embedded in their traditional/cultural knowledge systems [31]. The kind of Power that should matter here is power 'with', which enable collaboration and learning between abstract systems of civic tech – for this to occur, trust is fundamental to the civic tech design and implementation process. Trust enables or is enabled by access points between civic tech actor systems, and I postulate that these can take the form of its representatives, tasks exercised, artefacts or objects that enable access points, and governance/standards that determine the perceived legitimacy, technical competence, and ability of the abstract system. These access points most certainly will vary with each context – the hope of this study and experience is to point to missed points in structuring civic tech interventions that warrant further investigation and evaluation before, during, and after implementing civic tech.

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Follow the Surveillance: A Breadcrumb Trail of Surveillance Technology Exports to Africa

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Abstract. This paper describes the work done to track the supply chains of surveillance technologies from the global North to African governments for illegal surveillance of their citizens. We conducted desk research to analyze the supply side of surveillance technology exported to African countries. Our preliminary findings show nine key exporting states-actors for surveillance technologies to Africa. These are China; European Union agencies, and member states France, Germany, Italy; Israel, United Kingdom, Russia, and the United States of America.

Regarding the specific surveillance technologies being transferred, each exporting state tends to have a focus area, both in geographic area and within the five surveillance technology categories covered by this study. The paper identified six motives for state surveillance, including the suppliers' perspective. These are: 1) surveillance as legitimacy for state security, 2) surveillance for political gain, 3) surveillance as diplomacy, 4) surveillance as a tool for development, 5) Surveillance as neocolonialism, and 6) surveillance as business opportunity. Further research is needed to deepen the analysis of surveillance technologies exports to the African continent and the human rights violations.

Keywords: Surveillance · Digital rights · Civic Space · Africa

1 Introduction

African citizens are being profiled, targeted, and followed online more frequently with malicious intent. African governments frequently use pandemic or terrorism-related security risks to grant themselves additional surveillance rights and significantly increase their collection of monitoring apparatus and technologies [1]. There are worries about insufficient checks and balances when using these monitoring capabilities.

Illegal state surveillance is a well-documented phenomenon in the USA, China, and Europe [2, 3]. However, the supply chains of surveillance technologies across Africa have not received the same scrutiny. Despite the numerous investigations into digital mass surveillance in the global North, research on surveillance practices in Africa remains limited. However, a growing body of literature on the subject is emerging, with authors such as Duncan [4, 5], Hunter and Mare [6], and Munoriyarwa and Chiumbu [7, 8]

contributing to the discussion, primarily focusing on a particular technology or country [5].

Many African civil society organizations lack sufficient information on the surveillance technology in their nations to secretly monitor journalists, civil society, opposition leaders, and the general public. To fill this knowledge gap, a research effort was started to investigate who supplies what technologies to whom with what effect on human rights.

This paper covers the first part of this question: *Who supplies what technologies (to governments) in Africa?* Secondly, we explored the motives for exporting, importing, and deploying state surveillance technologies, exploring the *Why* question. We identified the following major Northern Hemisphere countries hosting surveillance technologies suppliers exporting to Africa: China, European Union agencies, Germany, France, Italy, Israel, Russia, the United Kingdom, and the USA. This article aims to provide an explorative overview of the leading surveillance tech supplying states exporting to African countries.

This paper is structured as follows. First, we conceptualize the categorization of surveillance technologies and the application of a Panopticon lens. Then, we explain the desk-based research on suppliers of surveillance technologies. This is followed by our findings presented per country. Then, we delve into the motives of supplying and deploying state surveillance and synthesize it into a cross-supplier-country comparison. We conclude with implications, reflections on limitations and future research.

2 Surveillance Technologies

The surveillance practice was first used by colonial governments, continued by postcolonial governments, and is currently being digitalized and accelerated by African countries [5, 9, 10]. Throughout history, surveillance has been passed down from colonizers to liberators, and some African leaders have now automated it. With the help of digitalization, these leaders have enhanced the scale and intensity of state spying, enabling mass surveillance of all citizens and extending surveillance into several aspects of citizens' social, economic, and political lives [1].

State surveillance is defined for this study as any observing, listening, monitoring, or recording by a state or its agents to track citizen's movements, activities, conversations, communications, or correspondence, including the recording of metadata [11]. Governments may have legitimate reasons for surveillance not directly aimed at political repression and limiting human rights, for example, to prevent terrorism [2].

As more and more technical means become available to conduct mass surveillance of citizens' mobile and internet communications, concerns have been raised about the possibility of a descent into what Freedom House has termed 'digital authoritarianism', particularly in the context of the closing of democratic space worldwide [12].

Most African constitutions and international human rights conventions guarantee the right to privacy, also protected by domestic laws. In a democratic society, citizens should be able to communicate and express their opinions freely, even when they differ from those of the current government, president, or other power holders.

However, the provision for surveillance based on national security concerns is often not clearly defined or enforced in African constitutions [11]. This paper is concerned with state surveillance that is unlawful or which violates protected human rights.

Rather than focus on the differences in technical functionality of the surveillance technologies, we highlight five of the most important product categories of surveillance technology:

1. **Internet interception technologies**: enable covert spying on citizens' emails, instant messaging, browsing and search histories, etc.
2. **Mobile phone interception technologies** enable covert spying on citizens' phone calls and all communications using a mobile phone.
3. **Social Media monitoring** – surveillance of citizens on social media platforms
4. **Safe City / Smart City** – including CCTV and remote sensing surveillance.
5. **Digital/biometric ID**: biometrics are the recognition of human features such as fingerprints, retina, or facial features as a form of identification.

Internet interception technologies allow governments or other users to read private emails or instant messages and search for phrases like "bomb" or "protest." Mobile interception technologies allow actors to intercept mobile phone calls and capture private information from mobile phones. Social media monitoring technologies are used to capture what users post, who they "friend," and what they "like" on social media. Digital sensors are used in smart city technology to collect information on people's movements and behaviors, such as how they enter a building or use a device. Digital/biometric Identification technologies give each citizen a unique identifier number validated via biometrics (iris scan, fingerprint, facial recognition). Identification data for all members of a population is recorded on a central registry and then integrated with data from mobile phones, bank accounts, driving licenses, store cards, passports, medical records, and so on. In practice, these product categories may overlap in functionalities, but they were helpful in grouping the suppliers of the surveillance technologies and their products and services.

2.1 Surveillance Technologies as Panopticon

The widespread use of mobile phones for email, text, voice calls, and social media, along with the common practice of leaving GPS switched on, presents a potential for governments or corporations to carry out panoptic real-time surveillance of a citizen's geolocation, communications, financial transactions, browsing history, social media posts, and 'likes', as well as access to their entire network of contacts and digital traces. When states embrace the five categories of surveillance technologies together, as mentioned in the previous section, the potential for panoptic real-time surveillance of citizens increases.

Surveillance is a prominent strategy that African governments use to limit civic space [13]. Repressive governments monitor journalists and opposition figures through surveillance, creating a "chilling effect" where citizens change their (online) behavior out of fear of the consequences that may follow, limiting civic spaces and shrinking democratic spaces, which reduces people's agency and violates their human rights [14].

Technology is not the root of surveillance because it predates the digital age [8]. The surveillance practice was first used by colonial governments, continued by post-colonial governments, and is currently being digitalized and accelerated by African countries [11].

Surveillance reflects a power relationship in which the watcher covertly gains an advantage at the expense of the fundamental rights of those being watched [11]. For this reason, we apply Foucault's concept of 'panopticon', commonly used in surveillance studies. Foucault utilizes Jeremy Bentham's 'panopticon' in which an invisible overseer (*surveillant* in French) has a panoptic view of every element of prisoners' or workers' lives. Some scholars like Mitchel argue that the 'panopticon' can be traced back to colonial implementation in Egypt of disciplinary mechanisms, such as the model village or the army barracks, and therefore has colonial roots [15]. Using panoptic power as an analytics lens might help evaluate state agencies' growing digital surveillance capacity.

Giles Deleuze [16] suggested that Foucault's "disciplinary society" is increasingly being replaced by what he termed "societies of control" by drawing on Foucault's historical analysis of surveillance and punishment. The ability to automate widespread surveillance across all communication media and digital platforms stands in for the panopticon's watchtower in this notion.

The concept of "societies of control" has been increasingly used to describe modern societies characterized by "surveillance capitalism," in which social media corporations and internet intermediaries are capable of real-time tracing and monitoring of users' digital footprints through the use of analytic tools and cookies [17]. While studies on the "surveillance state" have frequently drawn on Foucault and Deleuze's notions of panoptic power, it is imperative to move beyond the mere documentation of power misuse and rights violations to examine the reasons and mechanisms behind the existence of contemporary surveillance states, as well as the justifications the government provides for state surveillance, as argued by Giroux [18]. We apply these concepts to the findings in this paper.

3   Desk-Based Research on Suppliers of Surveillance Technologies

For this study, the researchers used a combination of information sources in the public domain, such as open-source databases, including news media articles; open government data on export licenses; export and import license portals, procurement notices, civil society research and databases into the spread of surveillance equipment; academic articles; information openly published by digital surveillance companies, such as press releases and brochures (Table 1). We also analyzed archival records of websites and publications on company websites via the Internet Archive Wayback Machine.

In many countries, companies are legally required to publish annual reports of their operations. These reports offer valuable information on the countries where surveillance technology companies operate. Furthermore, exporting particular products out of the country often requires an export license that is governed by the global Wassenaar Arrangement for arms and dual-use technologies [19]. Dual-use technologies have applications in both commercial and defense sectors. Some surveillance technologies fall under this arrangement and require licenses. Accessing the database of export licenses can provide useful data.

Mainstream business and domestic media frequently report on major contracts, market sector growth, and the geographical expansion of companies. Such stories are often shared on social media. Investigative journalists and mainstream media have conducted

Table 1. Descriptive features of desk research data sources.

Types of sources	News media articles; open government data on export licenses; export and import license portals, procurement notices, civil society research and databases into the spread of surveillance equipment; academic articles; information openly published by digital surveillance companies, such as press releases and brochures. Archival records
Northern Hemisphere supplier countries	China, European Union agencies, Germany, France, Italy, Israel, Russia, the United Kingdom, USA (including UN agencies)
African customer countries	Main research focus of this research project on: Nigeria, Ghana, Morocco, Malawi, and Zambia Additional information was collected from all other African countries found in the analyzed sources
Surveillance Technology Category	Internet interception technologies Mobile phone interception technologies Social Media Monitoring Safe City/Smart City Digital/biometric ID

extensive multi-country analyses of the most important surveillance technology stories. The Pegasus Spyware story is a prime example, and we have come across media stories that report on the use of this surveillance technology in many African countries. All these media sources are readily available online.

We have used Google Scholar and other search engines and academic repositories to access existing academic and NGO research on surveillance technologies in Africa. For the document analysis, we applied guidelines from academic desk research, a checklist from Privacy International on data collection, as well as investigative journalism such as mapping stakeholders, triangulation of sources, and 'who, what, when, where, how, and why' questions to identify the surveillance technology firm, category of surveillance technology, exporting country and importing African state [20–22].

We observed that publicly available information from governments and surveillance technology suppliers is often superficial. Most detailed information can be found in investigative reports by journalists and NGOs. Even governments that provide elaborate export license databases, like the UK, still obfuscate details of the surveillance technologies. Analysis has been done by summarizing the surveillance technology exports per supplier country and per surveillance technology category and applying the panopticon concepts.

We carried out a thematic analysis [23] to understand the motives for surveillance by governments. This process resulted in the identification of five motives for surveillance. This thematic analysis followed a middle-range coding procedure, where categories can come from the data and the literature [24].

4 Preliminary Findings and Analysis

Our preliminary findings show nine key exporting states-actors for surveillance technologies to Africa. These are China; European agencies, and member states France, Germany, Italy; Israel, United Kingdom, Russia, and the United States of America.

We briefly summarize our findings.

4.1 China

Chinese firms, notably Huawei, are significant suppliers of artificial intelligence (AI)-based surveillance technologies worldwide [2, 25].

At least 63 countries are known to use technology linked to Chinese companies, and Huawei alone has provided AI surveillance technology to at least fifty countries [2]. Huawei has launched a US$1.5 billion fund to facilitate the development of smart cities across Africa [26]; however, there have been reports alleging that Huawei has helped authorities in Zambia intercept encrypted communications and track political opponents using mobile data [27]. The Digital Silk Road (DSR), a component of China's Belt and Road Initiative (BRI), is the primary conduit for transferring digital surveillance technology from Chinese firms to African governments. The DSR encompasses multiple technology areas, including 5G, data centers, e-commerce, smart cities, smartphones, undersea fiber optic cables, IoT, AI, and fintech.

Huawei is actively deploying smart city technologies in Ghana, Ivory Coast, Malawi, Morocco, Nigeria, and Zambia [28]. It is also using the US$1.5 billion fund to support comparable projects in Ghana, Kenya, Nigeria, Rwanda, and South Africa [29–32]. Nevertheless, Huawei has denied reports of its complicity in intercepting encrypted communications and tracking political opponents [33].

4.2 European Union Agencies

Exporting companies in the European Union (EU) must adhere to the regulations governing the sales of 'dual-use' equipment and conduct human rights assessments before exporting such equipment. Notably, the transfer of surveillance equipment and associated training to use it involves the European Border and Coast Guard Agency (Frontex), the European Commission (EC), the European Union Agency for Law Enforcement Training (CEPOL), and the European External Action Service (EEAS) [34, 35]. However, the EEAS and Frontex are currently undergoing an investigation by the European Ombudsman over the lack of human rights assessments in their surveillance technology transfers to non-EU countries. A recent investigation by the European Ombudsman found that the EC failed to protect human rights in the transfer of surveillance technology to African governments [36].

The EU also employs foreign investment mechanisms to transfer various technologies to the African continent, similar to China's approach. Funding mechanisms for controlling migration include the AENEAS Programme [37], the B7–667 budget line, and the EU Trust Fund for Africa [38]. The European Union Agency for Law Enforcement Training (CEPOL) facilitates training sessions for law enforcement officials throughout Northern Africa, including Morocco [34]. The EU Trust Fund for Africa (EUTFA),

established in 2015, aims to address the root causes of instability, forced displacement, and irregular migration [39]. The EU coastguard agency, Frontex, operates the Africa-Frontex Intelligence Community (AFIC), which conducts training and capacity-building activities to develop national and regional strategies to fight cross-border crime and set up integrated border management systems, among other objectives, in African countries such as Ghana, Morocco, and Nigeria [40].

NGO Statewatch has identified the projects funded through these mechanisms, which can be divided into three phases: creating border infrastructure, improving integration, and the current phase of "enhancing security" [41].

Aside from surveillance transfers at the EU level, many member states have their own relationships and surveillance export arrangements with African countries. Under the EU's dual-use export regulation, member states are only required to offer data about transfers voluntarily. Next, we discuss France, Germany and Italy.

4.3 France

France has had a long-lasting presence on the African continent, with a history of maintaining ties with its former colonies through military bases, control of monetary systems via gold reserves, and close political and business relationships under its 'Françafrique' neocolonial doctrine [42]. Although the French military presence in Africa may have diminished, an increase in military training and equipment may imply a rebranding of that doctrine [43]. In addition to French governmental politics, certain French surveillance technology companies have hired former French officials to facilitate business dealings in Francophone Africa [44].

Altrnativ, founded in 2002, asserts that it has provided surveillance technologies to the governments of Benin, Cameroon, Chad, Comoros, Gabon, and the Republic of Congo. The company has secured a €13.8 million contract for radio surveillance equipment and intelligence training in the Ivory Coast [44]. Altrnativ offers its clients a customizable search engine called "Targets," which retrieves publicly available data to analyze and identify connections between places, people, and organizations, providing information on individuals and their whereabouts. Nexa Technologies, another French cyber-surveillance firm, has obtained permission from the French government and export licenses to sell its surveillance software, CEREBRO, to repressive regimes such as the Egyptian government [45]. CEREBRO enables real-time surveillance of targeted citizens' mobile phones and the collection of personal data and metadata [46].

4.4 Germany

Germany is Europe's largest arms exporter and has at least 41 firms active in the high-tech surveillance industry (PI, 2016).

Trovicor is one such company headquartered in Munich, and it provides monitoring centers to law enforcement and government clients globally to capture, monitor, analyze, and store data from various networks, including mobile and Internet networks. Notably, Trovicor was once a part of Nokia Siemens Networks (NSN), which had earlier supplied communications surveillance equipment to the Ethiopian government [47].

Another prominent surveillance technology firm in Germany, Finfisher Gmbh, had to cease operations and file for bankruptcy recently. The company is known for selling its products to authoritarian regimes that monitor human rights advocates and journalists. Evidence of FinFisher Command and Control servers was found in South Africa [48]. Finfisher sold FinSpy, a surveillance software suite that can intercept communications, access private data, and record audio and video from computers or mobile devices on which it is silently installed [49]. The company faced public and legal pressure from human rights organizations for years and eventually closed down. It is worth mentioning that all Finfisher staff members moved to other technology firms and continue to work in the security or surveillance services sector [50].

4.5 Italy

Italy has a considerable defense and security sector. In addition, the surveillance technology sector is growing, with over twenty active companies [51]. The roots of the Italian surveillance industry can be traced back to the domestic demand for monitoring organized crime [52]. Legislative Decree No. 221 of 2018 has assigned the Italian Ministry of Economic Development (MISE) the responsibility of granting export licenses for dual-use technologies [53].

AREA, RCS, SIO, and INNOVA are the four companies that are most frequently present in the Italian surveillance sector deals. In contrast, others have made a comeback after being embroiled in scandals. Hacking Team, now operating under Memento Labs, is an example of such a company [52]. The Moroccan intelligence services, for instance, made use of Hacking Team's 'Remote Control System' spyware and paid over €3 million for Hacking Team equipment [54]. Similarly, other African governments, including Egypt, Ethiopia, Nigeria, and Sudan, employed this spyware [55, 56].

Tykelab, initially a subsidiary of Italy-based RCS Lab, sells service to track individuals worldwide. It has garnered attention from European lawmakers expressing their concern about an out-of-control surveillance industry with the Israeli spyware Pegasus revelations, and they may now start looking into Italian firm Tykelab and RCS Lab following media revelations of mass surveillance [57]. Tykelab and RCS have both been acquired by Cy4gate, becoming the surveillance conglomerate Cy4gate-RCS [58].

4.6 Israel

The history of Israel is closely intertwined with the development of arms and digital surveillance technologies that are used to perpetuate its occupation of Palestine and to target countries deemed adversarial. The Israeli surveillance sector emerged in the early 2000s based on a state-corporate surveillance model that had previously been developed in the US [59], known as surveillance capitalism [17].

Israel's 'military-innovation ecosystem' includes military and state agencies, tech start-ups, private companies, universities, research institutes, banks, venture financing, and public research funding agencies for 'dual-use' technologies with civil and military applications [60]. In this ecosystem, the line between private and public space is blurred [61]. Additionally, former military personnel from Israel's cyber-surveillance units work for weapons companies and digital surveillance technology start-ups [60]. Some of the

most prominent investors of Israeli surveillance firms are US-based venture capital funds and technology companies [62].

Furthermore, the ongoing occupation of Palestine provides "an open-air laboratory for Israel to test techniques of espionage and surveillance before selling them to repressive regimes around the world", Dr. Shir Hever, author of "The Privatization of Israeli Security" argues [63]. These field-tested products are monetized via exports, which cover a broad range of products and services, including spyware, digital tools for surveillance, espionage, psychological operations, and disinformation [64, 65].

Prominent Israeli spyware firms supplying surveillance tech to Africa include Briefcam, whose "video synopsis technology" has been incorporated into smart city surveillance networks in suburban areas throughout South Africa [66, 67]. Other prominent suppliers include spyware firm NSO Group, active in 45 countries worldwide, including Algeria, Egypt, Ivory Coast, Kenya, Morocco, Rwanda, South Africa, Togo, Uganda, and Zambia [68]. A growing trend is Israeli companies' involvement and offering of disinformation and influencing services at election campaigns in most African countries [69].

In 2022, a consortium of journalists and civil society organizations revealed that Israeli Pegasus spyware targeted about 50,000 journalists, human rights activists, and foreign leaders worldwide (65).

4.7   United Kingdom

The UK has had a long and brutal colonial history in Africa for centuries [70]. Some of the surveillance systems used during the colonial era, such as those operated by the Special Branch, have been adopted by post-independence governments and continue to be used in modernized forms today [71]. The UK government has maintained close political and economic ties with many of these governments, sometimes involving the transfer of surveillance equipment and training.

The UK government openly publishes more dual-use export licensing data than many other governments. However, there are still severe limitations in the data's level of detail and transparency. For example, it does not show whether the goods were exported, only that the license holder has been permitted to export them and does not disclose specific suppliers or technologies. More information can be gathered about suppliers through freedom of information (FOI) requests. An FOI from Motherboard in 2016, for example, found that companies involved in transferring surveillance technology include the billion-dollar arms exporter BAE Systems, as well as Pro-Solve International, ComsTrac, CellXion, Cobham, and Domo Tactical Communications (DTC) [72]. Motherboard noted that 33 licenses were explicitly marked as being for IMSI-catchers. An 'IMSI catcher' is a surveillance device that can locate and track all mobile phones within a specific area by simulating a mobile phone tower. The device deceives nearby mobile phones into connecting to it, allowing it to intercept data from the connected phones to the cell tower without the phone user's knowledge [73].

A follow-up report from Motherboard in 2018 noted that the UK government has since been reluctant to release information about suppliers, claiming the information needs to be protected for "commercial interests" [74].

BAE Systems is active in Morocco, which, according to a joint investigation by BBC Arabic and Dagbladet from 2017, has sold a mobile and internet interception system called Evident (developed by a firm called ETI that BAE purchased in 2011) to authorities in Morocco, as well as Saudi Arabia, the UAE, Qatar, Oman, and Algeria [75].

4.8 Russia

Like China, the EU, and the US, Russia is also attempting to project its influence over Africa.

Since 2015, for example, Russia has signed military-technical agreements with 21 African countries [76], including Nigeria [77], Zambia and Ghana, which allow for technology transfers. The Federal Service for Military-Technical Cooperation (FSVTS) also exists under the Ministry of Defense to manage military-technical cooperation with foreign states. While it does not publish information about technology exports or transfers, the director of the FSVTS noted in September 2018 that Sub-Saharan African states have ordered $3bn of military equipment from Russia [78].

In June 2021, Russian state defense company Rosoboronexport – which sells a range of biometric identification tech – also announced it had signed contracts worth $1.7bn with 17 Sub-Saharan African countries [79].

World Bank data from 2020 shows that Russia's exports to Sub-Saharan Africa are dwarfed by those from Germany, India, the US and especially China (which accounted for 20.50% of all imports into the region) [80].

Despite this, several Russian companies are prominent in the surveillance technology sector, particularly around Systems for Operative Investigative Activities (SORM), which refers to hardware and software that can intercept and monitor internet and telecommunications network traffic [81].

4.9 The United States of America

There are 122 surveillance companies headquartered in the United States, and a large domestic market for surveillance technology fosters an ecosystem of surveillance companies due to the extensive apparatus of the US Secret Service, domestic intelligence, and security agencies. [51]. US companies supply AI-related surveillance technologies to at least thirty-two countries worldwide, with IBM, Palantir, Clearview AI, Clarifai, Intel, and Cisco being the most prominent [2, 82].

Although not related to governmental use of data collection or surveillance, the biometric data collection agreement between the UN's World Food Programme (WFP) and Palantir may affect migrants and refugees in Africa. The UN's special rapporteur on racism, racial discrimination, xenophobia, and related intolerance, Professor Tendayi Achium, stated, "data collection is not an apolitical exercise, especially when powerful global North actors collect information on vulnerable populations with no regulated methods of oversight and accountability" [83]. International aid funds are used to increase the digital surveillance of migrants and refugees.

US companies are also active in social media surveillance. For example, Dataminr specializes in advanced real-time social media monitoring and provides the United

Nations with its First Alert service to alert first responders on breaking news [84]. The company has also assisted US law enforcement agencies in tracking protests [85] and public authorities in South Africa to monitor student demonstrations in Cape Town [86]. Dataminr's African customers include governmental agencies in Kenya (used during the 2017 elections) and Nigeria [87].

Honeywell, a US company, delivers surveillance systems for large smart city projects in Egypt. Thousands of surveillance cameras across the city allow authorities to monitor citizens in public spaces and suppress dissent completely [88].

In several instances, technology and surveillance companies ignored potential human rights violations while doing business with governments that spy on their citizens [89]. For instance, US firms like IBM facilitated the apartheid regime in South Africa by creating a computerized national ID system that the South African government used to strip the country's black population of their rights as citizens [90]. Despite the sheer size, US surveillance companies are less visible than suppliers from other countries in the African countries investigated in this study. However, Duncan argues that surveillance is a significant issue on the African continent, and the US has been actively developing the Internet as a global spy machine for its own interests [4].

4.10   Analysis of Motives for State Surveillance

Using a thematic analysis approach, we identified six motives for state surveillance technologies imports, exports and use, namely: surveillance as legitimacy for state security, for political gain, as an instrument of diplomacy, as a tool for development, as a sort of neocolonialism, and as a business opportunity. These motives are not mutually exclusive and often complement each other in our analyzed cases.

Surveillance as Legitimacy for State Security. African governments frequently use pandemic or terrorism-related security risks to grant themselves additional surveillance rights and significantly increase their monitoring apparatus and technology collection. There are worries about insufficient checks and balances when using these monitoring capabilities. Citizens' privacy and digital human rights are in danger by using technologies being instrumentalized as tools for surveillance, control, and oppression [91]. A motive that further undermines civil rights is the exertion of authoritarian control over citizens by using digital surveillance technologies [2, 92]. As said before, automated widespread digital surveillance stands in for the panopticon's watchtower in this notion [16].

In November 2013, Ghana received a US$129 million loan from China Eximbank to extend dedicated security information infrastructure, including an "intelligent video surveillance" component, implemented by Huawei and ZTE [93].

Surveillance for Political Gain. Another motive for acquiring surveillance technologies could be, as Hillman [94] stated 'a vanity project' capturing votes during elections for ruling politicians who introduce smart city projects as progress. There are indications that Israeli companies may have been involved in misinformation campaigns to influence elections or bring about regime change in certain African countries (81, 83).

Although these interventions are not per se creating a "chilling effect" on citizens out of fear, their behavior is influenced, shrinking democratic spaces and people's agency [14].

Surveillance as Diplomacy. For Israel, the export of surveillance technologies is an instrument for geopolitics [95]. The NSO Group's Pegasus spyware revelations showed that the Israeli government, by allowing export licenses through its Ministry of Defence, has been using these military-grade surveillance tools for its 'spyware diplomacy'; creating a diplomatic bargaining chip for the country's political goals [95–97]. Morocco, for example, has used Pegasus spyware to hack journalists, activists, and political dissidents at home and abroad [98].

Some argue that spyware may have played a role in Israel being accredited observer status at the African Union [97, 99]. With spyware diplomacy, Israel seeks legitimacy in Africa, weakening solidarity with Palestine, increasing a pro-Israel stance among the African countries, and fighting Boycott, Divestment and Sanctions (BDS) campaigns against the occupation of Palestine [99, 100]. Israel may even have been involved in misinformation campaigns to influence elections or regime change in some African countries [69, 99]. Surveillance as diplomacy reflects a trend toward Deleuze's "societies of control" where one prison guard delegates power and watchtower capabilities to another guard [16].

Surveillance as Tool for Development – Smart or Safe Cities. Surveillance technologies have been exported as part of developmental or infrastructure projects. Attractive loans by the exporting state sometimes incentivize the acquisition of surveillance technologies. Feldstein [2] noted, "Chinese product pitches are often accompanied by soft loans to encourage governments to purchase their equipment."

For example, the primary vector for transferring digital surveillance technology from Chinese firms to African governments is the Digital Silk Road (DSR), part of China's Belt and Road Initiative (BRI) that focuses on improving information and communications technology infrastructure capabilities in other states. These surveillance packages branded variously as "Safe City" by the Chinese company Huawei or as "Smart City" by rival Chinese company ZTE transmit these multiple streams of surveillance data to a central command and control "data center" where citizens can be monitored and tracked in public spaces and online.

Huawei is active in Ghana, Nigeria, Ivory Coast, Zambia, Malawi and Morocco and is most associated with deploying smart/safe city technologies [29–32].

In 2015, Huawei launched a US$1.5 billion fund to support the development of smart cities across Africa [26], which has been used to support projects in Ghana (like ALPHA), Nigeria, Rwanda, South Africa and Kenya, and has been extensively involved in setting up digital infrastructure in Zambia [28]; where the Wall Street Journal reported it helped authorities intercept encrypted communications and use mobile data to track political opponents [27]. Huawei emphatically denied the allegations [33]. These surveillance systems are already operational in whole or in part in Ghana, Zambia and Malawi. This

motive of surveillance is tied to a trend from "disciplinary society" to "societies of control" by automated widespread surveillance via the Smart or Safe City [16].

Surveillance as Neocolonialism - Border Externalization or Data Extraction
This motive resonates with surveillance practices initially used by colonial governments, and now, post-colonial governments are tasked by former colonizing states with surveillance duties [9]. The chief guard has delegated the digital watch tower operations to a state guard on African soil.

The European Union (EU) has funding mechanisms for controlling migration [37]. These EU activities are aimed at migration management via border externalization "by both relocating the border outside the state's territory (externalization) and delegating border control functions to non-state and third-state actors (outsourcing)" [101]. Border externalization thus reflects colonialism by outsourcing to (former colonies) African states – assigned as guards- outside the EU the task of controlling migration. Following the argumentation of scholars like Mitchel, this border externalization is similar to the colonial implementation of disciplinary mechanisms, such as the model village or the army barracks in Egypt and has colonial roots [15].

Surveillance as Business Opportunity. There are economic benefits for surveillance sector firms in exporting to willing governmental clients in the global south, sometimes stimulated by intensive marketing campaigns or proving 'battle-tested' capabilities [2, 61, 92, 102].

For example, the Israeli surveillance industry sees growth potential in the African market. "African countries that have already bought Israeli security equipment represent a potential for further deals, such as the need to upgrade systems" [103]. "The commercial aspect is an important driver for Israel's arms sales. The Israeli arms industry is extremely export-dependent, and maintaining the industry is considered vital for both Israel's economy and security interests [104, 105]. This motive may not fit into a classic Panopticon lens analysis, but it can be identified as one of the reasons and mechanisms behind the existence of contemporary surveillance states, as argued by Giroux [17].

4.11   Cross- Surveillance-Supplier-Side Country Analysis

The surveillance industry is a global industry facilitated by governments of competing rich countries, and African governments are buying from all of them with little regard for their geopolitical rivalries. On the supply side, each supplier country has its own profile and specialisms that serve different market niches and geographies.

The supply of surveillance technologies to Africa is predominantly delivered by the US, China, Europe, and Israel.

AI-based Internet and mobile interception technologies are principally provided by the US and China, as highlighted in Feldstein's 2019 study [2].

China is currently the leading provider of 'safe city' market surveillance technology for public areas. In contrast, Egypt receives similar technology from the US. The European Union is the primary funding source for border surveillance technology throughout North and West Africa. The US and UK dominate social media surveillance and 'political marketing' consultancy, which seeks to manipulate voter beliefs and behavior. Mobile

Table 2. Comparison table surveillance technology supply-side countries.

Surveillance Tech Supply-side Country/institution	Summary	Main Export Category	African market focus	Panopticon lens concepts	Motives for supply or use of state surveillance
China	China's provision of surveillance technology to Africa is rapidly increasing. China is currently the leading provider of 'safe city' market surveillance technology for public areas. China has been offering billions of dollars in loans to purchase its 'safe city' package.	All, while emphasis on AI and Safe City/Smart City	Whole of Africa, with emphasis on African states involved with The Digital Silk Road (DSR), as a component of China's Belt and Road Initiative (BRI)	From "disciplinary society" to "societies of control" by automating widespread surveillance in Safe City.	Surveillance as development – smart or safe cities Surveillance as diplomacy; Surveillance as business opportunity
European agencies	The European Union is the primary source of funding for border surveillance technology; this technology transfer is often accompanied by a downplaying the surveillance element.	Digital/biometric I.D. (border control)	North and West Africa	Border externalisation is similar to colonial implementation of disciplinary mechanisms and has colonial roots.	Surveillance as neocolonialism - border externalisation or data extraction.
France	In the slipstream of French government politics come French surveillance technology companies with a particular focus on francophone countries	Internet and mobile surveillance technologies	Francophone Africa	Surveillance capitalism by state-corporate surveillance model	Surveillance for political gain Surveillance as business opportunity
Italy	Italy has a large defence and security sector.	Mobile phone spyware	Whole of Africa	Surveillance capitalism by state-corporate surveillance model	Surveillance as business opportunity
Germany	Germany is Europe's largest arms exporter, and many firms active in the high-tech surveillance industry	Mobile phone spyware	Whole of Africa	Surveillance capitalism by state-corporate surveillance model	Surveillance as business opportunity
Israel	The history of Israel is closely intertwined with the development of arms and digital surveillance technologies. In Israel's 'military-innovation ecosystem' the line between private and public space is blurred. Using military-grade surveillance tools for its 'spyware diplomacy.	Mobile hacking software A broad range of products and services, including spyware, digital tools for surveillance, espionage, psychological operations, and disinformation. misinformation campaigns aimed at influencing elections	Most African countries except adversaries	One prison guard delegates power and watchtower capabilities to another guard. 'Society of control' by occupied Palestina as an open-air laboratory for testing surveillance. Surveillance capitalism by state-corporate surveillance model. Misinformation campaigns aimed at influencing elections are changing citizens' behaviour, shrinking democratic spaces and people's agency.	Surveillance as diplomacy Surveillance as business opportunity Surveillance for political gain.
United Kingdom	The UK government has maintained close political and economic ties with many African governments of former colonies.	Internet and mobile interception technologies. Social media surveillance and 'political marketing' consultancy	Nigeria is the largest customer, followed by Morocco, Ghana, Zambia, and Malawi.	Surveillance capitalism by state-corporate surveillance model	Surveillance as business opportunity
Russia	Not sufficient evidence that Russia is a prominent supplier of surveillance technologies to African countries.	Intercept and monitor internet and telecommunications network traffic	n/a		
United States of America	US surveillance companies are less visible than suppliers from other countries in the African countries.	Social media surveillance and 'political marketing' consultancy	Most African countries except adversaries.	Surveillance capitalism by state-corporate surveillance model	Surveillance as business opportunity

phone hacking malware exporters include Germany, Italy, and Israel. Meanwhile, the United Kingdom exports IMSI catchers, also known as fake cell towers, to spy on mobile calls and messaging. Russia, on the other hand, plays a minor role in this market with little influence.

Table 2 provides a synthesis and comparison of the surveillance technologies in supply-side countries. The table summarizes the profile for each country, the main category of surveillance technologies and geographical focus in Africa, the application of Panopticon-related concepts, and reflections on the motives for the supply or use of state surveillance.

5   Conclusion, Contribution and Suggestions for Future Research

Our mapping of the supply lines of surveillance technologies from companies in the Northern Hemisphere revealed that African governments spend billions of dollars annually to conduct surveillance on their citizens. This surveillance is conducted to pursue specific interests.

African governments do not distinguish between competing powers when accepting surveillance technology, and all of these powers are engaged in providing it. We also note that suppliers may not distinguish their customers based on geopolitical alliances and sell to non-allied or adversarial countries. [106].

Russia is a significant global arms exporter, but it appears it is not a major supplier of digital surveillance technologies to African countries. While Russia can offer these technologies, the United States, China, Israel, and Europe have been far more active. However, with China's significant investment in Africa and its advanced tech sector consisting of dozens of active firms, it is crucial to conduct further research to understand the web of actors involved fully. Moreover, we need to investigate the surveillance technology transfers from the EU, which are carried out by a complex web of institutions at both supra- and national levels and those from the UK. These findings will bring more transparency and accountability to transferring digital surveillance technologies. It is also important to note that the report only investigates South Korea, as time constraints limit our ability to examine all large arms-exporting countries. Nonetheless, if we do not take action and conduct more research, we risk overlooking crucial information that could significantly impact the safety and security of African nations.

Concerning the specific technologies being transferred, each exporting country has a focus area, at least within the five technology types covered in this study. For instance, the United Kingdom is primarily involved in transferring mobile and Internet interception technology instead of biometric ID or smart city technologies. Surveillance technology exporting governments also tend to be focused on particular countries more than others, even if some, like the UK and China, are active in all of them. For example, the European Union is heavily involved in Morocco and other North African countries via border management externalisation projects, but its involvement in Malawi and Zambia is much less pronounced. Conversely, China is active in Morocco, but its involvement is considerably less significant than in Nigeria and Ghana.

A downplaying of the surveillance element often accompanies the transfer of surveillance technologies. For instance, the European Union's transfers are frequently presented

to assist African nations in managing migration and border control. Similarly, suppliers pitch smart or safe city technologies to boost the local economy or administer local government functions despite being equipped with powerful surveillance capabilities. In other words, while the stated purpose is not surveillance, the capabilities are still provided.

Northern hemisphere-based surveillance technology supplier-side governments see the exports of surveillance technologies as instrumental for their geopolitical interests in particular countries and for increasing the economic growth of their surveillance industry [107].

The panopticon lens is useful to identify state surveillance motives. In some cases, the surveillance actors are positioned in an assemblage with a hierarchy of surveillance where one state actor outsources border control activities to another state actor, thereby expanding the digital border to Global South regions [108].

A limitation of this study is that the panoptic lens and focus on the supply-side of surveillance are less helpful in analyzing how citizens or non-state actors like civil society attempt to evade or resist state surveillance, the ones under watch by state surveillance actors [8]. The consequences of deploying surveillance technologies vary based on the customer country's legal, political (level of authoritarianism), and other contextual factors.

A limitation of this study that needs to be addressed in future research is the power dimension, like the neocolonial aspects of data extraction to other state actors or private surveillance technology firms. The categories of surveillance technologies applied here are by no means exhaustive and, for example, a "detection", "positioning", "identification", "tracking", and "content handling" surveillance taxonomy or privacy frameworks (e.g., Solove Taxonomy of Privacy) could be applied on future work.

Despite the limitations of the research, our study offers an extensive mapping of surveillance technology exports to Africa.

A prerequisite to designing effective programs to curtail the supply and demand of rights-violating technologies is the availability of information regarding the companies and countries involved in supplying surveillance technologies. The absence of such information renders the development of programs for awareness-raising, policy formulation, and strategic legislation to prevent the supply of technologies that violate human rights ineffective.

As such, obtaining information about the companies and countries involved in supplying surveillance technologies is a prerequisite for the success of any initiative aimed at protecting human rights.

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Theories and Methods

Agnostic Affordances: Challenging the Critical Realist Connection

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Abstract. James J. Gibson's affordance theory (AT) and Roy Bhaskar's critical realism (CR) have both gained attention in Information Systems (IS) research. After works by Markus and Silver [1] and Volkoff and Strong [2], IS research has linked affordance theory (AT) with CR metatheory. However, this essay challenges this connection in three ways: 1) Gibson was not a critical realist; 2) The similarities between CR and AT are limited; and 3) The legitimacy of the CR-AT connection is questionable because it is not present outside IS. The essay then showcases examples of IS-AT research that use AT with non-CR perspectives, proving that affordance is a neutral concept that can be applied with any theoretical approach. Finally, I propose that an exploration of the New Mechanical Philosophy's (NMP) concept of methodological mechanism (MM) could aid in establishing a non-committal and neutral characterization of AT in IS.

Keywords: affordances · ecological psychology · Gibson · critical realism · Bhaskar · mechanisms

1 Introduction

James J. Gibson's affordance concept was first introduced in IT-related research by Norman [3] in the field of human-computer interaction (HCI), for the purposes of intuitive design [4]. While the concept was mentioned in IS papers already in the 1990s [e.g., 5], the affordance boom can be attributed to influential journal papers published in 2007 and 2008 [1, 6–8]. More recently, Critical Realism (CR) has been suggested as the theoretical foundation behind the concept of affordances [2, 9].

In this research essay, I investigate this AT-CR connection. My essay draws on the problematization genre [e.g., 10, 11]. Problematization emphasizes the critical examination of the foundations and assumptions behind the prevailing research streams, rather than just unreflectively filling minor research gaps. When successful, problematization leads to more impactful contributions than gap-spotting does [12, 13].

In Sect. 2, I will discuss the origin and prevalence of the supposed connection between Affordance Theory (AT) and CR. In Sect. 3, I will challenge the stronger claims made by Volkoff and Strong [2] that Gibson's affordances have CR roots. Section 4 examines the softer version of the CR-AT similarities claim by Volkoff and Strong [2], finding

them somewhat plausible but mostly thin. Section 5 argues that the CR-AT connection is mostly limited to the Information Systems field. Section 6 discusses four examples of MIS Quarterly articles that use AT without reference to CR and have different theoretical frameworks. Finally, in Sect. 7, I suggest that affordance could be considered a methodological mechanism instead of being CR-based.

2   The Prevalence of the CR-AT Connection in IS Research

The affordance concept was mentioned in IS papers already in the 1990s [e.g., 3], but its popularity rose by seminal research published around 2007–2008 [4–7]. The rising popularity can be at least partly attributed to the transformation from a narrow design concept to a more holistic use-centric perspective: "An affordance perspective recognizes how the materiality of an object favors, shapes, or invites, and at the same time constrains, a set of specific uses" [6]. Affordance's conceptual appeal comes from its simultaneous capture of both human and material agencies. In the words of Leonardi [14]: "Although the material properties of a technology are common to each person who encounters them, the affordances of that artifact are not." Furthermore, Meske et al. [15] claim that AT "provides one of the most prominent lenses through which the socio-technical aspects of a system's use can be investigated and understood."

The concept of affordances is now immensely popular in IS research [16, 17]. This rising popularity can be witnessed, for example, by the rising number of "affordance" papers in the AIS e-Library (Fig. 1). *This IS Research* podcast nominated affordances as "the new TAM[1]".

In an initially unrelated trajectory, the philosophy of critical realism (CR) has slowly made its way into IS research [18, 19]. *Information and Organization* introduced CR to the IS audience in 2004 [20]. CR penetrated the IS consciousness latest in 2013 when *MIS Quarterly* published a CR special issue [21]. CR is defined as "a philosophical system developed by the Indo-British philosopher, Roy Bhaskar, in collaboration with a number of British social theorists, including Margaret Archer, Mervyn Hartwig, Tony Lawson, Alan Norrie, and Andrew Sayer" [22]. According to Bhaskar [in 25], the term "critical realism" is a conflation between "transcendental realism" and "critical naturalism" – the topics of Bhaskar's first and second book.

The three main principles of CR are ontological realism, epistemological relativism, and judgmental rationality. According to Groff [23], the first principle means that "the natural world exists independently of human intervention" and "the social world is neither voluntaristically produced by, nor reducible to, the thoughts or actions of persons" (p. 408). The second principle implies that "scientific theory is ontologically 'relative' to human subjectivity in a way in which real structures are not." The third principle asserts that "the choice between competing theories is a rational one," based on "the relative explanatory power of alternative accounts." (p. 409). The CR discourse has been in existence since the 1970s, and thus it encompasses much more than this. *The Dictionary of Critical Realism* [24] comprises 500 entries across over 500 pages.

Many recent literature reviews have recommended critical realism as the one and only paradigm underpinning empirical affordance studies [17, 25, 26]. The critical realist

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[1] http://www.janrecker.com/this-is-research-podcast/affordances-is-the-new-tam/
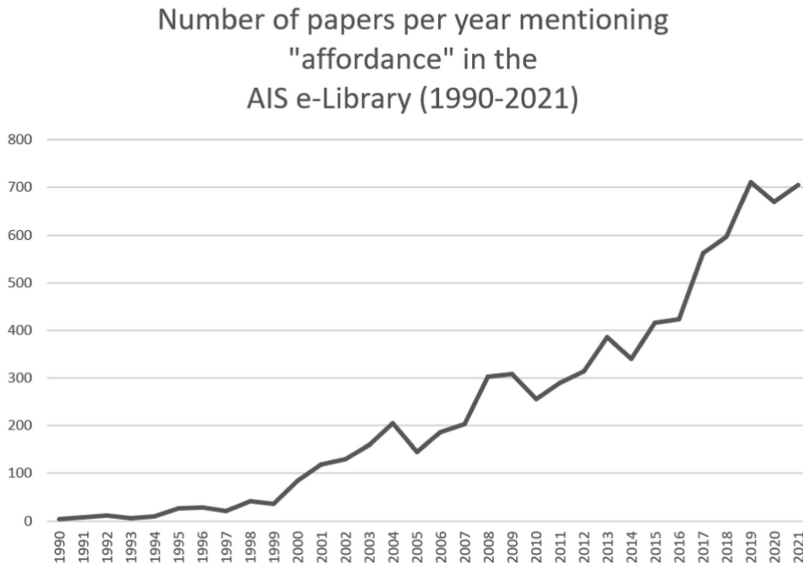
Fig. 1. The concept of affordances in the Association for Information Systems (AIS) e-Library papers (1990–2021). Adopted from https://aisel.aisnet.org/do/search/?q=affordance (Accessed 17 November 2022).

view of affordances, what Lanamäki et al. [27] label as the "potential affordances" stance, is claimed as "the most common [affordance] perspective" by Osmundsen et al. [28]. Thapa and Sein [29] adopt the CR-based affordance view and advocate this unity as an "important direction for research" (p. 813). The unity is also adopted by Anderson and Robey [30] who state that in "IS research, critical realism (…) has been used to support this ontological position [of Gibson's affordances]" (p. 103). Henningsson et al. [31], likewise, adopt and advocate the CR-AT unity. Mesgari and Okoli [32] make the case for the unity between CR and Gibson's ecological approach. Similarly, Mesgari et al. [17] promote the unity of AT and CR in their review essay, stating that "Affordance theory offers a critical realist approach to the study of technology use and its consequences." Valbø [26] claims that "in the last decade IS scholars have placed affordances within critical realism as a subset of generative mechanisms." Likewise, Fromm et al. [25] bluntly recommend everyone to "Apply critical realism as a research paradigm." Wynn Jr and Williams [33] similarly suggest combining affordances with CR. In the same vein, Kempton [34] categorizes affordance theory as a CR-based theory. Brown et al. [35] note that while "the concept of affordance has been developed independently of critical realism, it is frequently posited that CR provides a suitable theoretical fit for the affordances."

Next in this paper, I critically investigate the CR-AT connection claims made in the *MIS Quarterly* CR special issue paper by Volkoff and Strong [2]. This connection was earlier suggested by Markus and Silver [1] and has been reinforced by subsequent research. The MISQ paper by Volkoff and Strong [2] is very influential. On the date of

the IFIP joint conference deadline, 15 June 2023, it has been cited 660 times according to Google Scholar, making it one of highest cited affordance papers in the IS field.

3   Gibson Was Not a Critical Realist

Volkoff & Strong [2] make two strong claims about the alleged CR roots of AT:

> "First, the term affordance has become popular in the IS literature, but is used inconsistently and with an often unclear ontology. We hope that by explicitly connecting the concept of affordances to **its critical realist roots** we can improve the theoretical work that employs it." (Volkoff & Strong, [2], p. 822, emphasis added)

> "Many of the existing references to affordances in the IS literature either ignore or deny **the critical realist underpinnings of the original concept**. We linked the concept of affordances more firmly and thoroughly to **its critical realist roots** by explaining how affordances are a special case of generative mechanisms." (Volkoff & Strong, [2], p. 832, emphasis added)

In these two quotations above, Volkoff & Strong [2] boldly state that the concept of affordances has critical realist roots. But what do they mean with this claim? If the term "critical realism" refers to the British social science tradition originating in Roy Bhaskar's first book *A Realist Theory of Science* [36], then the claim is anachronistic. It is based on a chronological inconsistency. Gibson coined the concept of affordances already in his second book *The Senses Considered as Perceptual Systems* [37]. Bhaskar was 22 years old at the time and had not published anything yet. Costall [38] identified that the idea of affordances, but not yet the concept, was already implicit in Gibson's first book published in 1950 [39]. There is no evidence that James J. Gibson (1904–1979) was influenced by or even aware of the work of Roy Bhaskar (1944–2014) in any stage of his career. Gibson was forty years older than Bhaskar. Gibson died in December 1979, at a moment when Bhaskar's academic career was just taking off. Many differences exist between the two. Gibson was from the USA while Bhaskar lived in the UK. Gibson was a psychologist while Bhaskar published in social science.

Bhaskar's primary influence was Marx – he identified as a Marxist [40]. Rom Harré was Bhaskar's doctoral supervisor and a direct influence concerning "causal powers" [41]. There is no evidence that Bhaskar was influenced by Gibson's work in any way, or by other ecological psychologists. Gibson's main influences were his supervisor E.B. Holt (who was supervised by William James), the Gestalt psychologist Koffka, and his wife and life-long collaborator Eleanor Gibson (*née* Jack) [42]. The wide range of Gibson's influences have been discussed by Lombardo [43] and Heft [44]. Costall [45] defines Gibson as "a reluctant pragmatist." It is evident that the influences between Bhaskar and Gibson are vastly different.

Perhaps Volkoff and Strong claim that Gibson's affordance concept is based on some other critical realism, not Bhaskar's? In fact, Roy Bhaskar was not the first or the last to adopt the banner "critical realism." For example, Losch [46] provides a history of various critical realisms. The earliest starting point for critical realism is Kant (1724–1804). According to Losch, a German variant of Kantian CR has been prominent, for

example, in the works of Carl Stumpf (1848–1936) and Oswald Külpe (1862–1915). Roy Wood Sellars has been the main figure to use the label "critical realism" in the US.

However, based on the references of Volkoff and Strong, it does not seem plausible that Volkoff and Strong refer to any other critical realisms than Bhaskar's. In IS research, we can safely depend on the definition of critical realism by Gorski [22], that CR is "a philosophical system developed by the Indo-British philosopher, Roy Bhaskar, in collaboration with a number of British social theorists, including Margaret Archer, Mervyn Hartwig, Tony Lawson, Alan Norrie, and Andrew Sayer."

The two main books of the CR canon are "A Realist Theory of Science" [26] and "The Possibility of Naturalism". The subsequent books "Scientific Realism and Human Emancipation" and "Reclaiming Reality" supplement the canon. However, Bhaskar's later work about eastern philosophy, spirituality and MetaReality have not been well received among CR advocates and are mostly interpreted as Bhaskar's departure from original CR commitments. In his later life, Bhaskar took some unearthly steps that many found hard to swallow. For example, Bhaskar claimed that the real domain of his stratified ontology consists of such entities as "deities and avatars … and angels … and the denizens of the astral and causal worlds, including discarnate souls" [47]. Callinicos [48] described Bhaskar's later writings as "a major tragedy. A leading philosopher of the Left has committed intellectual suicide." Regardless, many prominent critical realists do approve later Bhaskar and the religious/spiritual worldview that equates metaphysical transcendence with the transcendent God [49, 50]. Callinicos [48] argues that the loyalty of Bhaskar's followership shows how "it has long been true that the critical realism movement around Bhaskar displayed certain unhealthy cult-like qualities."

Volkoff and Strong [9] acknowledge that "Gibson does not state his philosophical orientation," but postulate that "others have described the critical realist nature of ecological psychology in general, and Gibson in particular [1, 2, 51]." My counterclaim is that none of these references provide sufficient evidence about this link. Michaels [51] does not once mention Bhaskar or CR. Markus and Silver [1] refer to Bhaskar's work only once in a footnote (p. 613) and mention Gibson only once (p. 619). The assumed link is established not by ecological psychology's explicit acknowledgement of Bhaskar's work, but by the interpretation made by Markus and Silver [1]. They view that some ecological psychological literature bears similarities with some aspects of critical realism. Markus and Silver [1] state their allegedly CR-compatible definition of affordances as "potentially necessary relations between animals and objects."

It is true that Gibson was flirting with realism and sometimes defined himself as a realist. For example, one of his papers was titled "New reasons for realism" [52] and his posthumously published collection is called "Reasons for Realism" [53]. However, just because Gibson may have identified as a realist does not make him a *critical* realist. And even Gibson's realism is ambiguous because Gibson's influences were wide-ranging and often not explicit. Gibson tended to write in a tentative fashion, suggesting ideas and new directions rather than claiming the final word set in stone. Gibson's thinking about affordances was not completed during his lifetime [54]. Gibson concluded his third and final book by stating that "These terms and concepts are subject to revision as the ecological approach to perception becomes clear" [55].

Good [56] reveals that the label "ecological realism" was imposed by Edward Reed, not by Gibson. Good [56], Still and Good [57], Leudar [58], and many others refer to Gibson's ecological approach as "mutualism." In a review of Reed's primary works, Costall [59] calls Reed's modifications to Gibson's mutualism as "an awkward compromise," that draws from "a very conventional (and highly contested) line of selectionist theorizing within ecological and evolutionary biology." Reed's selectionism has been also faced criticism from others [60]. Costall [59] also observes that when Gibson mentioned the word "realism," he mostly "prevaricated" what he meant by it. Ingold [61] points out that Gibson's definition of affordances rests on two conflicting positions: one being "realist" and the other "relational."

Volkoff and Strong [2] commit a fallacy when they jump from the debatable observation that "ecological psychologists have realist roots" (p. 823) to claiming that these roots are "critical realist" (p. 832). All realism is not critical realism. Reed's ecological realist version of Gibson's ecological psychology is not critical realism. Bhaskar [62] himself distinguishes between varieties of realism:

"The crucial questions in philosophy are not whether to be a realist or an anti-realist, but what sort of realist to be (an empirical, conceptual, transcendental or whatever realist); whether one explicitly theorizes or merely implicitly secretes one's realism; and whether and how one decides, arrives at or absorbs one's realism."

I also question Volkoff and Strong's [9] assertion that the post-Gibsonian affordance debate was "resolved" (p. 261) in an by Chemero and Turvey's article [63]. This appears now as a premature assessment. That paper [63] is not much cited, and it does not appear to have "resolved" anything.

In summary, I completely disagree with the strong claim. Whether Gibson's ecological psychology and his concept of affordances have realist origins or not depends on which texts one chooses to support their argument. However, it is certain that Gibson's foundations are not rooted in Bhaskarian critical realism. To suggest otherwise is both historically inaccurate and factually incorrect.

4   The Similarities Between CR and AT are Limited

Volkoff and Strong [2] argue in the following two quotations how there are "underlying similarities" and "clear parallels" between CR and AT:

"While the claims about the value of critical realism and of affordances to IS researchers have both been argued persuasively, and **despite their underlying similarities**, there has been little to no connection developed between the two, and few suggestions about how IS researchers can make use of either of them." ([2], p. 820, emphasis added)

"Since ecological psychologists have realist roots [4, 72], it is not surprising that there are **clear parallels** between the description of affordances and the description of generative mechanisms. For example, both are seen as a potential for an event to occur, rather than the event itself." ([2], p. 823, emphasis added)

In their softer claim, Volkoff and Strong [2] do not identify Gibson as a literal critical realist, in a sense that he was directly influenced by Bhaskar's *A Realist Theory of Science* [36]. Instead, Volkoff and Strong state that there are "underlying similarities" or "clear parallels" between these otherwise unrelated writers' texts. Great minds think alike, as the saying goes.

In the previous section I already weighed on some of the differences between Gibson and Bhaskar: they represent different generations of scholars located on different continents, working in entirely different disciplines. But there are many more differences. While Gibson is known for his conceptual contributions, he engaged in many experiments and field studies. Bhaskar, on the other hand, was an archetypal armchair sociologist. He never conducted empirical research. Even though he had a lot to say about experimental science, in his own words he "was never very concerned with experimental activity as such" [64].

Bhaskar, in his transcendental realism, prioritizes ontology: "what must the world be like for science to be possible?" [36]. Gibson is oriented almost completely in epistemology: "The central question for the theory of affordances is not whether they exist but whether information is available in ambient light for perceiving them" [55].

Bhaskar was deeply committed to Marxist political goals. Bhaskar believed that the role of academics is to advance socialism over capitalism [65], promoting a non-market alternative "contrary to the tradition of contemporary social democracy" [65]. Bhaskar and Collier [66] formulate that CR "supports the possibility of a form of socialism which is neither a market economy nor a command economy nor a mix of the two, but a genuine extension of pluralistic democracy into economic life."

Gibson's battles were not societal-political in a similar sense, but intra-disciplinary, against mainstream academic psychology [67]. Gibson was an iconoclast among psychologists: "Psychologists are simply, on an absolute scale, dullards." [68]. Gibson's dissidence can be seen as an influence he inherited from his supervisor E.B. Holt. This intellectual inheritance can be traced back to Holt's supervisor William James, "who encouraged the younger men in the field to break with tradition, to explore new possibilities and new horizons" [69]. From James also comes the inheritance of pragmatist thought that was a persistent source of inspiration for Gibson [70].

Granted, there are similarities between Gibson and Bhaskar. A central similarity is an attempt to avoid dualisms of structure and agency. Having it both ways, for Gibson, means that affordances are simultaneously directly perceived and real [71]. "An affordance cuts across the dichotomy of subjective-objective and helps us to understand its inadequacy. … An affordance points both ways, to the environment and to the observer" [55]. Direct perception implies that perception is not based on learning or inference. Once a perceiver confronts an object, (s)he directly perceives its affordances as a member of the species those affordances are for. On the other hand, the notion of *ecological* psychology implies that perceptual systems extend beyond individuals [72].

Gibson [73] does acknowledge that correctly perceived affordances require correct information and therefore misinformation may lead to identification of false affordances. Regardless, he views that "the basic affordances of the environment are perceivable and are usually perceived directly, without an excessive amount of learning." [73]. Contrary to Bhaskar's celebration of appearances versus reality, Gibson denies this dichotomy:

"affordances of the environments are facts of the environment, not appearances" [73]. According to Costall [38], the claim that affordances are real "marks Gibson's truly radical break with the long tradition of Western thought that has held that meanings and values are purely subjective and hence unreal."

In sum, there are parallels between CR and AT, but those are thin. In the next section, I argue these parallels have not been all that obvious to scholars outside the IS field, because the CR-AT link is prevalent mostly only within the IS research community.

5   The Legitimacy of the CR-AT Connection is Questionable Because It is Not Present Outside IS

When investigating the assumed link between critical realism and the concept of affordances, a critical question, perhaps the question, is that why this link has not been identified almost anywhere outside IS research? Ecological Psychology, the eponymous flagship journal for ecological psychology, has never published an article that includes "Bhaskar" in its body text. Throughout its history, it has published only two articles that feature the phrase "critical realism." These two articles are Pickering [74] and Mark [75]. Neither of these articles discuss CR in the familiar sense, as the tradition started by Bhaskar. The concept of affordances has remained a very active conversation in ecological psychology, but never together with "critical realism".

It is also notable that affordance theory has had and remains to have much influence in communication and media studies [76, 77]. This line of research is entirely separate from CR. Likewise, AT has a long history in HCI [78]. Again: there is no connection to Bhaskar in HCI-AT.

In the *Ecological Psychology* journal, the paper by Rietveld and Kiverstein [79] seems to be a key piece inspiring new developments and reflection with the affordance concept. This paper, "A Rich Landscape of Affordances," is currently the all-time most cited paper in the journal according to the journal's own website. According to this website, the most popular Ecological Psychology paper in the last three years is "Collective Affordances" [80]. Neither of these two have anything to do with CR.

Thus, it appears that the concept of affordances remains open-ended, allowing for exploration of new intellectual territories, rather than being closed off by critical realism. The apparent lack of recognition of the connection between critical realism and affordances outside of IS research raises suspicion about the validity of this connection, as it has not been acknowledged by researchers in other fields. It seems that the link between affordances and critical realism is purely an invention of IS research.

6   The Prevalence of Non-CR Perspectives in IS-AT Research

Many IS studies explore affordances with no reference to CR. Four such papers, all published in *MIS Quarterly*, are Faik et al. [81], Karahanna et al. [82], Salo et al. [83], and Seidel et al. [84].

These four studies share a common characteristic in that they do not reference CR or any of the key CR-AT-IS papers, such as Volkoff and Strong [2] or Bygstad et al.

[85]. Additionally, each of these papers utilizes a different theoretical framework: Faik et al. [81] incorporates institutional logics, Karahanna et al. [82] builds on psychological needs theories, Salo et al. [83] explores the concept of technostress, and Seidel et al. [84] links affordance to sustainability transformations, sensemaking, and socio-technical systems theories. This diverse range of theoretical perspectives highlights the lack of a unifying core among these theories. The methodologies used in these papers also vary, with Faik et al. [81] being a theoretical review paper, Karahanna et al. [82] performs a longitudinal online survey, and the other two being qualitative case studies.

This theoretical and methodological diversity suggests that affordances are a flexible concept that can connect to various theoretical and empirical frameworks. There does not appear to be any clear limitations in these four studies because of their lack of alignment with critical realism. Conversely, a comparison of these four non-critical realism affordance papers with explicitly critical realism-oriented papers does not highlight any distinct advantages of the latter. In the following section, I explore a lesson learned from New Mechanical Philosophy.

7   Affordance as an Agnostic and Ontologically Non-committal Concept

In this section, I focus on the idea that affordances are mechanisms. For example, Volkoff & Strong [2] define affordances as "a special case of generative mechanisms" (p. 832). Likewise, Bygstad, et al. [85] emphasize both the similarities and differences between affordances and mechanisms, noting that "a mechanism is usually a relatively abstract (and unobservable) chain of causality, an affordance is more concrete" (p. 93).

The field of philosophy concerned with modern mechanistic science is called the New Mechanical Philosophy (NMP) [86]. It is important to note that CR and Bhaskar have not influenced the NMP literature, despite CR's focus on "mechanisms." Nevertheless, I believe there is a significant lesson to be learned from the development of the NMP, especially regarding the role of ontology in defining mechanisms.

The birth of the New Mechanical Philosophy (NMP) can be traced back to the article "Thinking about mechanisms" published in the journal Philosophy of Science [87]. A significant precursor to NMP is Salmon's book "Scientific explanation and the causal structure of the world" [88], which introduced the concept of ontic mechanisms. From this, two views emerged within NMP: the ontic view, which holds that mechanisms exist in the world, and the epistemic view, which holds that mechanisms are human-made models [89]. These two perspectives have been debated for years by various scholars [90–92], to determine the correct view.

In recent years, a consensus has emerged in the New Mechanical Philosophy (NMP) literature regarding the definition of mechanisms. The Representation Thesis states that "[s]cientists can only discover, describe, and explain mechanisms through the construction of models, and these models are inevitably partial, abstract, idealized and plural" [89]. Ioannidis and Psillos [93] offer a concise definition: "A mechanism is a causal pathway that is described in theoretical language" (p. 3). This definition that they call Methodological Mechanism (MM) aims to eliminate "ontological excess" and inessential concerns not central to investigating mechanisms:

"MM … illuminates practice in a way that ontologically inflated accounts of mechanism do not. It accounts for the centrality of mechanisms in scientific discovery and explanation, since according to it, discovering mechanisms (i.e., causal pathways) is the central task of science. At the same time, however, it refrains from imposing on scientific practice ontic constraints that are not licensed by it. According to MM, the mechanistic view need not be taken as something stronger than a certain methodological commitment to a kind of explanation."

This definition, along with the preceding debates that lasted for decades, is something the field of IS has not yet addressed. We have not critically evaluated the definitions of CR and AT to determine their practical usefulness. It is worth mentioning that in the article "Causal Mechanisms in the Social Sciences," Hedström and Ylikoski [94] blasted CR for having "stalled," for containing "often quite cryptic original statements by Bhaskar," and for carrying "extra philosophical baggage that we may want to avoid" (p. 57).

I suggest that if the IS community had dedicated more time to critically evaluating how we conceptualize affordances, with or without CR, we would have stripped away many additional definition layers. We would have arrived at something like the Methodological Mechanism definition provided by Ioannidis and Psillos [93], which "is non-committal about fundamental ontology" (p. 227).

Affordance is a valuable concept due to its theoretical agnosticism, allowing for flexibility in combining with various theories and methods. Most notably, affordance aids in comprehending practical interactions with technology. While practices have limitations, they are inherently open-ended in nature [95]:

"To say that the properties of things exist as affordances only relative to an activity is merely to say that we have no interest in or access to things, experiences, or even possible thoughts, other than as we engage them—but also, that new things, experiences, and thoughts are always possible."

8   Conclusion

In this paper I have examined the link between critical realism (CR) and the concept of affordances. This link was initially suggested by Markus and Silver [1] and was articulated in more detail by Volkoff and Strong [2] on the pages of *MIS Quarterly*, the leading journal in IS research. The unity between affordances and CR have been reinforced in subsequent research [29, 85]. It seems that many researchers are taking this unity for granted. Many claim a mandated status for this unity [17, 25, 26].

The claims made by Volkoff and Strong [2] can be separated into a strong and a weak variation. In the strong form, they claimed that Gibson's affordances have CR roots (p. 822; 832), a position I have refuted in this paper. A softer version of the CR-AT commonalities claim argues that affordances and CR have "clear parallels" (p. 820) and "underlying similarities" (p. 823). I weighed on the softer claim, and I found the commonalities mostly thin. I then observed how CR-AT as a unity witnessed inside the IS research community, but not mentioned outside our field. I also discussed four exemplary *MIS Quarterly* articles that apply AT without a reference to CR. All these

articles differ in their theoretical framing. Finally, I suggested that AT could be conceived as a methodological mechanism [93] rather than a CR-based metaphysical entity.

The concept of affordances is, perhaps unintentionally, a perfect theory in two respects. On a superficial level, it is remarkably simple. Anyone can grasp that a chair is for sitting, thereby comprehending the key idea of affordances [96]. At a deeper level, AT contains many contradictions and complexities, such as that they are real while directly perceivable [71]. This is a reason why the concept of affordances has not achieved closure: ecological psychologists are still debating it. This is a virtue for any theory: enabling the conversation to keep going. The concept of affordances is vague and ambiguous. My suggestion is that instead of enforcing one mandatory paradigm, let's allow many flowers to bloom.

The concept of affordances does not have critical realist roots and it is even debatable whether it has any kind of ontological roots outside the tentative ideas provided by Gibson. Some in the IS field have suggested other roots [97]. In this essay I have argued that affordances are best seen as theoretically agnostic and ontologically non-committal. This aligns with arguments in another paper where I questioned the "third way" rhetoric of CR [98]. What affordances are and how they operate is an empirical question, not a metaphysical or philosophical one. To quote Czarniawska [99]: "Deciding ontological status *a priori* once and for all – and worse still, distributing it according to a researcher's preferences – terminates the research process even before it has begun."

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Use of Mobile Application to Support Community Health Workers in Patients' Assessment and Referrals. The Case of Malawi Rural Healthcare

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Abstract. The dispersion of mobile technology in developing countries especially in rural areas has led to the belief that adopting mobile health applications is beneficial in supporting delivery of healthcare in developing countries. In this study, we explored the affordances of mobile-based Integrated Community Case Management (iCCM) as a protocol that aims at providing basic lifesaving treatment to children who are under five years of age at community level. Using the qualitative approach, this research provides the health informatics and information systems community with an understanding of how the digital iCCM may affect the level of assessment of patients' illness and referrals to higher level facilities. Data was collected through semi structured interviews, focus groups, observation and documents analysis. Thirty-two (32) participants were interviewed. Affordance theory was employed as a lens for analyzing the findings and three functional affordances were identified as diagnosis, treatment, and remote data collection.

Keywords: Referral · mHealth · Affordance · Integrated Community Case Management · Sick Child Recording Form · Integrated Community Health Information System

1 Introduction

There are many technologies that are being used in the provision of healthcare services, one of which is mobile phones. The use of mobile applications in healthcare can bring a wide range of benefits such as: better delivery of care, improved patient safety, more effective communication between providers and increased access to information [1–3].

The dispersion of mobile technology in developing countries especially in rural areas has led to the belief that adopting mobile health applications is beneficial in supporting delivery of healthcare in developing countries [4]. The substantial growth of mobile users in the world has made the field of mHealth which is defined as use of mobile phone technology to deliver health services become more attractive to researchers and health practitioners in the provision of healthcare services [4]. Access to reliable health information by Community Health Workers (CHWs) can bring sustainable improvement in

healthcare in developing countries and one way of providing such information is through mobile applications [4]. Mobile applications can offer opportunities that complement conventional methods of accessing and disseminating healthcare information effectively [5]. Evidence suggests that a range of services provided by CHWs can improve by mobile technology for example, mHealth can enhance the performance of CHWs through communication amongst the health workers, data reporting, dissemination of clinical updates, reminders, assessment, classification, and referral of patients among others [2, 5, 6]. In a study that was conducted in Tanzania where CHWs used smart phones and tablets with an electronic version of Integrated Management of Child Illness (IMCI), an initiative aimed at reducing child morbidity and mortality rate, it was found that the application simplified their work, reduced antibiotic prescription, and gave correct classification and treatment for common causes of illness in children [7]. Another study that was also done in Tanzania found that there was greater adherence to protocol for electronic IMCI than for paper based IMCI [8]. Similarly, a study done in Burkina Faso reported that the eIMCI helped to improve patient management and encouraged rational use of antibiotics [9]. A study done in Uganda that was aimed at supporting CHWs in the treatment of acutely ill children found that 92% of the children from the targeted sites where CHWs were using mobile phones were correctly treated [10].

Many studies on mHealth applications that have been implemented in developing countries focused on maternal and neonatal healthcare, HIV prevention and care and non-communicable diseases [2, 7–9]. Similarly, some mHealth studies done in Malawi have reported their use to support maternal and neonatal healthcare and HIV/AIDs prevention and care [1, 14]. However, most studies have mainly focused on sustainability issues, data reporting practices, acceptability, and impact of mHealth and perception of mHealth interventions [11–15, 19]. Furthermore, a few studies have reported the use of mobile applications in supporting CHWs in assessment, classifying patient's illness, treating, and referring patients who present danger signs to the health facilities for specialized treatment. A pilot study in four districts of Malawi evaluated the use of a mobile application for Integrated Community Case Management (iCCM), a protocol adapted from IMCI aimed at reducing mortality and morbidity for under five children, by CHWs [20]. Findings from this study revealed that using iCCM mobile applications encouraged CHWs to adhere to protocol and to make accurate identification of danger signs in patients requiring referral. The study further found that the application increased the number of referrals that were made to health facilities, prevented unnecessary re-consultations at village clinics and minimized hospitalization rates among under five children. Similarly, a study in Malawi found that, using mobile applications, CHWs adhered to iCCM protocol when assessing and classifying sick children [18]. Another study evaluated the acceptability and impact of the Supporting LIFE Community Case Management App (SL eCCM App) by CHWs and caregivers [21]. The results revealed that most CHWs recommended the mobile application as being more reliable, less error prone, facilitated more accurate diagnoses and treatment recommendations and enhanced prompt decision making in patient referrals by accurately identifying children with danger signs. However, some CHWs believed that additional features were needed to improve the usability of the application while others pointed out that electricity and mobile network outages were some of the challenges affecting the use of mobile applications.

Despite mHealth applications registering greater impact on healthcare outcomes, evidence that is available is based on implementation of pilot projects that have never been brought to scale and are not centrally run by the government [22]. There is also little information about mHealth technologies that support CHWs to identify patients who require specialized treatment by referring them to higher level healthcare facilities hence it is the focus of this study. The study therefore is building on and reinforcing some findings from previous studies. Consequently, this study addresses the following research question.

- *How can the implementation of a mobile-based iCCM module afford Community Health Workers in assessment, classification of child illness, prescription of treatment and referral of patients from community to higher level facility?*

This paper, therefore presents the current activities of CHWs in patient assessment and referrals at the community level during village clinics conducted in hard-to-reach areas of rural Malawi. The paper will further discuss the potential advantages of using mobile technology to support CHWs in patients' referrals.

The paper is structured as follows: Sect. 2, covers the bresearch context including the Malawi health system, its segments, and various players in the value chain at the community level. This section further presents the status of mhealth in Malawi and introduces the Integrated Community Health Information System, which is an initiative that is being implemented by the Ministry of Health. Section 3 discusses affordance as a theoretical lens for this study. Thereafter, we discuss the methodology that was used to collect and analyze data followed by the analysis of the findings. Finally, we discuss the findings and then summarize the study.

2 Research Context

2.1 The Malawi Health System

This study was done in Malawi where 84% of the population live in rural areas and 24% live five kilometers (or more) away from a health facility.

The health sector is divided into four levels of service delivery: community, primary, secondary, and tertiary. The community services are the lowest level and are delivered through community initiatives, village clinics, and outreach clinics by the community health workers. CHWs include Clinicians, Medical Assistance, Community Nurses, Community Midwives, Health Surveillance Assistants (HSAs) and Village Health Committees (Volunteers). HSAs are the primary health providers at community level and each HSA is assigned a catchment area that they serve. The HSA is mandated to serve one thousand people but due to shortage of staff, they usually serve a larger population.

The healthcare system is designed in a way that encourages patients to seek care first at the lowest level and then be referred, if necessary, to a higher level of care. As such, the CHWs play an important role of providing access to primary health services especially in the underserved and hard-to-reach areas. Serious conditions beyond what the CHWs can treat are referred to a health facility for further treatment.

In an attempt to reduce child morbidity and mortality, Malawi adapted the Integrated Community Case Management (iCCM) strategy from World Health Organization (WHO) and United Nations Children's Fund (UNICEF) [20]. The program is administered by CHWs on under five children at community level through village clinics [20]. Under the iCCM program, CHWs are guided by a paper-based Sick Child Recording Form that has a step by step set of questions in assessment, classification of illness and treatment prescription [8, 18]. Depending on the outcome of the assessment, the sick child is either treated at the facility or referred to the nearest hospital if the child presents danger signs, for comprehensive clinical management [20, 21]. For CHWs to make correct identification of the patients requiring urgent referral to a higher-level facility mostly depends on CHW following iCCM guidelines which have been reported as being suboptimal [20]. Incomplete assessment of the sick child may hinder early identification of danger signs which may consequently affect referrals to higher level facilities for specialized care [20]. Management of referrals from community to the health facility are essential to save lives and ensure both the continuity and quality of care [24, 25].

2.2   mHealth Initiative in Malawi

The number of mobile phone users around the world is estimated at 5 billion [26]. Out of this number, it is estimated that 64% of these users are found in developing countries [27]. It was further estimated that half of rural residents would have mobile phones by the year 2020 (ibid). This rapid growth in the use of mobile phones has triggered the growth of mHealth in both developed and developing countries [27].

Malawi, as one of the developing countries, has embraced mHealth as an initiative aimed at improving healthcare more especially at community level. Over 45 mHealth applications have been initiated in various districts in an effort to solve health challenges like HIV/AIDs, maternal, neonatal and child health, nutrition, supply chain management and many others [22, 23, 28]. The majority of mHealth projects have been implemented at community and health facility levels of health sector targeting hard to reach areas. Most of these projects are funded by international donors through Non-Governmental Organizations who have their own areas of interest. Some of these projects have registered positive impacts like increased knowledge of maternal and child health, increased clinic attendance, increased follow-up visits and many more [1, 10]. Despite these results, the implementation of mHealth has also been faced with a number of challenges such as poor infrastructure, lack of financial resources, lack of interoperability standards, poor ICT governance, lack of buy-in from both users and government, lack of coordination among others [22].

In terms of mHealth readiness, mobile phone service providers in Malawi are targeting rural customers in an attempt to increase their subscription customer base because the urban market is becoming increasingly saturated [27, 28]. There have been recent attempts by regulators to liberalize the market so that the cost of usage is reduced [27]. There is also an opportunity to define mHealth-friendly regulations in the health sector as a means to enable phone service providers to participate positively in mHealth [27].

2.3 The Integrated Community Health Information System (iCHIS)

The Ministry of Health and Population in Malawi implemented a five-year National Community Health Strategy (2017–2022). As part of the implementation of this strategy, the Ministry of Health and Population through the Community Health Services Section in collaboration with the Digital Health Department, with technical support from the University of Malawi – Computer Science Department is developing a comprehensive national Integrated Community Health Information System (iCHIS). This is a mobile based system that is aimed at addressing the service delivery and information needs of community health services at all levels.

The development and implementation of iCHIS is expected to improve the quality of community health services and address fragmentation in the delivery of community health services including reporting and information management and to provide multi-level access to data and patient-level data analytics. It is also expected to support improved performance and higher quality service provision through standardized guidance on clinical decision-making and management of longitudinal health data records. iCHIS has three main high-level modules: the household register, the community register and the personal register. This study will mainly focus on the personal register because this is where the iCCM module for under five children belongs. The digital iCCM module is aimed at replacing the paper based Sick Child Recording Form that CHWs are currently using in village clinics.

iCHIS is built on the District Health Information Software (DHIS2) platform. The system is currently being implemented in five selected districts and will eventually be rolled out in all the districts in Malawi and it is expected to eventually completely replace the paper based iCCM protocol. This study is aligned to iCHIS.

3 Theoretical Approach

This study uses affordance theory as a lens to analyze the findings. In particular, the concept of functional affordance will be employed. Functional affordance can be defined as material properties of an information system capable of identifying how an individual may use the system based on their capabilities and goals [29, 36, 37]. This affordance emerges when material properties of information systems that affords action possibilities are congruent with the imposed new action goals of individuals [30].

3.1 Affordance

The concept of affordance originated from James J. Gibson writings and has since been applied in many fields of research [16, 34]. Gibson defined affordance as the relationship between the environment and the animal. He argued that the affordance of the environment are what it offers the animal, what it provides or furnishes, either for good or ill [33]. He further argued that the verb "afford" is found in the dictionary, but the noun "affordance" is not. He actually made it up, to describe something that refers to both the environment and the animal in a way that no existing term did.

Affordance has three fundamental properties. These include: i) affordances exist relative to the action capabilities of a particular actor. An example for this could be a

horizontal, flat, extended, and rigid surface that affords support. The fact that the surface provides support for one actor, does not mean that it also provides support for another actor; ii) the existence of an affordance is independent of the actor's ability to perceive it; iii) an affordance does not change as the needs and goals of the actor change [16, 34]. Therefore, for an affordance to be of use, it must be perceived and actualized.

The concept of affordance has over the years been applied in many fields including human computer interaction. Although the concept has become popular over the years, it has been misunderstood in some cases [16, 34]. For example, Norman's original definition and use of affordances deviated from Gibson's definition where he defined an object as having three major dimensions: conceptual models, constraints, and affordances, leading to varying use of the concept. Norman [34] subsequently clarified that his intention was to advance the notion of perceived affordance (ibid) and not Gibson's real affordances. Norman actually used the concept to refer to both perceived and actual properties of an object, without reference to an associated actor [35]. This ambiguity has contributed to misinterpretation of the concept in the IS field.

3.2   Affordance Theory in Information Systems

Affordance theory has been used in many disciplines including Information Systems (IS). For example, Thapa and Sein [31] used the affordance lens in their case study of a telemedicine project in a remote mountainous region of Nepal in which they looked at how affordances are perceived and actualized and they developed a concept called "Trajectory of Affordances" arguing that for an affordance to be actualized, there must be a goal oriented actor with action capabilities and IT artefacts that afford the possibilities of the action. They further argued that how affordances are perceived and actualized is influenced by cultural, social, and technical factors. [36] extended the definition of affordance to address the organizational context by looking at how the concept applies across organizational levels. In trying to bring clarity to the discussion of affordance and how it may be applied in IS research, Volkoff and Strong [35] defined six affordance principles as follows: i) affordances arise from the relationship between the technology and the actor and are therefore not features of a technology. ii) Affordances relate to potential actions and the purpose they are intended to achieve while actualization relates to a particular individual actor and details regarding the specific actions that actor will take or has taken. Iii) An affordance is about potential action, not about the state or condition that is reached after an action is taken. The focus must therefore be on the action and not the state or condition reached after an action. iv) An appropriate level of granularity for the affordances must be selected. v) Affordances may support other affordances or may interfere with them therefore all salient affordances and how they interact must be identified. vi) Affordances are not actualized in a vacuum, but rather in a social context and therefore there is a need to recognize social forces that affect affordance actualization. Following Volkoff and Strong's affordance principles, we will apply principle number one which talks about the relationship between technology and the actor. In this paper, we aim to identify the functional affordances that can be provided by iCHIS to assist CHWs in patient assessment, classification of illnesses and referral to higher level facilities.

To summarize the discussion above, affordance is not determined by the actor alone nor the artifact alone but the relation between the two [37]. Affordance still exists independent of user perception but remains hidden and can only be actualized by interaction between goal-oriented actors with action capabilities and the IT artifacts that affords possibilities of the action [31].

4 Methodology

This study adopted a qualitative approach. Primary data was collected through semi structured interviews, focus group discussion, document analyses, observation, and informal chats with different stakeholders. The semi structured interviews with CHWs were conducted to get a deeper understanding of their work and activities when conducting village clinics and how iCHIS affords them in assessment, classification, and treatment of the sick children and how those with danger signs may be referred to the nearest health facility. Interviews were also conducted with different stakeholders and mostly those from the Ministry of Health which is the main funder of the project. The reason for conducting these interviews was to get the iCHIS perspective and the purpose of implementing the application across the country. The interviews helped the principal researcher to have a clear understanding of the functional affordances of the application from the stakeholder's perspective. These interviews were very important as they helped the Principal Researcher observe the same occurrences from different perspectives hence having an understanding of the views of the users on the application and how they thought it may help to improve their daily routines. The interviews were carried out face to face and were scheduled according to the availability of the participants. During interviews, some predefined questions were used but there was no strict adherence to them. Some follow up questions were asked depending on how participants responded to the questions and in certain situations, questions had to be paraphrased. These questions were prepared in line with the ethical approval received from the National Health Science Research Committee, a research committee under the Ministry of Health. Thirty-two (32) participants were interviewed and these included Health Facility Personnel (4), Health Surveillance Assistants (20), iCHIS District Coordinators (2), iCHIS Trainers (4) and iCCM Coordinators (2). Consent was obtained from the participants before the date of the interview, and they were clearly informed that the interviews were voluntary and they had the right to withdraw at any stage without penalty. During the interview, the purpose of the interview was clearly explained to the participants, as well as their right not to respond to a question if they were not sure, their right to withdraw and their right to remain anonymous.

Focus groups were conducted during the iCHIS implementation training workshops and the principal researcher attended the workshops in four districts. The researcher took advantage of the workshop to bring together small and carefully selected groups of five to seven CHWs who run village clinics in their respective catchment areas. The focus groups were aimed at sharing CHWs thoughts, feelings and experiences of iCHIS and in particular the iCCM module. These interactions helped to get different opinions of how the village clinics are conducted and how the application may improve their work. Informal discussions which were aimed at getting more insight about the application

were also held with participants during the workshops. The participants were mostly members of staff from the Ministry of Health and district hospitals. Data was also collected through observation of how CHWs' conduct village clinics and how iCHIS was used in four health facilities in Balaka district.

Secondary data was collected by analyzing the documents which helped the principal researcher to have an understanding on iCCM implemented at the community level hence helping to identify the functional affordances of the application. The iCHIS user manual helped the principal researcher to get familiarized with the application. The following documents were reviewed: Malawi National Community Health Strategy, Reports from National Statistical Office, Integrated Community Health Management Information Systems (iCHIS) Phase I and Phase II reports and the annual Integrated Management of Childhood Illnesses Reports (2019/20, 2020/21, 2021/22) and iCHIS manual. For data analysis, the interviews which were mostly done in the local language (Chewa) and translated into English. The transcribed data files were analyzed to identify affordances emerging from iCHIS implementation during village clinics. Similar actions described by participants during the interviews were grouped together and assigned a thematic name hence, the functional affordances were identified and named.

5 Findings

The iCHIS application has eight (8) integrated modules namely; the Community Register that registers villages in each catchment area, the Household register that stores details of households in each catchment area, a Personal Register that records details of household members, Integrated Community Case Management that registers patients and four reporting modules (monthly, quarterly, semi-annual and annual). The area of focus in this study is the Integrated Community Case Management module that is replacing the Sick Child Recording Form, a protocol used by the CHWs during village clinics to assess the patient, classify the illness and refer those with danger signs to the nearest health facility for specialized care. After analyzing the data, three functional affordances were identified.

5.1 Diagnosis Affordance

The diagnosis affordance depends on material properties of the electronic iCCM that allows for the assessment of the sick children. iCCM guides CHWs in assessing a sick child using a step by step set of questions that are strictly followed, as shown in Fig. 1. The iCCM module is built in such a way that the user is not allowed to move forward before completing a particular step hence preventing users from skipping some important steps. This ensures that the assessment of the sick child is complete and effective. This is what one of the CHWs said.

"Unlike the Sick Child Recording Form where CHWs are guided by the color of the form in order not to miss some steps when assessing and classifying the child illness, this application is developed in such a way that one cannot proceed to the next step if the previous step has been missed or skipped. This ensures that

all necessary steps are completed and proper diagnoses is made. This gives us confidence that we have made a full assessment of the sick child." CHW1
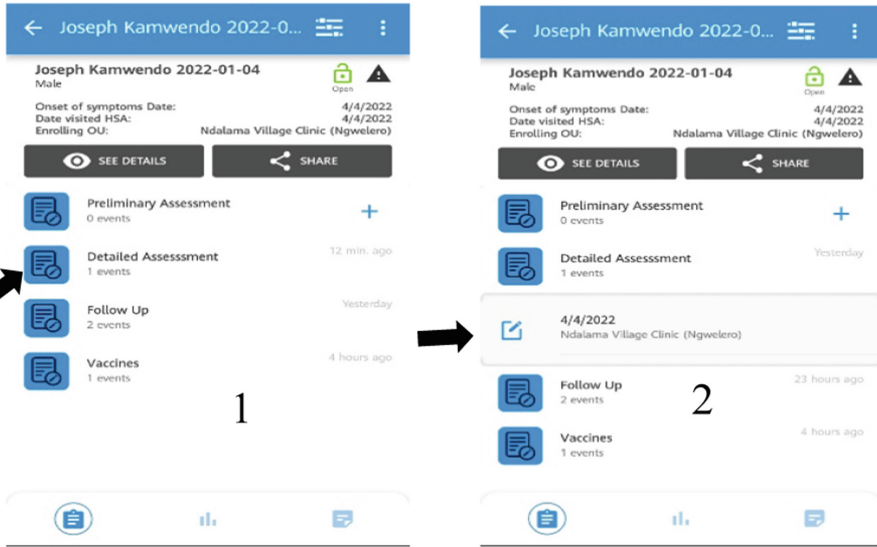
Fig. 1. Patient Assessment Form

5.2   Treatment Affordance

Classification of sick children follows proper assessment. The iCCM module guides CHWs in classifying the illness as either presenting "danger signs" of illness or sickness or as presenting "no danger signs". CHWs are also guided on what diseases they can treat and what they cannot treat. Therefore, depending on the signs and symptoms that are presented and the number of days that the child has presented with the signs, the application classifies the child as either presenting severe signs of illness or not. Consequently, those presenting with severe signs are prescribed pre referral treatment in order to stabilize their condition and thereafter referred to a health facility without delay. While for those with no danger signs, the application guides them on what treatment to be prescribed. The findings revealed that when set guidelines are followed properly, they afford more accurate diagnosis and treatment recommendation. Where there is incomplete assessment of a sick child, this may lead to wrong classification of the ailment. Consequently, misclassification may lead to delayed referrals that may result in serious complications and in the worst situation may lead to death.

The findings also revealed that the iCCM module aids CHWs in making prompt decisions especially when a patient is to be prescribed treatment or referred to the health facility once they present some danger signs. CHWs argued that although the Sick Child Recording Form (a protocol used by CHWs) has set guidelines on various ailments and

treatment, the final decision on what treatment to be given to the patient was mostly dependent on the CHWs judgment. Wrong judgment would therefore result in wrong treatment. With the mobile application, the decision on what treatment to be given is made by the application itself depending on the information that has been entered into the system. This ensures that accurate treatment is given.

"The Sick Child Recording Form does not have controls. If you miss a step, it will not stop you from proceeding with your assessment hence if you are not careful, you end up with a wrong decision on classification of treatment. At times, we have ended up prescribing wrong treatment due to some steps that were skipped during assessment and classification." CHW2

"Using this mobile application, if you miss one field, it will not allow you to proceed to the next level. Because of these controls, we are always confident that the treatment recommendations made by the application are always accurate." CHW3

CHWs felt the application helped them in making accurate referral decisions. They felt some of the referrals made could not have been made had they used the Sick Child Recording Form. There are also times when CHWs have determined a patient to be critically ill when they are not.

"The application has got greater impact on referrals. There are cases when you just look at the child and think they are not supposed to be referred but using the application, it decides that the child should be referred" CHW4

"Based on our experience, we have at times judged the patient as being critically ill and required to be referred to the health facility but the application decides that the patient be treated at home." CHW5

Patients who present danger signs of illness are supposed to be immediately referred to a health facility. However, CHWs argued that using the Sick Child Recording Form once one skips one step, one may end up not referring the patient as is required.

"The application is capable of telling me that the patient has got danger signs and therefore must be immediately referred to the health facility." CHW6

"Using the application, the referral decision is made quickly because the moment you finish the assessment process, the decision on whether to refer the child or not would have been made hence saving life." CHW7

The findings revealed that treatment affordance actualized into follow-up on the patients. The protocol requires that patients must be followed-up three days from their last clinic visit or three days after being discharged. Follow-up allows CHWs to check the progress of the patient and either discharge the patient if they are getting better or refer the patient to the health facility if the condition is not improving. Using the follow-up module, the CHW can set the date of follow up in the system as a reminder as shown in Fig. 2.
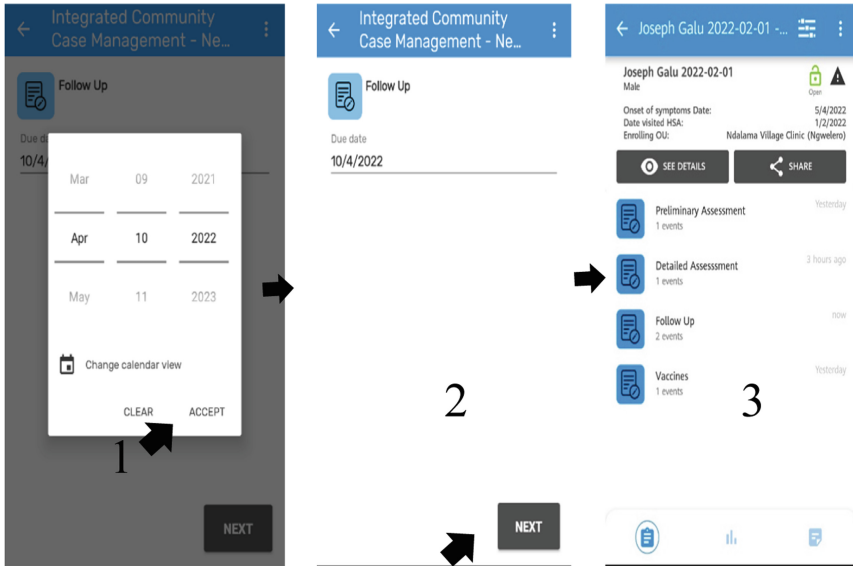
Fig. 2. Patients Follow–up Form

5.3 Remote Data Collection Affordance

iCHIS allows CHWs to collect data as when conducting household visits and during village clinics and thereafter, they sync the collected data to a server. The data can be accessed at any time for instance when they want to retrieve details of household members who were registered in their respective catchment areas, details of household members that have visited village clinics, details of treatment that was prescribed and details of patients that were referred to higher level health facilities. CHWs are able to produce quick monthly reports because they are able to access data at any time. Such data is also easily accessible by other stakeholders with the right to access the system as was commented by one CHW.

> *"Using this application, we are able to access our data at any time and we can also be able to produce reports quickly unlike the registers. Since the modules are integrated, data that is stored in one module can also be retrieved by another module. For instance, if a child visits a village clinic and is already registered in the personal register module, you don't need to re-register their details but you can just retrieve from the system. It is very efficient." CHW10*

6   Discussion

We examined iCCM module of iCHIS that is aimed at reducing child mortality and morbidity in hard-to-reach areas in Malawi. CHWs have highly accepted the application and cited reduced errors in assessment and classification of child illness as the key benefits. The application leads them to make more accurate assessments and prompt

decision making. On the referral process, the majority of CHWs reported that the iCCM module has greatly improved and simplified their decision-making process and increased their confidence in the referrals made.

In this study, affordance theory was employed as an appropriate lens to analyze our findings. Following [35] guidelines for using affordance theory, we identified three functional affordances of iCCM modules and their outcomes. The functional affordances were identified based on their material properties affording action possibilities and the action goals [30] as follows: diagnosis, treatment and remote data collection. As for the diagnosis affordance, the findings revealed that through some set validation rules, the application restricts users from skipping rules when conducting an assessment of a child's illness and thereby affords CHWs to provide proper assessment. However, for an affordance to be actualized, there must be a goal-oriented actor with action capabilities and the IT artefacts that affords the possibilities of the action [31]. Our findings resonate with Thapa and Sein [31] that the actualization of proper assessment depends on how the actor perceive the object. If the object is perceived but not properly used, the affordance may not be actualized as intended. For example, using the Sick Child Recording Form, CHWs could sometimes not follow guidelines properly or skip some steps due to the absence of validation checks and this resulted in wrong assessment being carried out that resulted in wrong classification and treatment.

Treatment was another affordance that the application provides. CHWs argued that the application is capable of identifying children who would otherwise not have been referred using the Sick Child Recording Form. Findings reveal that when set guidelines are followed properly, they afford the CHW to classify the child as either presenting danger signs of sickness or not. Where there is incomplete assessment of a sick child, this may lead to wrong classification of the ailment. Consequently, misclassification may lead to delayed referrals that may result in serious complications and in the worst situation may lead to death. Our findings agreed with earlier studies [17, 18] that found that the use of mobile applications by CHWs facilitated decision making in identifying children that needed to be referred to a health facility. This resulted in increased number of referrals to the health facility, prevented unnecessary re-consultations at village clinics and hospitalization rates for children under five years of age [24, 25, 38].

Remote data collection is an affordance that CHWs mentioned that it has simplified their work as it enables them to collect and use their own data and produce reports effectively.

Overall, almost all CHWs felt the application had a great impact on the referral process of the sick children and that it facilitated the referrals decision by accurately identifying all danger signs. However, CHWs varied in the number of patients referred to the health facility. While most CHWs felt the application had increased the number of referrals, some argued that the number had remained the same.

Another affordance which was identified but not implemented in this application is **Communication Affordance**. Communication between CHWs and health facilities personnel is a facilitating condition that would enhance communication between the two healthcare levels. Communication is important especially where the patient is being referred to a health facility and the facility needs to be informed in advance of the impending referral or where a patient has been discharged from the health facility and

there is need for further follow-up by CHW. Communication between the two levels will also ensure that referral feedback is sent to CHWs. Referral feedback is important at every level of healthcare. Feedback from the health facility to community level ensures proper follow-up of patients by CHWs, continuity of care, and improves coordination between CHWs and health facilities [38]. We therefore recommend that further development of the application should include features that will afford communication between CHWs and the health facility to enhance referrals.

7   Conclusion

In this study, functional affordance theory has been applied as a lens for analyzing and discussing our findings. Three functional affordances have been identified as diagnosis, treatment, and remote data reporting. The findings have revealed that diagnosis affordance uses material properties of digital iCCM to strictly assess the sick child resulting in the identification of signs and symptoms for the disease. We also found that digital iCCM provides action possibilities that allow CHWs to classify the illness and eventually prescribe treatment if there were no danger signs, or to refer to the higher-level facility where the patient presented danger signs of sickness. Lastly, we found that the digital iCCM afforded CHWs to collect data remotely and also produce reports.

Our research lends some evidence to the argument that the use of mobile phones and related technologies will continue to enhance healthcare management at the community level [20, 22, 27]. Our findings suggest that the use of mobile applications helps CHWs in making accurate assessment, classification, and treatment of patients. The findings further revealed that the iCCM module has greatly improved and simplified the decision making process and increased confidence of CHWs in patient referrals that they make.

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Technical Mediation in Building an Institution for AMR Monitoring in Resource-Constrained Settings

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Abstract. This paper examines the relationship between technology and ongoing institutional work to address the challenge of AMR data management in resource-constrained settings. The study explores the three sequential stages involved in building a digitally mediated institution, where technology influences and is influenced by institutional work. The first stage focuses on enrolling actors and designing the digital monitoring system, with institutional work mitigating challenges and shaping actor participation. In the second stage, the generated reports serve as mediators, facilitating institutional work to enhance data quality and drive decision-making. The third stage involves translating heterogeneous actors through conversations around data, creating a new institution of generating state data on AMR. The concepts of technical mediation and institutional work provide insights into the complex dynamics and collaborative efforts necessary for effective AMR data management and improved patient care. This approach recognizes the influence of social and cultural factors on data practices and emphasizes the role of diverse actors in building digitally mediated institutions to address AMR.

Keywords: Technical mediation · AMR · Institutional work · actor network · information system · digital · AST · NAP

1 Introduction

Antimicrobial Resistance (AMR) is one of the most significant health challenges facing the world today, particularly in low- and middle-income countries (LMICs) already grappling with existing inequities in access to and quality of care across various socioeconomic, geographic, and demographic categories [1]. The causes and effects of AMR are interconnected and mutually reinforcing, with AMR being both a cause and a consequence of existing inequities in LMICs. In India, for example, high disease burden, limited resources, and weak health systems result in the inappropriate use of antibiotics, which is the leading driver of AMR, thereby exacerbating the existing inequities [2]. Several policies and frameworks are defined at the global and national levels. For instance, the Global action plan (GAP) developed by WHO guided the development of National action plans (NAPs) in partner countries. It discusses the key strategies

to address AMR at national and global levels. All NAPs emphasize the importance of using antimicrobials carefully and appropriately [3]. However, they do not consider the contextual challenges and obstacles hindering progress towards this goal, especially in resource-constrained settings already grappling with existing challenges [4]. These challenges include inadequate legal and regulatory frameworks, unequal access to diagnostic tools, lack of electronic health record systems, limited knowledge and awareness, particularly when dealing with multiple systems of medicine, difficulties with access to quality-assured medicines, over-the-counter (OTC) availability of antibiotics, and a shortage of well-trained healthcare professionals. Efforts to combat AMR are challenged by the poor availability of reliable data [5, 6], particularly from low and middle-income countries [7], making it very difficult to estimate the burden of disease [8].

The availability of information is a critical component to identifying the contextual challenges to address the challenge of over and irrational use of antibiotics. One of the key strategic priorities in NAPs is to *strengthen the knowledge and evidence base through digital surveillance and monitoring to strengthen policy and practice.* However, owing to the poor digital infrastructure, most LMICs lack the capability to capture routine health information to understand the existing health disparities effectively [9]. For example, in India, the surveillance of AMR is fragmented, with three independent networks[1] collecting surveillance data based on antimicrobial susceptibility tests (AST[2]), lacking uniformity and scalability, and incomplete information [10]. Addressing these challenges requires a profound contextual understanding of contextual and sociocultural practices and challenges at the local level in the health institution and how novel digital capabilities can mediate the efforts to address AMR monitoring challenges for local action.

Despite the urgency and global significance of the challenge of AMR, there remains a noticeable lack of focus on these issues within information systems (IS) research. While IS research has made valuable contributions in various areas of healthcare, the specific intersection of AMR exacerbating the existing health challenges demands increased attention. Given the pressing need for innovative solutions to combat AMR, there is a compelling opportunity for IS research to address this critical gap and contribute to the broader goal of achieving sustainable healthcare systems. A deeper understanding of the sociocultural and technical factors, including the contextual practices and challenges and their impact on AMR, is crucial for developing effective strategies and interventions. This contextual understanding can guide the process of development and implementation of information systems, especially in low-resource settings shaping new practices and processes that guide patient care and policy-making at local levels with the ability to be scalable to other contexts [11]. While it is widely acknowledged that technology has an impact on shaping organizational practices [12, 13], there is still limited understanding of the specific mechanisms and processes through which this influence occurs. The

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[1] The National Centre for Disease Control (NCDC)- 35 laboratories in state medical colleges, Indian Council of Medical Research (ICMR)- 30 tertiary laboratories and WHO Country Office for India with the Indian Association of Medical Microbiologists Delhi (IAMM-DC) to establish the WHO-IAMM Network for Surveillance of AMR.

[2] Antimicrobial susceptibility testing (AST) is a laboratory procedure performed by microbiologists (clinical laboratory scientists) to identify which antimicrobial drugs are specifically effective for individual patients for particular infections.

relationship between technology and practice development is complex and multifaceted, involving various factors such as individual action, organizational influences, social interactions, and contextual elements.

Drawing from a sociocultural and technical approach, this paper explores the entanglement of social and technological elements and how they shape practices leading to building digitally mediated institutions to address the challenge of AMR. This research draws from Latour's [14] technical mediation and institutional work [12] to understand and analyze this phenomenon within the organizational context. This framing provides insights into the interdependencies between sociocultural factors and networked relationships and the role played by human and non-human actors in creating, maintaining, and disrupting institutions. This paper addresses the question, '*How does technology mediate the institutional work in the process of building a new institution of AMR data management in resource-constrained settings for local action?*' In answering this question, this paper describes the process of design, development, and implementation of a digital monitoring system for AMR monitoring at a tertiary hospital in India grappling with the existing challenges of lack of infrastructure and resources.

The rest of the paper is organized as follows. In the next section, a theoretical overview of technical mediation and institutional work, along with their application in the paper, is described. In the third section, the methods adopted for data collection and analysis are followed by the case study in section four. Section five presents the case analysis guided by technical mediation and institutional work. Discussions and conclusions are presented in sections six and seven.

2   Technical Mediation and Institutional Work in AMR Data Management

AMR is a hybrid problem [15] characterized by the blurring of traditional boundaries between global, national and regional levels, humans and non-humans, various domains of knowledge and practice. This highlights the need for biosocial-technical approaches to address it. Actor-Network Theory (ANT) provides an epistemological perspective for this research, focusing on complex relationships within actor networks [16] by avoiding preconceived assumptions about actor significance, relationships, and identities, allowing them to emerge through empirical analysis. In ANT, both human and non-human actants are considered equivalent, following the principle of generalized symmetry [17]. This paper explores actor interactions and translation processes are examined through three modes of technical mediation defined by [14], enrolment, alignment and translation. One actor can enroll another, aligning their goals and facilitating a shared translation process. Human and non-human actors collaborate as a network to achieve their mutual objectives.

ANT is particularly well-suited to case study investigations as it allows both social and technical – or, more appropriately, socio-technical – actors to be considered in their dynamic interrelationships. ANT is also valuable for studying organizational change, particularly when driven by a diversity of actor types. Its application with institutional work [12] can overcome traditional human-centric perspectives and gain a more comprehensive understanding of the complex socio-material dynamics at play in institutional

processes. This approach helps uncover the various actors involved, their interactions, and the role of non-human elements in shaping and maintaining institutions. Ultimately, it enhances our understanding of how institutions emerge, persist, and change over time. ANT has been used in many organizational contexts, including Project Management Information System programs [18] and the impact of information technology on organizational change processes [19]. Raviola & Norbäck [20] studied institutional change across Italian newspapers due to changing technology by using ANT with institutional work [12] to account for the influence of material elements (non-human actants) without denying the prerogative of human actors. They employed this approach in partial response to DiMaggio's [21] warning that classical institutional scholarship had neglected individual agency.

Institutional Work is *"the purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions"* (p. 215) [12]. It acknowledges that institutional work encompasses both the visible and dramatic endeavors as well as the often overlooked and mundane practices that shape the functioning and evolution of institutions [22]. Hampel et al. [23], in their review of existing studies on institutional work, emphasized the employment of other social theories like ANT to study and understand the impact of material on institutions. This paper takes a similar approach, recognizing the need to explore the role of material elements and heterogeneous actor networks in institutional work [23] to build a digitally mediated institution of AMR data management for local action. The application of ANT (technical mediation) and Institutional theory (institutional work) for this paper was thoughtfully considered, as these two have different ontological and epistemological foundations, which pose challenges for their synthesis [24]. This perspective views reality as a construct that is continuously in flux and shaped by dynamic configurations of human and non-human entities. This understanding is recognized in both institutional work [23] and ANT [14, 25]. Modell et al. [24] observed that studies adopting these concepts, while not rigidly adhering to the notion of embedded agency [26, 27], have resulted in a more comprehensive and nuanced understanding of the evolution of practices within institutional settings, offering a "richer understanding" (p. 72) [24]. ANT also offers a useful to explore a challenging aspect of agency in the ongoing institutional work during the periods of institutional stability when they are habitually reproduced. This is because it is during the creating or disrupting work that the agency of the actors becomes evident. ANT allows extending the understanding during these phases by focusing on the processes rather than the outcome itself. Furthermore, the authors [12] observed that ANT provides a valuable research strategy and methodology that effectively expands the understanding of institutional work by challenging the conventional perception of institutions as static and enduring social structures. Drawing from these perspectives, this research explores the intricate interplay between actors, material elements, and sociocultural factors using ANT (technical mediation) [14] and institutional work [12]. These two concepts together help uncover the complexities and nuances of institutional dynamics, thereby guiding how digitally mediated institutions for AMR data management are shaped, maintained, and challenged through the collective efforts of various actors.

3   Methods

This is an ongoing qualitative longitudinal case study started in 2019 in a tertiary hospital in a north Indian state. The hospital under study, typical of most public hospitals, has limited experience with digital systems and suffers from constraints of weak diagnostics, limited capacity, manpower, and infrastructure, with information on antibiotics prescriptions and consumption currently largely invisible. The hospital has a high patient load (of around 2000 patients every day) that, while struggling with historically existing constraints of manpower, resources, and digital infrastructure, took the decision to implement a digital AMR reporting system.

The process started with the design and development of an AMR surveillance system at the microbiology lab of the hospital based on a free and open-source digital platform called DHIS2 (see dhis2.org) with technical support of a local NGO called HISP (Health Information Systems Programme) India. The author of this paper holds dual roles as a researcher and a member of the HISP team. As a researcher, the author explored how digital systems can effectively intervene in this process. At HISP India, the author is actively involved in the practical processes of designing, developing, and implementing the digital antimicrobial resistance (AMR) monitoring system. The author's unique position allows her to observe the real-world practices of antibiotic use in context while also analysing them through the lens of research. This enables bringing a critical perspective to the development and implementation of the AMR monitoring system and to identify areas where improvements can be made. The data collection to study the challenges associated with AMR data management and the design and implementation of an AMR monitoring system were parallel activities and hence discussed together.

3.1   Data Collection

Data collection and the design and development of the digital monitoring application are carried out as ongoing activities. To understand the challenges associated with AMR data management and the ongoing design and development of the AMR surveillance system, I studied the overall information flow at the hospital about how AMR data is generated, where it is generated, and how it reaches the treating physician and the patient, and the practices of the stakeholders involved in AMR data handling. The data collection included interviews and discussions with the hospital stakeholders, with a key focus on the microbiology lab, to understand the practices around sample testing, starting from the arrival of the patient at the hospital, the physician ordering for the AST, sample collection, sample transfer, testing at the lab, documentation, dissemination, and data use. This empirical work fed into the design and implementation of the AMR surveillance system. Table 1 provides an overview of the data collection tools of AMR data management, and in the next section, I will discuss data collection in detail:

Table 1. Data collection tools

Stakeholder group	Method	Numbers	Details
Staff at the registration and billing counter	Interviews	2	Workflow and activities involved during registration, billing, sending the patient for consultation, collecting the sample and getting test results from the lab. Challenges faced with the existing workflow
Staff at the sample collection unit responsible for collection and transfer		2	Existing methods of sample collection, transfer to various labs, challenges faced
Physicians		10	Information needed for patient care, if it is readily available, what information is needed, preferable format for reporting, challenges with the existing workflow, suggestions for improvements
Microbiologists		5	Data reporting and details of reporting to physicians and the state/reports dissemination to patients/physicians
Lab technicians		3	Receiving samples, maintaining records, testing, etc., at the lab
Data entry operator (DEO) at the lab		2	Data entry and flow of information using the application and challenges in cases the test is delayed, missing information in registers, etc
Registration staff, sample collection staff, Microbiology team, Lab technicians, DEO	Observation		AMR data handling in the registers and digital application; Billing and sample collection; Microbiology lab-data entry, reports dissemination, data use
Microbiology teams, Physicians, Hospital management, HISP India (technical) team, Microbiology team from other hospitals in the state	Discussion		During the design, development, implementation, and efforts to use the data
	Workshop		Annual workshop for requirements analysis, implementation progress, challenges, and the way forward

Semi-structured Interviews

The interviews were important sources of empirical material. In some of these interviews, the interaction between the researcher and informant was a planned event and was structured as an interview. Often, however, the data collection was more ad-hoc,

which resulted because of observation or a discussion. The microbiologists, lab technicians, and data entry operators were first interviewed using a semi-structured interview guide to understand their respective workflow at the billing and registration department, sample collection unit at the hospital, and microbiology lab. Subsequent interviews were scheduled either because of observations or follow-up interviews from discussions.

Observation of AMR Data Management Practices

Along with the interviews, observing the workflow starting from the patient's arrival at the registration desk at the hospital was an important source of data collection. The observations were limited to understanding the AMR data handling practices - how patient data was captured and reached the physician through the microbiology lab during treatment at the hospital. The purpose of being physically present in the hospital, rather than relying solely on interviews, was to witness their organization and practices, contributing to an in-depth contextual understanding of the flow of information. These dynamics have been important in shaping knowledge from interviews [28].

Annual Workshop

An annual workshop was held every year at the hospital premises organized by both the hospital and the HISP India team to discuss the progress implementation challenges and way forward. It was an important data collection tool to both observe and discuss the progress of the implementation over a period of years and to hear the views of both the microbiology team and the hospital management. The annual workshop was especially relevant, as the diversity and number of participants over the years increased as the microbiology teams from the nearby hospitals and physicians from several departments in the hospital joined.

3.2 Data Analysis

Data analysis was carried out in four sequential stages. Data collation and organization: All data collected, including interview notes, observations, and study of documents, were organized, and collated to facilitate analysis. Transcriptions: All primary data was transcribed and translated from Hindi to English wherever needed and digitized. Thematic analysis to identify the AMR data management challenges: First, responses were grouped, and major practices were identified, representing the understanding of the problem.

The first stage of data analysis comprised broad thematic analysis of interviews which revealed: a) the three key periods; b) ongoing institutional work by the actor; and iii) evidence of technical mediation in the activities. In the second stage, the interview transcripts were read and read to code each interview looking for the various modes of technical mediation, its resultant translation, and for the institutional work done by the actors. This process used (Lawrence & Suddaby, 2006) typology of institutional work types under creating, maintaining and disrupting categories. In the third stage, the three different stages, data entry optimization, ii) enhancing data circulation and visibility across the institution, and iii) data utilization to drive clinical practice and policy-making within and across hospitals - each of these phases were studied individually and their interrelations related to each other when considering technical medication. This allowed identifying the associated institutional work types.

4 Case Study

The case is described in three sequential phases i) data entry optimization, ii) enhancing data circulation and visibility across the institution, and iii) data utilization to drive clinical practice and policy-making within and across hospitals.

4.1 Data Entry Optimization

At the hospital, the practice of managing the AMR data at the microbiology lab is largely manual. The lab has manual registers where the technicians record the patients' samples and test results daily before being relayed back to the indenting department. Existing data in the manual registers was not subjected to any systematic analysis before the introduction of the digital application and was now captured and analyzed to identify the resistance patterns in the hospital. However, this journey of transformation involved work and transformation of the existing practices of manual data collection and management to enable the digital system to make the problem of AMR visible.

To initiate the process, the principal of the hospital organized a meeting with the entire microbiology department. The AMR data monitoring system was demonstrated and was subsequently implemented for digitization as the microbiology team saw potential in the application. A microbiologist described:

We have all of the historical data lying in the registers which has never been analyzed. Whenever any data is demanded from us, data needs to analyzed from the registers. However, if this is automated and the data is analyzed automatically, our process of generating reports will become easier.

The initial focus of the work at the microbiology lab was mainly on i) recording the AST requisition form sent by hospital physicians to the lab and ii) recording the test results. Subsequently, other modules have been incrementally added (for example, data analysis and infection control) based on continuous discussion and interactions with the team in the lab. Several challenges were observed after the introduction of the digital system that required changes in the existing practices to stabilize the use of the digital application. For example, a data entry operator from the registration desk of the hospital who was assigned to do data entry at the microbiology lab for two hours in the day. However, he had no experience working in the microbiology department and was new to the terms used, and often needed help from the lab assistants. Some problems were also experienced with the regularity of the operator since this was not his exclusive responsibility. The data entry operator explained:

I come to the microbiology department after getting free from the registration desk. Sometimes, I cannot come to the lab when I have pending work at the desk because that is my primary duty at the hospital. In the lab, I copy and enter the details written in the register into the digital application. Sometimes, I do not understand the terms and handwriting in the register and ask the lab assistant for help.

To help the data entry operator, microbiologists prepared a manual sheet with codes and the names of the antibiotics, which were pasted on the wall next to his desk. A full-time data entry operator was subsequently hired as challenges were experienced in the data entry routines and data quality.

Another challenge was to strengthen the practices by which the missing details in the requisition form, such as the patient's clinical symptoms, diagnosis, antibiotics treatment, and sometimes even the sample type and location, could be filled. A microbiologist said during an interview:

'The requisition form received with each sample from either the sample collection unit for outpatients or wards/in-patient departments is incomplete in many cases or is illegible. There is no information on the diagnosis, proposed antibiotic treatment plan, etc., advised before ordering AST'.

This missing information needed to be filled in to generate more meaningful reports, such as resistance patterns by departments and sending test results to the treating physicians and, ultimately, the patients. The software team worked closely with the microbiology team to identify missing fields by creating a report, which was then presented to the microbiologists.

The microbiology team used this report as evidence and took it to the medical superintendent of the hospital to drive policy actions, such as requiring trained medical interns to be primarily responsible for sample collection and ensuring all sample details were filled in the requisition form before they were accepted for testing. The microbiology team also changed the format of the requisition form, where they highlighted the mandatory information which was required to be filled in before the sample was accepted. The software team then automated the process of report generation, and now a monthly report is generated and reviewed monthly to understand what gaps persist. A data quality report generated two months after the workarounds were implemented at the hospital reflected a significant improvement in completeness, with now less than 20% of the fields being incomplete as compared to 70–80% previously.

4.2 Enhancing Data Circulation and Visibility Across the Institution

The data quality report generated provided the microbiology team with the necessary information to drive changes at the administrative level. These interventions led to significant improvements, as shown in the data quality report generated two months after the intervention. Additionally, the microbiologists trained interns at the lab to collect samples at the sample collection unit. These interns were microbiology graduates completing mandatory monthly duties at the lab as a part of their course. These interns would go to the sample collection unit to collect all samples themselves and write all the necessary details on the requisition form to facilitate completeness and accuracy of data.

As the data entry processes were increasingly streamlined, the attention shifted to the outputs, and the microbiologists started giving requirements for their desired data outputs. These requirements were discussed with the software team, developed, and made available through the customized dashboards offered by the digital platform. The microbiologists could now independently download the automated reports from the application dashboard, which was updated daily with current data, and a stack of reports started to be compiled and emailed to the hospital management, such as the Antibiotics Stewardship Committee, the clinical departments, and also the State Secretariat. Some of

the reports on the dashboard are shown in Fig. 1, including an aggregation of the sample types received at the lab, organisms identified from the samples, and the antibiotics sensitivity pattern.
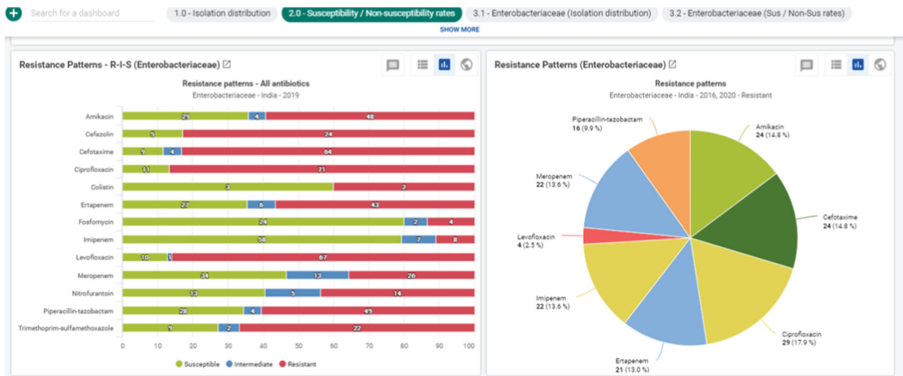

Fig. 1. A sample dashboard

A microbiologist mentioned the utility of these reports in day-to-day work:

'It used to take us weeks to count the numbers from the register and prepare a report. Sometimes, we even skipped developing this report because it was cumbersome and practically impossible to count several figures and document them correctly'.

But now, with support from the digital application, the microbiology lab sees the potential of evolving the existing quarterly susceptibility report into a quarterly organization-wide susceptibility report. After many rounds of discussions, it was decided to develop an aggregate report with department-wise trends of resistance, which could potentially help physicians to decide on the antibiotics to be prescribed based on the sensitivity patterns highlighted by the test reports. The microbiology lab took 4–10 days from the day of sample collection to the generation of the test report. This was too long, and in the meantime, the physician would end up prescribing broad-spectrum, higher-generation antibiotics to provide immediate care to the ailing patients. With this report, the team identified that physicians could make better evidence-based decisions, even in the absence of immediate test results. A sample monthly resistance report sent to all physicians is shown in Fig. 2.

Total no. of isolates (1/patient)	Location	%/N Per Location	Amikacin	Amoxicillin/Clavulanic acid	Ampicillin	Sulbactam Ampicillin-	Aztreonam	Cefepime	Ceftazidime	Cefuroxime	Ciprofloxacin	Colistin	Doripenem	Doxycycline	Gentamicin	Imipenem	Levofloxacin	Meropenem	Piperacillin	Piperacillin/Tazobactam	Tetracycline	Ticarcillin-clavulanic acid
Escherichia coli (N=98)	OPD	47.96 / 47	(1/1)	(19/23)	(2/12)	(1/1)		(2/2)	(5/10)	(3/5)	(3/9)				85.29 (29/34)	(2/2)		(14/15)			(3/3)	(1/1)
	Ward	31.63 / 31	(3/3)	(12/14)					(2/8)		(1/8)				(16/22)	(1/1)		(5/8)			(1/5)	
	ICU	6.12 / 6							(1/1)			(1/1)	(1/1)	(1/1)				(1/1)	(1/1)		(1/1)	
	Unknown	13.27 / 13	(1/1)		(3/5)				(1/7)						(8/10)			(3/4)	(1/2)			
	CCU	1.02 / 1													(1/1)			(1/1)				
Pseudomonas aeruginosa (N=9)	Ward	77.78 / 7		(1/2)			(1/1)		(4/6)		(2/4)	(1/1)			(4/5)	(2/3)		(1/3)	(1/1)	(1/2)		
	OPD	11.11 / 1													(1/1)					(1/1)		
	CCU	11.11 / 1										(1/1)										
Acinetobacter spp. (N=7)	Unknown	14.29 / 1								(1/1)				(1/1)								
	Ward	14.29 / 1																				
	CCU	28.57 / 2								(1/2)		(1/1)	(1/1)	(2/2)	(1/1)		(1/1)	(1/1)			(1/1)	(1/
	OPD	42.86																				

Fig. 2. A sample department-wise report

Another new practice introduced was the generation of reports based on the test results. The existing manual registers did not have the fields (and space) to capture details of the department, location by month and year, and to also fit in one page the long computer registration number. To resolve this issue, the microbiology team decided to design stamps with a predefined list of antibiotics for each sample and organism to be printed in the register to minimize manual data entry by the lab technicians, maintain data quality by standardizing the output, and in saving time to circulate the results. As a future practice modification, the microbiology team has also decided to change the format and reprint the registers to capture the necessary information after finishing their existing printed stock of registers. For example, the existing register does not have the fields for departments (Medicine, Surgery, etc.) and location (OPD, IPD, ICU, etc.). The format of new registers is being defined with the data set to be analyzed in consideration.

4.3 Data Utilization to Drive Clinical Practice and Policy-Making Within and Across Hospitals

As the microbiology team started generating their reports in their desired formats, the focus shifted to enabling the use of the data to build greater awareness about the problem of AMR within the hospital. As data entry processes improved, the microbiology team identified clinically relevant data to be reported to the physicians and the hospital management. For example, the microbiology team included age and gender-specific data to

identify the age and gender-specific resistance. Another reporting format was developed, which identified the top three resistant and sensitive isolates in the hospital.

Dissemination Of Information To The Treating Physicians

The monthly and quarterly department-wise reports sent to all treating physicians at the hospitals can potentially guide them to prescribe antibiotics therapy. Interviews were conducted with the physicians at various departments in the outpatient departments, wards, and ICUs to understand how these reports can be improved to better meet their needs. A consultant from the Gastroenterology department said:

> *'I always wondered if I had such a report available while prescribing, I would have an idea of what antibiotics are susceptible and resistant in the area. Currently, we prescribe a second or third line of antibiotics during the first consultation, but it is better to prescribe the first-generation antibiotic if it is susceptible in almost 80% of cases, as I see in this report. However, I did not think anyone would take the initiative to make such data available at a public hospital'.*

Dissemination of Information to the Antimicrobial Stewardship (AMS) Committee and State

As per the national guidelines, all public hospitals were mandated to form an antimicrobial stewardship committee. The hospital formed a committee in October 2021, which is led by the Head of microbiology and includes members from other departments, such as Medicine and Surgery. The committee meets every month, and the HOD microbiology presents the monthly resistance profiles downloaded from the monitoring application to the members. The committee decided to use one year of resistance profile report data to develop an infection control, and antibiotics use policy for the hospital. Additionally, the hospital shares a monthly resistance profile with the AMR coordinating centre in the state. A depiction of the flow of information with these interventions is shown in Fig. 3.

This process is now ongoing with the research team to have discussions with the different teams, understand their information needs identified in reference to the current organization-wide report format, and for the technical team to provide the required data support.

In an annual workshop organized in July 2022, the new hospital that had adopted the application updated the progress of data entry and AMR data management. This time the physicians from all clinical departments also attended the workshop to discuss the possibility of using the resistance data effectively, particularly for patient care and policy making. All departments in the meeting after the workshop were directed to develop a department-wise guideline based on the reports they received and submit it to the Department of Pharmacology. The microbiologists showed their reports from the last three years to all department heads attending the meeting. The chief pharmacist and team were made responsible for developing and presenting a hospital antibiotic policy in consideration of the guidelines shared by all departments. The hospital antimicrobial stewardship committee was thus tasked to develop a local antibiotics policy with guidance from experts from other hospitals who have developed this policy. This stage had its challenges, and further work is required to create the policy and implement it.
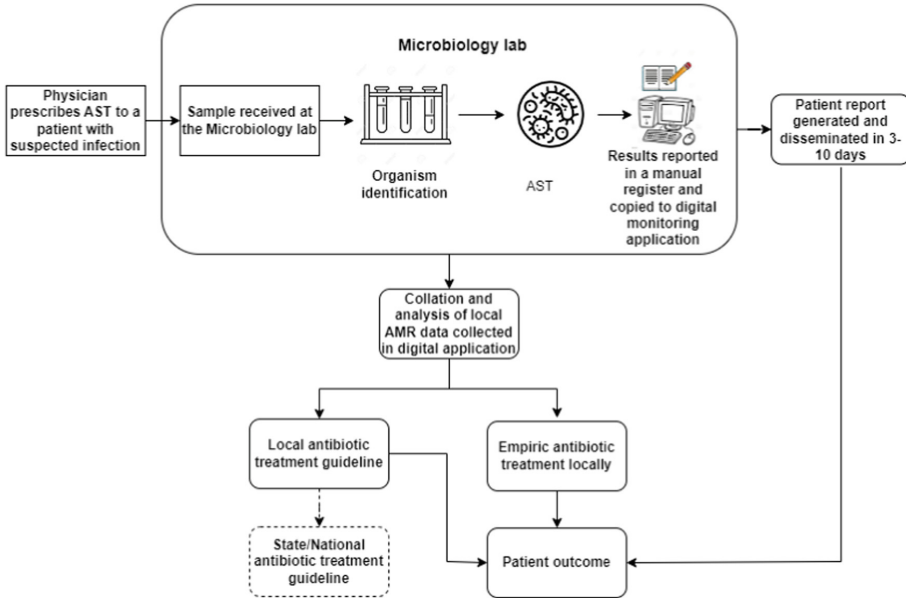
Fig. 3. Information flow after the interventions and data use efforts

Additionally, a baseline AMR application with minimum data set for AMR monitoring was maintained by the technical team with basic features to report, monitor, and analyse AMR data. This allowed the implementation of the application in other contexts with minimal development requirements. At the same time, new requirements, like the Android reporting and new reports developed at other sites, have been incorporated for new facilities, and some of them have been made available to the original facility to add greater value to their processes. Having data reported on standard parameters also helped in extending the learnings from this hospital to other medical college hospitals in Himachal Pradesh state to strengthen the state-wide reporting system.

5   Case Analysis

During the project initiation, the microbiologists were managing their AMR data manually at the hospital. The NGO enlisted the microbiology team to use the application while working on re-designing it along with the technical team at the NGO. Both teams had different goals for using and implementing the application. The microbiologists wanted to automate their reports which they were asked to report to the state and to streamline their AMR data management process, which was carried out manually. The technical team wanted to implement the application in a hospital setting and simultaneously work on re-designing the application from a patient perspective. This work was carried out with a potential vision to use the data, but it was unclear how it would be used during the project initiation. The technical team at the NGO and microbiologists working together led to translation, the development of a new link mediated by the digital monitoring application that did not exist before. This shaped the institutional work [12] to

design and implement the application at the microbiology lab at the hospital. The forms of institutional work employed for analyses are based on Lawrence & Suddaby's [12] classification of institutional work in creating, maintaining and disrupting categories.

In the first stage, the focus was on stabilising the data entry, which was met with several challenges and roadblocks that hampered the smooth process of capturing data. Addressing these challenges required ongoing institutional work. The role of technical mediation in work enacted by the actors in the process of stabilization of data entry is described in Table 2:

Table 2. Stage one – Institutional work and technical mediation

Institutional work	Institutional work description	Technical Mediation
Creating work		
Advocacy	Policy support from the hospital principal to assign a data entry operator to conduct daily data entry work, first part-time and then full time with support from NGO	Enrolling a new actor into the network to complete daily data entry from the manual registers to the digital application
Mimicry	Development of the custom user interface similar to the existing manual data entry form	The development of an interface that mimics manual processes serves as a means to translate actors and facilitate their acceptance of technology
Maintaining work		
Enabling work	Regular training and supporting the DEO by providing him with sheets of the list of antibiotics codes and departments to enable completing the everyday task of data entry	The shifting of the work of the actor by delegating new responsibility in the actor network and providing support with the everyday work

This describes the creating and maintaining work mediated by digital technology to stabilize the process of data entry. Advocacy work was mobilized by the hospital management by enrolling a DEO to initiate a new practice of using the digital monitoring application for capturing AMR data at the microbiology lab. Simultaneously, during the process of re-designing the application, the development of the user interface, which looked similar to the manual data entry forms, enabled the translation of the microbiologists and facilitated the acceptance of the application in their everyday practices. Enabling work was further mobilized by shifting the work of the DEO by delegating extra duties and by making the process of data entry easier by providing sheets of the list of antibiotics codes and departments.

After the data entry stabilized, the focus of the technical and microbiology teams was aligned towards generating outputs and their dissemination. With this alignment of interests during stage one to ensure regular data entry, the components of the digital monitoring system were black-boxed. It was when the focus shifted to data analysis.

Institutional work was mobilized to identify the challenges in generating the reports, which revealed gaps in the data quality as well as in the operations at the lab. During this process of reverse black boxing [14], these challenges were identified, and institutional work was mobilized to mitigate them. For instance, the data capture component was a collective of several other components like the completed requisition form from other departments, complete data entry in the register, and lab technicians doing timely data entry. Each of these components was analyzed to identify the challenges and the subsequent institutional work needed. This aligns with Latour's [14] example of the projector. As long as it works fine during a lecture, its functioning and its role goes unnoticed. It is only after the projector stops working, is its role is noticed, and the several components that the projector is comprised of are realized. Table 3 depicts the institutional work and technical mediation in stage 2:

Table 3. Stage two – Institutional work and technical mediation

Institutional work	Institutional work description	Technical Mediation
Creating work		
Constructing normative networks	Sharing of a monthly data quality report by the HISP team to enable the microbiology team to monitor and evaluate	Creating a collective of human (technical team, microbiologists, DEO) and non-human (data quality report) to expand the network for enabling data analysis
Maintaining work		
Enabling work	Interns at the lab are trained to conduct sample collection and accurately record the corresponding data	Enrolling new actors into the network to ensure the accuracy, completeness, and reliability of the data for the generation of reports
Disrupting work		
Undermining assumptions and beliefs	Regular evaluation of the data quality for the microbiology team to decide to replace register formats and design stamps	Sharing regular reports with microbiologists facilitated the translation of their perspectives, allowing them to contribute to improving operational challenges to improve data quality

Stage two included creating work by constructing normative networks by sharing a data quality report to enable action by the microbiologists to ensure the completeness and accuracy of the data collected. Maintaining work involved enrolling interns into the network as a means to improve the data quality by ensuring correct sample collection techniques. Disrupting work included regular evaluation and discussions about the processes and challenges that facilitated the translation by allowing the microbiologists

to identify and acknowledge the operational challenges and take corrective action. For instance, developing a new format of the requisition form, changing the format of the manual register and developing stamps to ensure correct data entry for accurate reports generation.

In stage three, the focus moved to the dissemination of reports and data use for patient care and policy making. The institutional work mobilized, and technical mediation is described in Table 4 below:

Table 4. Stage three – Institutional work and technical mediation

Institutional work	Institutional work description	Technical Mediation
Creating work		
Defining	Building a new practice to share a monthly and quarterly susceptibility report with the physicians	Use of a department-wise report as a mediator to enrol new actors in the network and enable them to engage with and make use of evidence-based data for prescription writing
Maintaining work		
Valorizing	Recognition of the work done by the microbiology team during the annual meetings and giving them the space to share their experiences	Acknowledging the agency of the microbiologists and the actant (the digital application) among the larger network
Disrupting work		
Undermining assumptions and beliefs	Regular evaluations and discussions among the teams as a means to substantiate the need to define standard guidelines for testing	Ability to generate their own reports by microbiologists facilitated the translation of their perspectives, allowing a shift by necessitating changing current practices

A new practice of disseminating the department-wise report to physicians generated from the digital monitoring system was initiated to enroll physicians into the network to facilitate evidence-based patient care. Recognizing the work of the microbiologists and giving them the space to share their experiences with the digital monitoring system gave them the agency to voice their concerns and translate other actors from nearby hospitals in the state to adopt the digital monitoring system.

6   Discussion

This paper explores how technology influences and is influenced by ongoing institutional work. Drawing from the findings, this paper describes the process of building a digitally mediated institution of AMR data management through the ongoing institutional work

throughout the three stages. These three stages are interconnected, with one leading to the other. The actors were enrolled into the network in the first stage, and institutional work was mobilized to stabilize the data entry, which led to the second stage, where the activities and goals of the actors were aligned to generate essential reports and disseminate them at the hospital level. This subsequently led to the third stage, where efforts where institutional work was mobilized to subsequently use the information that led to the translation of heterogeneous actors into the network. This is described in Fig. 4.
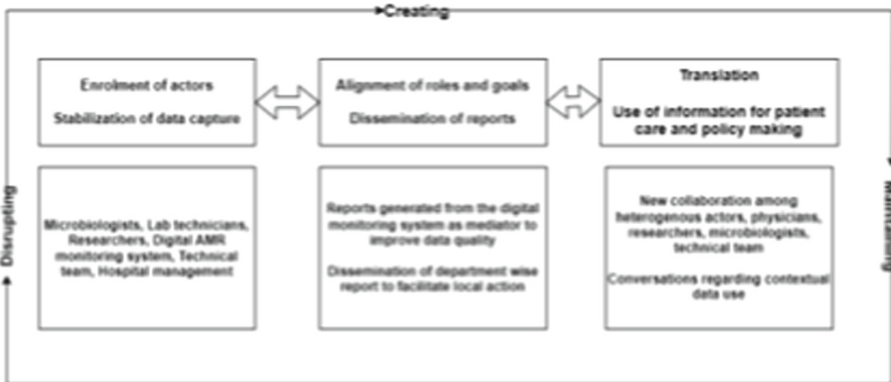

Fig. 4. Institutional work and actor network in the building of the digitally mediated institution

In the first stage, the actors were enrolled into the network to initiate working on the design and implementation of the digital monitoring system. Several challenges were experienced during the process, and subsequent institutional work was mobilized to mitigate the challenges. The digital monitoring system and the ongoing efforts to develop the data capture interface similar to the manual formats acted as a mediator that guided the enrolment of microbiologists and the laboratory team into the network. Making the work of the data entry operator easier by providing manuals facilitated regular data entry. The digital monitoring system and the ongoing institutional work of the actors acted as mediators, influencing, and shaping the enrolment and participation of actors within the network.

The enrolment of actors in the first stage paved the way for the second stage. In this stage, the report generated by the digital monitoring system assumed the role of a mediator, playing a crucial part in facilitating institutional work focused on enhancing data quality. The improved data quality, in turn, aligned the efforts of the actors towards generating a department-wise susceptibility report. The report, acting as a mediator, facilitated the coordination and collaboration necessary to drive institutional work and promote effective decision-making within the healthcare setting. This process subsequently initiated conversations around data, thereby translating heterogeneous actors in the network, both within the hospital and nearby hospitals, thereby developing a new institution of generating state data on AMR.

The concept of technical mediation [14] describes the intricate interplay between actors, technology, and institutional work to build a new institution facilitating local

action. It underscores the significance of digital technology in mediating interactions, enabling coordination, and driving the advancement of institutional action. It helps in identifying the institutional work [12] needed and mobilised by the actors to shape new institutions, leading to conversations around data to enable change at the local level in the form of improved practices for patient care and antibiotics policy making. This new institution represents a collective effort to address AMR data management challenges, transcending individual hospital boundaries and fostering collaboration among diverse actors. The role of technical mediation and institutional work becomes evident as this new institution takes shape, paving a path toward more comprehensive and effective management of AMR through the generation and efforts to use data for patient care.

Initiating conversations around data necessitates understanding the contextual social and cultural factors that shape data generation, interpretation, and application. It involves recognizing the influence of social norms and cultural values on data practices and exploring how these factors impact data management and decision-making. The concept of technical mediation and institutional work help in understanding the intricate dynamics at play, offering valuable insights into understanding and navigating the complexities of contemporary socio-technical systems and studying how specific elements and functions of an IS relate to organizational issues. It allows an understanding of interplay between technological systems and the broader institutional work done by actor networks to address AMR data management challenge.

7   Conclusion

This paper describes the interplay between technology, actor networks and institutional work in the development of a digitally mediated institution for AMR data management. The concept of technical mediation has highlighted the pivotal role of digital technology in facilitating interactions and enabling institutional work, while institutional work has been instrumental in shaping new practices and institutions. This collaborative effort has transcended individual hospital boundaries, fostering collaboration among diverse actors to address AMR data management challenges. Understanding the contextual factors and employing the concepts of technical mediation and institutional work has provided valuable insights into navigating complex socio-technical systems and advancing AMR data management practices.

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Institutional Pressures Shaping Data Use in Health Management at the District Level in Malawi

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Abstract. This paper explores how institutional theory illuminates the factors influencing the use of Health Management Information System (HMIS) data in healthcare service delivery at the district level in Malawi. It specifically probes the coercive and normative dimensions of the healthcare system's institutional framework and their impact on data utilization. The research adopts a qualitative methodology, comprising semi-structured interviews, participant observations, artefact reviews, and field visits to four District Health Offices in Malawi. The results demonstrate that healthcare staff's behavior towards data use is moulded by directives from the government and health partner organizations. While the Ministry of Health has endeavoured to introduce standardized data reporting formats, certain health partner organizations maintain non-congruent reporting structures for HMIS data. This duality compels healthcare staff to comply with both reporting formats, resulting in parallel reporting that impedes effective data utilization at the district level. This research offers valuable insights into the Information and Communication Technology for Development (ICT4D) domain by presenting empirically based viewpoints on the institutional pressures affecting data utilization in resource-limited settings. The findings hold particular relevance for Malawi's HMIS, which grapples with the continuous task of enhancing the volume and calibre of data to bolster healthcare service delivery.

Keywords: Institutional Pressures · Data Use · Health Management Information Systems

1 Introduction

Information Systems (IS) research has extensively studied data use [1], with a notable focus on health data derived from Health Management Information Systems (HMIS) in developing countries [2, 3]. Yet, there's a research gap concerning the role of institutional

pressures on data use. Data use encompasses the collection, analysis, synthesis, interpretation, and review of data from various sources to inform decisions [4, 5]. Examining institutional pressures, such as technology implementation dynamics [6], can elucidate the rationales underpinning healthcare staff behaviors. Furthermore, it can foster a comprehensive understanding of how these behaviors affect data use in health management decisions. Data use is intricate and socially embedded, exhibiting dynamics that might remain obscured [7]. Recognizing healthcare staff behavior as being influenced by institutional factors can unveil distinct research insights [8].

This paper delves into a case study on data use in health management decision-making within the national HMIS. The HMIS amalgamates data collection, processing, analysis, and reporting to bolster data-driven improvements in service delivery management across the healthcare sector [9]. This study seeks to explore the innate behaviors and actions of individuals and their subsequent influence on data use [8]. Our analysis is steered by institutional theory [11], enriching our understanding of concepts like institutional pressures [12] and their impact on healthcare data use [13]. Institutional theory's adaptability [14] offers a distinctive perspective to comprehend individual actions [6] and their influence on data use processes.

Malawi, mirroring many other developing nations in Africa, has since 2002 embraced the District Health Information System version 2 (DHIS2) as its principal HMIS data repository to fortify data use [15, 16]. Operating on a web-based platform, DHIS2 showcases aggregated statistical data, enabling integrated health data analysis. DHIS2 serves as a pivotal tool, enhancing the quality of data used in health surveillance and aiding in the prompt identification, prevention, and management of diseases [17]. Although the adoption of DHIS2 is evident, its effective use remains limited due to factors like a delayed response to institutional dynamics [18] and an insufficient evaluation of institutional elements and social contexts [2, 16, 19]. Moreover, Malawi grapples with deficits in human resources, infrastructure, and funding [20], all of which profoundly hamper effective data use. This paper thus raises the question:

'How do institutional pressures shape processes of data use at the district level in Malawi HMIS?'

The paper is structured as follows: Sect. 2 introduces the relevant literature on data use and the theoretical framework. Section 3 details the research methods employed in the study. Section 4 presents the findings and analysis. The discussion and conclusion are covered in Sect. 5, while Sect. 6 lists the references for the study.

2 Related Literature

Research in Information Systems has grappled with defining data use [1]. Often, data are presumed to uniformly represent an independent reality. Data forms the foundation for our objective representation of the world [21]. In their raw state, data are inherently meaningless; they only become informational when contextualized. Given the myriad of data sources available, both manual and system-generated, users constantly engage with data, encountering challenges in the process. Hence, the emphasis is on 'bringing

the user to the data instead of the data to the user' for meaningful interpretation [22]. Data can be empirical or non-empirical and may vary in perceived value [4].

Furthermore, data come in various formats, necessitating processing to address uncertainties and extract value [22]. The worth of data is influenced by its quality, including aspects such as relevance, accuracy, completeness, understandability, timeliness, and trustworthiness [1]. While data quality is pivotal for data use, achieving it requires an assessment of the data production process and a distinction between the contexts of production and use [23]. Achieving this distinction in practice is challenging due to the need to harmonise diverse interests, often coupled with varying understandings of data use processes and limited training opportunities.

2.1   Data Use

Data use is typically viewed in a restricted manner, focusing solely on data as an outcome, which obscures the underlying processes of data generation and distribution. This process includes various activities such as data collection, compliance, analysis, interpretation, and application [24]. These activities involve a myriad of stakeholders, both internal and external to the health department, each with a unique vested interest in the data. Such stakeholders might comprise clinical and non-clinical healthcare staff, administrators, managers, external entities, technologists, and support personnel. The myriad of interests and participants adds substantial complexity to the task of data utilization [23]. Many healthcare professionals engaged in data-related tasks often lack specific training. They might not view data tasks as integral to their roles but are obligated to undertake them [25]. For example, in many developing nations, due to staffing shortages, nurses are tasked with collecting statistical data at the point of service delivery [26], which detracts from their primary caregiving responsibilities. The mandatory monthly data reports by health professionals frequently lack consistent feedback and incentives to promote data use at the local level. As a result, data often suffer from issues related to completeness, promptness, and accuracy [27]. A study by [25, p. 435] raises a pertinent question, which is central to this research: 'How is the institutional pressure to be "data-driven" altering the management of healthcare organizations?'. This research delves into this query to comprehend the impact of such pressures on data use.

Prior studies on data use have suggested frameworks to enhance data application [5, 28], particularly in resource-limited settings [29]. Research by [30, 31] highlights the benefits of peer-driven data use workshops in elevating data quality and application. Another study underscores the positive ramifications of the rapid adoption of DHIS2 on data utilization methods [4]. While the findings of [4] align with those of [32] and [3], indicating progress in DHIS2 data use, they also underscore the importance of probing 'how data were created and who utilizes such data'.

Research underscores the variability in data use; such studies indicate that the application of data differs across various tiers of the healthcare hierarchy. For example, data from the DHIS2 platform informs decisions at community, sub-district, and district levels. These decisions encompass aspects such as DHIS2 platform performance, the promotion of data use, role revisions, responsibilities, resource allocation, advocacy, as well as policy and strategy formulation [3]. The District Health Management Team (DHMT), the primary decision-making administrative body, depends on high-quality

data for the comprehensive coordination of service delivery throughout the district [33]. However, the quality and application of DHIS2 data are bolstered not just by government commitment but also by support from donors and the attitudes of healthcare staff towards data use [34]. Despite this, factors such as limited human resources, concurrent data reporting systems [34], inconsistent feedback, inadequate supervision, capacity development, training, and motivation pose barriers to making informed decisions at the district level based on data use [32].

IS research has incorporated institutional pressures in data use analysis. Such an approach can potentially address long-standing concerns, specifically why 'the problem of underused data, and indeed, the total absence of data use, remains pervasive and has persisted for many years' [4] - questions which demand further concentrated research. A study by [35] indicated that coercive and normative pressures significantly impact organizational actors' behaviors and actions, leading to innovative concepts for organizational transformation. Subsequent sections will delve into IS research focusing on the impact of institutional pressures on organizational staff behaviors and actions, pertinent to the scope of this research.

2.2   Theoretical Framework

The study utilizes the concepts of institutional pressures from institutional theory. While prior research has approached institutional pressures through the lens of isomorphism, exploring how and why organizations within a particular field come to resemble each other [11, 12], this study adopts a different angle. It employs institutional pressures to investigate the challenges faced by healthcare staff engaged in data use processes at the community level. Institutional pressures encompass coercive, normative, and mimetic influences exerted on organizational staff to establish legitimacy. The notion of legitimacy posits that an individual's actions are seen as appropriate, fitting, and desirable within a system shaped by socially constructed beliefs, norms, values, and definitions [36, 37].

Other IS researchers have sought to understand the effects of institutional pressures on the behaviors and actions of organizational staff. For instance, [6] used institutional pressures analytically to determine the sources of crises and opportunities that affected staff behaviors and actions during technology adoption. These sources were categorized into coercive and normative institutional pressures. Additionally, [8] illustrated that staff behavior towards the intention to use technology was moderated by prevailing organizational norms and rules, suggesting that both coercive and normative pressures can profoundly influence healthcare staff's approach to data reporting.

Coercive pressures denote the formal and informal demands placed on individuals or organizations by entities they rely upon [11]. These entities often provide vital support or wield significant legal or regulative influence. Organizations dependent on them are typically expected to adhere to established rules, regulations, procedures, guidelines, and the external controls of their superior entities. The significance of acknowledging coercive pressures in organizational environments, especially during the implementation of healthcare technology, is emphasized by [36, 38]. External partners exert distinct pressures on organizations compared to governmental entities, which are primarily responsible for exerting coercive pressures [39]. Moreover, whilst governments may

value the professional input from external collaborators, such as donor agencies and investors, these external entities, due to limited understanding of the local milieu, might fail to pinpoint critical institutional challenges within the organization [40].

[41]'s study revealed that coercive pressures from the government, when combined with incentives and normative pressures, play a pivotal role in shaping healthcare staff behavior towards technology adoption. Normative pressures refer to the societal system norms, behaviors, and understandings that organizations and their staff need to adhere to for legitimacy [12, 42, 43]. Professional associations, accreditation agencies, and practice associations typically exert these pressures. Such normative pressures might manifest as expectations from the professional community regarding qualifications and accreditation standards specific to a domain. For example, the legitimate licensing of healthcare personnel with accredited bodies is crucial for effective service delivery. The Ministry of Health (MoH) might stipulate that healthcare professionals undertake a 48-h continuous professional training course on specific normative data standards at a recognized institution. Without this accreditation, the professionals might be prohibited from practicing [42]. While organization staff consistently aim for compliance with these standards, they also seek a legitimate foundation for their actions and a degree of occupational autonomy.

Moreover, these staff members often adhere to 'values and norms shared among the members of their social networks', learning about the potential outcomes of organizational decisions through 'direct and indirect interactions with others' [44]. [45] contends that inter-organizational interactions within social networks wield the most potent influence on individuals. Organizational staff often standardize practices to facilitate data sharing among interacting entities, with the study noting that normative pressures tend to be more effective than coercive ones.

[35] posits that the behaviors and practices of individuals and staff within organizations, such as external entities and governmental agencies, set the standard. Research suggests that employees with a deep understanding of a particular issue can introduce novel methods and persuade peers to embrace established procedures. If these informed employees can rally support from like-minded colleagues to endorse a specific norm, it is likely that the broader staff will follow suit. The success and impact of a norm hinge on its level of acceptance within the organization. A widely accepted norm invariably enjoys greater success than one that lacks widespread endorsement.

Organizational staff frequently grapple with a myriad of priorities, perceptions, and regulations in their daily tasks, leading to the establishment of specific norms. They often navigate diverse instructions from various hierarchical levels, each with its unique dynamics. These directives might lack cohesion and often necessitate distinct sets of knowledge and skills [46]. Healthcare professionals are typically expected to conform to standardized data reporting templates set by various partner organizations. While these partners aim to augment governmental funding [39], they often design program-specific healthcare systems tailored to enhance service delivery. Regrettably, many of these health information systems are not compatible, leading to interoperability challenges. For instance, standard data reporting formats like the Human Immunodeficiency Virus Electronic Medical Records (EMRs) are not always compatible with facility-level

aggregate reporting formats, such as DHIS2 [47]. This situation complicates the health-care landscape, as it becomes riddled with diverse normative datasets, elements, and reporting templates that are often embedded in uncoordinated and fragmented organizations [42, 48]. Such multiplicity in reporting formats can detrimentally affect data quality and impede its effective utilization. Another study indicated that institutional pressures from external entities active within the healthcare realm prompted healthcare organization staff to develop data processing proficiencies [13]. This trend emerged even when there wasn't a robust technical justification for the technology in question. The study underscores that adherence to normative and coercive pressures often stems from a desire to secure support and gain legitimacy.

A study by [49] sought to discern the impact of institutional pressures and top management on the assimilation of an information system. It posits that the sway of institutional pressures remains consistent and continues to adapt throughout the lifespan of intricate information systems. Moreover, the study contends that irrespective of the intensity of external pressures, they won't influence organizational behaviors unless they first resonate with the motivations of internal organizational actors. Consequently, this research employs institutional pressures as an analytical prism to explore the determinants molding health management's data utilization endeavors at the district level in Malawi. The subsequent section presents the conceptual framework guiding the study (Fig. 1).
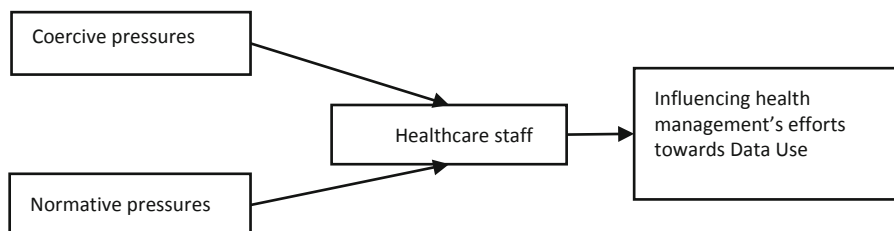

Fig. 1. Study Conceptual framework

3   Research Methods

3.1   Research Design

The interpretive qualitative case study was designed to attain a more profound understanding [50] of the factors influencing healthcare staff data use. In this research, the investigator approached knowledge within its inherent reality, acknowledging its subjectivity to context and relationships [51]. The case study method facilitated a multi-faceted approach to data collection and incorporated various sources to probe the institutional pressures influencing healthcare staff data use in health management at the district level [52]. This methodology provided valuable insights into the behaviors and actions of healthcare staff within their professional settings.

3.2 Study Context and Researcher Role

The study was conducted during the first author's PhD program at the University of Malawi (UNIMA). Within this program, the first author engaged in the Health Information Systems Programme (HISP) initiatives. The core aim of HISP revolves around the design and implementation of DHIS2 in developing countries [42]. Some data for this study were gleaned during the rollout of the Integrated Community Health Information System (iCHIS), a collaborative venture between the MoH Community Health Services Section and UNIMA. iCHIS is a mobile application that bolsters DHIS2's reach at the community level, which has been compromised due to various obstacles. The primary goal of iCHIS is to facilitate the collection, validation, analysis, interpretation, and reporting of aggregated statistical data, thus empowering informed data utilization across different levels of the healthcare system.

3.3 Empirical Setting: Malawi Health Management Information System (HMIS)

Malawi's HMIS mirrors a nationally coordinated health system segmented into five tiers of service delivery: national, zonal, district, facility, and community [53]. The national HMIS serves as the nexus where aggregated healthcare data reports, sourced from District Health Offices across the country, converge into an exhaustive data report. This compiled data is instrumental in monitoring nationwide health metrics, such as the prevalence of the COVID-19 pandemic, thereby informing decision-making processes geared towards health sector plan formulation and enhancing healthcare delivery and national health policy development. Historically, Malawi's HMIS was reliant on paper-based records. However, in 1999, a digital transformation was initiated, aspiring to bolster data use and thereby facilitate efficient, effective, and equitable healthcare delivery to the populace [16, 53].

Malawi is among over 70 developing nations that have implemented DHIS2 at the district level to bolster national HMIS data utilization. This system comprises predefined essential standard data, datasets, and indicators gathered using either paper-based or automated tools during healthcare service delivery. These tools encompass electronic devices like mobile phones or personal digital assistants, as well as registers, forms, exercise books, pencils, pens, tally sheets, health passports, patient folders, client record cards, and stock cards [54]. During each service interaction with patients, community healthcare staff document data. At the day's conclusion, they compile a daily aggregate paper-based report, which they submit to their respective health facilities. These facilities, in turn, manually amalgamate data reports based on submissions from community healthcare staff within their jurisdiction, forwarding the consolidated reports to the district level. At the District Health Office (DHO), fragmented paper-based reports from various health facilities are collated. These aggregated data points are then entered into DHIS2, producing integrated data reports that serve the informed data needs of stakeholders across the health system.

4   Data Collection and Data Analysis

Data was gathered across a multi-site case study involving four selected District Health Offices (DHOs): Blantyre, Zomba, Machinga, and Kasungu, spanning from December 2021 to October 2022. The first author employed a diverse set of data collection methods (refer to Table 1). This range included reviewing existing theses to comprehend prior studies on data use and examining strategies, guidelines, policy documentation, and artefacts to aid key informant interviews and actively observing healthcare staff in their typical environments to grasp various officers' interactions in the data usage process. Participant selection was influenced by each officer's degree of involvement in data use processes. Additionally, interview data offered a window into the individual perceptions of different officers concerning data use [52].

Table 1. Data Collection sources

Research Method	Data source
Secondary Data Review	MoH Strategy and Policy documentation
	Research articles, Ph.D. and Master Thesis
Participant Observations (on-site)	1 Local Assembly Performance Assessment (LAPA) review meeting
	1 Healthcare partner organizations' planning meeting
	1 General Health Management Information System performance data review meeting
	1 DHMT health facility Supervision
	1 Extended DHMT health facility Supervision
	1 DHMT Supervision performance data review meeting (Blantyre)
	4 Healthcare partner organizations' assessment review meetings (Zomba)
	7 iCHIS Training Workshops - UNIMA (Blantyre and Kasungu)
Interviews	2 Ministry of Health Executive Officers
	1 Ministry of Health Technical Staff
	1 Ministry of Health ICT Systems Officer
	1 Ministry of Health Community Health Services Officer

Table 1. (*continued*)

Research Method	Data source
	3 Director of Health and Social Services
	4 Health Management Information System Officer/Statistical Data Clerk
	1 Data Use Facilitator
	9 District Health Management Team
	8 Programme Coordinators
	2 Health Partner Organization staff
	2 Health Facility in Charge
	2 Community Health Workers' Supervisors
	4 Community Health Workers

The data analysis was grounded in transcripts sourced from Table 1. Additionally, field notes were taken based on the first author's interpretation of events and healthcare staff behaviors pertinent to data use throughout the study duration. Engaging with participants, the first author discerned a palpable sense of pressure. For instance, securing meetings with key interviewees proved challenging. Meetings would be scheduled, only to be rescheduled either just before or on the agreed day due to normative pressures, compelling the informant to meet other professional commitments. Moreover, the interviews took place during the COVID-19 era, a period marked by coercive pressures in line with World Health Organization (WHO) guidelines. Throughout the data collection, normative and coercive pressures emerged as recurring themes, which informed the empirical data collection and steered the subsequent data analysis (refer to Fig. 1). Adopting an iterative approach, the first author constantly navigated between data and the literature [51]. The analysis commenced by extracting significant quotes reflecting specific actions or practices related to data use. Once identified, these quotes were categorized into coercive and normative themes based on the underlying justifications for specific behaviors and actions.

5   Findings and Analysis

The conceptual framework (Fig. 1) was instrumental in facilitating data analysis. The findings illuminate institutional pressures as determinants influencing health management's efforts towards data use at the district level within Malawi's HMIS. The ensuing sections delineate findings categorized under coercive and normative pressures.

5.1 Institutional Pressures as Determinants of Influences Strengthening Health Management's Efforts Towards Data Use

This segment delves into both coercive and normative pressures, spotlighting their role as significant influences bolstering health management's endeavors towards optimized data use at the district level.

Coercive Pressures.
The study shows that Malawi HMIS experiences coercive pressure from international organizations. World Health Organization (WHO) exerted coercive pressure on the MoH, suggesting the need for strengthening the data use, as it states that,

> '… *further effort is needed to strengthen data collection and use at the Primary Health Care level*.' [55].

WHO, an international health authority, provides guidance and coordination on health policy, as referenced by [12]. Consequently, the Ministry of Health (MoH) imposes pressure on the District Health Organizations (DHOs) through the District Environmental Health Office. This mandates health facilities to engage in data collection, compilation, analysis, and review to satisfy the WHO's regulatory requirements, specifically the need for prompt responses to emerging diseases based on informed data-driven decisions. This aligns with prior research advocating enhanced data-driven decision-making at the district level [29].

Moreover, in response to WHO's emphasis on data utilization, the study identified coercive pressures exerted by the government that shape data generation and management across the healthcare ecosystem. The Health Services Strategic Plan II, under Objective 6, mandates District Health Offices to…

> '…*generate quality information and make it accessible to all intended users for evidence-based decision-making.*'

One District Health Environmental Officer commented that,

> '*I need statistics on a day-to-day basis, especially in informing decision making in terms of principles to be able to plan and also respond to disease outbreaks and any other diseases*'

Yet, the study further found coercive pressure from MoH demanding CHWs to collect data at the community level. The Health Partner Monitoring and Evaluation Officer said,

> '*... [CHWs]…they're ... Quite a heavy lift, to the Ministry of Health... Minus them… the health system is going to collapse.*'

A Community Health worker explained that,

> '…*we know how to do our job and…they [health organizations] always use us... [to collect data for use in decision making]*'

Coercive pressures drive Community Health Workers (CHWs) to gather data in response to the demands of the MoH. As [12] notes, these demands from governmental entities can be both formal and informal. This means that the MoH has specifically designated CHWs as primary data collectors, ensuring data is sourced directly from its origin before dissemination through various levels of the healthcare system. The placement of CHWs at the community level ensures that data collection aligns with the MoH's prescribed datasets, elements, and indicators.

The study also revealed that the WHO places coercive pressures that advocate for integrated data collection. The MoH's introduction of the Integrated Community Health Information System (iCHIS) is a direct response to this requirement.

'*Several different data systems and devices for collecting data are in place and need to be harmonized across facilities and integrated with DHIS2.*' [55].

One Community Health Worker confirmed that,

'*…D-Tree, had two programmes which were running online. They gave us some small phones with the Application installed on them which we were using to enter data for Family Planning and Maternal Health and Child Care.*'

iCHIS is a tool that provides CHWs with integrated data collection including Household registers and Community Health registers which encompass Family Planning, Maternal Health and Child Care. The Health Partner Organization Monitoring and Evaluation Coordinator disclosed that,

'*…iCHIS as one of our pathways to support strengthening that system [DHIS2] … The coming together of… The University of Malawi, the Ministry [MoH] and all other partners are a testament that we are heading towards the right direction. Our hope, with iCHIS, is we will have an engine that would facilitate decision making, at the community level… health facility level… district level… national level.*'

Integrated data reporting bolsters informed decision-making for enhanced management and planning of healthcare service delivery throughout the system [9, 10]. This leads to the delivery of efficient, effective, and equitable healthcare services to the district's health population.

The study also identified coercive pressures stemming from the funding provided by healthcare partner organizations. Such funding enhances service delivery activities, as articulated in the Health Services Strategic Plan II, which states:

'*…it is well known that healthcare provision in Malawi is highly dependent on external financing.*'

One Public Services Health Services Administrator confirmed that,

'*...the funding we receive … from the central government … cannot sustain the operations of the hospital...*'

Besides*,* a Health Information Systems Officer reported that,

'ONSE [healthcare partner organization] would provide transport and lunch allowances to and from the Facilities… for data collection every month.'

Through coercive measures, ONSE mandated monthly data collection, offering funding as an incentive to motivate healthcare staff. While earlier studies highlighted incentivized technology adoption [41], this research reveals incentivization in data collection. Nonetheless, the support from health partner organizations, channeled through the government [39], reinforces efforts in data utilization at the district level.

Normative Pressures.
The study also identified multiple normative pressures arising from the supportive funding of healthcare partner organizations. As an Integrated Disease Surveillance Response (IDSR) Officer noted,

'The IDSR office receives training on international trending issues i.e., International Health Regulations … mostly held by WHO. The same training material is passed on to Health Facility personnel for implementation.'

Further, DHOs healthcare staff experience normative pressure as a District Health Office Administrator reported that,

'… the Malaria programme is being championed centrally… with the funding that they have for Global Fund, they also call for the [data] review for each specific district... we have them maybe twice a year… we showcase our data, with the players from the central level …[they] … appreciate how we are performing ... in these data review meetings.'

The data review meetings foster inter-organizational interactions between healthcare staff and The Global Fund staff. These interactions facilitate the sharing of not only standard data reporting formats but also shared behaviors, values, and norms. As highlighted in a previous study, such influences eventually establish consistent behaviors, values, and norms among organizational staff [35]. The more frequent these inter-organizational staff interactions, the more these influences permeate, leading to either desired or undesired outcomes, echoing the sentiments of [44]. As a result, the desired actions reinforce data use in health management decision-making at the district level.

Additionally, the study identified normative pressures arising from supportive partnerships. A Clinical/HIV Coordinator commented,

'…our partners have helped us... They have recruited ... Human Immunodeficiency Virus Diagnostic Assistants'

This was confirmed by a Health-in-Charge who determined that,

'The Data Clerks were employed by EGPAF [Elizabeth Glasier Paediatric Aids Foundation] as our partner here…after the two-year contract they will be absorbed into the government…Global Fund is training them on how to enter data in DHIS2.'

This suggests that while the recruitment augmented the quantity of human resources [20], the training equipped healthcare staff with the necessary knowledge and skills for quality data collection and reporting, consistent with findings from a previous study [23]. Thus, supportive partnership funding bolsters health management's endeavours towards data use at the district level.

Community Health Workers (CHWs) felt normative pressure to use multiple data systems and devices for data collection at the community level. One Community Health Worker noted,

> '...I did the [D-tree] job very well such that I became a Super User, whereby I would be called to train fellow HSAs [CHWs].'

This suggests that by adhering to the D-tree data reporting formats, CHWs were presented with an opportunity [6] and felt compelled to gain the skills and knowledge necessary for data processing in the application [23, 46]. Furthermore, as highlighted in prior studies, CHWs utilized their acquired skills and knowledge to train others [35]. This had the effect of not only enhancing the quality of data collection but also ensuring reporting was in line with specified standards. As a result, these influences shaped health management decisions on data use at the district level.

Table 2 below outlines the institutional pressures that bolster health management's focus on data use.

Table 2. Institutional Pressures as determinants of Influences Strengthening Health Management's Efforts towards Data Use

Institutional Pressure	Action	Claim	Implication for Data Use
Coercive	WHO recommends enforcing quality data collection	Strengthen CHWs' capacity for quality data collection	Strengthen the data use at the origin of the healthcare system
	DHOs to generate and manage data	Motivate CHWs to collect quality data	
	CHWs are MoH data collectors at the community level	MoH informal data collection resource	
	WHO Recommend harmonized data collection systems and devices at the Primary Health Care level	Enforce an integrated data collection system at the community level	HMIS integrated data use
			Shared data use
Normative	Funded Staff training	Coordinate Supportive Partnership	Healthcare staff data use knowledge and skills capacity building
	Funded Data reporting		

5.2 Institutional Pressures as Determinants of Influences Undermining Health Management's Efforts Towards Data Use

This section outlines the coercive and normative pressures that act as influential factors, potentially undermining health management's efforts to utilise data at the district level within Malawi's HMIS.

Coercive Pressures.
The study revealed that Community Health Workers (CHWs) face coercive pressures to collect data without any motivating factors. A Monitoring and Evaluation Coordinator from a Health Partner Organization noted that,

> '... [CHWs] need support…. Supervision…mentorship…someone to go there regularly... to see what they're doing…how they're doing it… they need encouragement…'

This suggests that a lack of motivation, stemming from insufficient supervision, mentorship, and encouragement [32], might lead to CHWs' negligence in their duties. As highlighted in a previous study, supervision and mentorship can bridge the gap between the user and the data [22], ensuring adherence to the MoH's established standard datasets, elements, and indicators for data reporting formats. Moreover, the Data Use Facilitator remarked,

> '…due to lack of personnel, the facilities tend to use labourers or ground personnel (hospital attendants) to cover up on the shortage of staff. These are not trained to do any office work or data recording.'

The implication here is that the absence of supervision and mentorship, combined with the recruitment of untrained personnel for data collection, pushes staff to simply fulfil the MoH's mandate for monthly data report compilation and submission, while overlooking quality concerns, as highlighted in [27]. Such concerns include data accuracy, timeliness, and completeness, which are essential to meet the user's requirements [1, 26]. However, data reporting that neglects these quality aspects undermines health management's efforts to utilise data at the district level.

Additionally, the study identified a coercive pressure on CHWs to collect data in the absence of a guiding policy. One Community Health Worker remarked,

> '...we do not have any written conditions of service to guide our work......'

This suggests that CHWs operate without a legal framework for data collection [24]. Moreover, District Health Offices lack the authority and oversight to ensure CHWs' adherence to data quality standards. A District Environmental Health Officer noted,

> '… the problem is, we don't have information from the community...the [data], which is collected by the HSAs [CHWs]…'

The study found the absence of policy exerted coercive pressure from partner organizations influencing CHWs to adhere to their policies. The partner organizations used

CHWs to deliver healthcare activities using their programme-specific designed Applications installed on different devices. The District Environmental Health Officer continued to say,

'… you will find one HSA [CHW]… Have got three or four phones for different donors, collecting different [data] indicators.' and.

'I am in control of the HSAs [CHWs] …But ... Not given powers to control them. Everybody [healthcare partner organizations] can come straight [to the CHW] …without passing through this office [District Environmental Health Office].'

A Community Health Worker confirmed that,

'…we used to make a lot of money, for example, I remember receiving K44,000 [$41] in a week and another K65,000 [$61]in the next training session. We used to enjoy eating money from that project which ran for about 2 years.'

The implication is that CHWs were influenced by coercive pressures to adopt incentivized data collection technologies from external organizations, echoing findings from previous studies [41]. Furthermore, the multitude of devices used by CHWs indicates diverse data reports generated across different systems and devices. These devices, sourced from multiple uncoordinated organizations [48], necessitate specific knowledge and skills [46]. Additionally, these varied systems operate in parallel to the national HMIS [34]. However, data reports from these parallel systems are not consolidated with reports submitted to the DHO and, subsequently, the national level. As a result, the HMIS remains fragmented, undermining health management's capacity for informed decision-making in the district's healthcare service delivery.

Normative Pressures.
The study also found MoH exerting normative pressure on CHWs with demands to provide essential basic healthcare services to the community population without a legal basis. One Community Services Monitoring and Evaluation Officer said,

'…[CHW]… it's a cadre that's not regulated because they don't have any license like somebody who registers with the Medical Council of Malawi.'

The CHWs lack both occupational autonomy and accredited recognition, in contrast to the findings of [43] and [42]. While the MoH's directive regarding CHWs might be considered a valid informal regulation due to its governmental position, as suggested by [12], the sustainability of this mandate is questionable, as highlighted in the previous section. Furthermore, given that the CHWs' mandate encompasses quality data collection for reporting into DHIS2, it is essential that they receive adequate training and supervision in data processing, in line with the recommendations of [23]. Only with this support can CHWs' data reporting truly serve the intended purpose of health management's data use at the district level.

Additionally, the study identified ongoing normative pressures causing healthcare staff to conform to multiple partner organizations' programme-specific data reporting formats. One Health facility-in-charge commented,

'.. You produce reports for them, or their employees are the ones who collect whatever is required for … their reports and sometimes they are different from what we do. Because they have got their indicators.… then it's for a certain period.'

While the MoH trusts external health partners to bolster data use [52], some of these partners collect data that aligns more with their own objectives rather than the necessary support. Additionally, certain partners possess limited insights into the institutional challenges, rendering them unable to offer sustainable solutions tailored to the local context, as corroborated by the study [40]. Moreover, healthcare staff generate data reports adhering not just to the MoH's guidelines but also to the normative standard reporting formats of partner organizations. Consequently, healthcare personnel grapple with multiple directives and formats, echoing the findings of [46]. In some instances, the plethora of standard data reporting formats causes CHWs to produce reports that deviate from the expected normative standards for integration into the DHIS2. A Data Use Facilitator noted,

'*Emergence Triaging Assessment and Treatment (ETAT) programme is… always lagging due to scarcity of resources... Reporting tools are not available and it is complicated since it has a specific reporting form.*'

This highlights the presence of numerous fragmented and uncoordinated standard data reporting formats, as indicated in a prior study [47]. As a result, the healthcare system grapples with inconsistent and incomplete data reports. This affects the district healthcare management staff who must rely on subpar data quality for their decision-making processes. This leads to inefficiencies and ineffectiveness in managing healthcare service delivery to the population.

The study also identified normative pressures impacting the DHO's ability to maintain consistent monthly data use for decision-making in health management at the district level. The Health Partner Organization Monitoring and Evaluation Coordinator remarked,

'… since that [USAID] project ended, no [key indicators] analysis supports the district ...'

The project supplied a charted data analysis summary of key indicators reflecting the district's performance, aiming to support informed decision-making. However, the continuity of this charted data reporting was disrupted, primarily due to a lack of sustained funding. Additionally, the Health Services Strategic Plan II mentions that,

'…financing of health care is not sustainable in Malawi'

Consequently, health management was unable to maintain ongoing data reviews to analyse district performance through the summarized key indicators. This failure can be attributed to the periodic projects of partner organizations, as noted by [47]. As a result, there are inconsistencies in health management's data-driven decision-making concerning healthcare service delivery at the district level. Table 3 below outlines the institutional pressures that undermine health management's focus on data use.

Table 3. Institutional Pressures as determinants of Influencing undermining Health Management's efforts towards Data use

Institutional pressure	Action	Claim	Implication for Data Use
Coercive	Inadequate CHWs Supervision and Mentorship	CHWs lack motivation for quality data collection	Weak data use
	Absence of CHW Conditions of Service	CHWs lack a legal basis for quality data collection	CHWs lack the commitment to the expected data use
Normative	CHWs are not certified technical healthcare officers	CHWs lack professional accreditation	Weak data use
	Parallel Systems	Lack of control over integrated data collection	Fragmented HMIS data use
	Lack of quality data collection control	Lack of control over quality data collection	Weak data use
	Discontinued Chart data reporting	Lack of Sustainable funding	Fragmented HMIS data use
	Inadequate Supportive partnership		

6 Discussion and Conclusion

The study aimed to investigate how health management efforts regarding data use are shaped at the district level within Malawi's HMIS. It was discerned that the influences on data use resulted from institutional pressures inherent in the healthcare system's context. Prior research has utilized institutional pressures to categorize identified sources of opportunities or challenges that impacted organizational staff behaviors during information systems implementation [6].

This current research suggests that beyond presenting opportunities or challenges influencing organizational staff behaviors during technology implementation, institutional pressures also categorize sources of influence on healthcare staff behaviors and actions related to data use. Such behaviors and actions subsequently produce data reports that influence health management's approach to data use at the district level.

In this study, the identified sources of influence on data use have been categorized into coercive and normative pressures, stemming from the healthcare system context. This distinction is vital in healthcare data usage, particularly in developing countries where there's a significant presence of international health partner organizations [47]. While these organizations augment the MoH's data use strategy via supportive funding [39], they introduce novel data use methodologies that sway healthcare staff behavior

and actions [43]. For instance, while the MoH has set normative standards for datasets, indicators, and elements at the community level, healthcare partner organizations often have distinct requirements. The subsequent pressures from both the MoH and these organizations lead to normative pressures that healthcare staff often conform to. This conformity can result in parallel reporting, undermining health management's efforts at the district level. Consequently, this highlights a rich tapestry of coercive and normative pressures, as healthcare staff within Malawi's HMIS appear to be influenced by partner organizations, leading them to adapt to certain practices and behaviors that shape data use.

This research indicates that the efficacy of data use is challenged due to the divergent, non-integrated reporting formats introduced by various partner organizations. As a result, there's an evident need for a nationally coordinated set of normative standards for data processing across various programs. Moreover, prioritizing the training of CHWs in quality data collection and reporting will bolster efficient data use processes [23], subsequently strengthening health management efforts at the district level.

The study revealed that the lack of a clear legal framework governing the work of Community Health Workers (CHWs) makes them susceptible to adapting to any emergent policies [24]. While external partner organizations engage with CHWs without the direct oversight of District Health Officers (DHOs), the DHOs themselves lack the legal foundation to ensure the quality of data collected by CHWs. Introducing structured regulations for CHWs can promote adherence to established performance standards, thereby refining data use processes. Hence, it is imperative to regulate and control access to CHWs to bolster the quality of data processes and, in turn, improve health management decisions at the district level.

While this research offers valuable insights, it did not encompass all twenty-eight districts in Malawi due to constraints related to resources and time. Notwithstanding this limitation, the findings presented can act as a bedrock for future investigations examining how institutional pressures can influence health management's approach to data use within Malawi's HMIS. It would be beneficial for subsequent studies to span multiple districts and health facilities, providing a more comprehensive understanding of the prevailing institutional pressures. Moreover, there is a clear need for further research to devise an effective legal framework that can amplify the quality and efficacy of data use in health management at the district level within Malawi's HMIS.

This research enriches the ICT4D academic discourse by offering empirically derived insights into the institutional pressures impacting data use in a resource-constrained setting. Specifically, it brings a noteworthy contribution to Malawi's HMIS, highlighting an existing challenge: enhancing the extent and quality of data that can further improve health service delivery.

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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 Re-search 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.
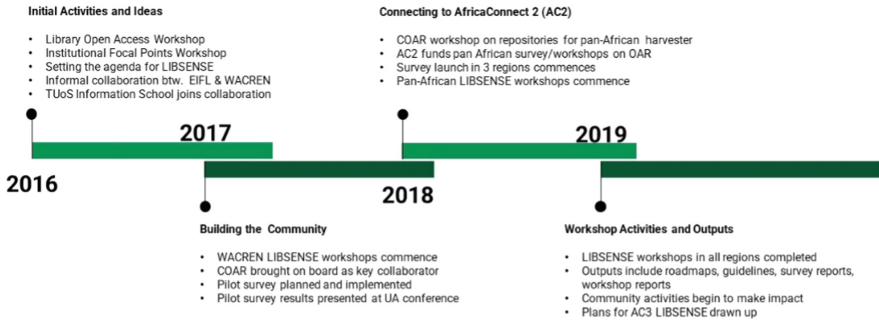
Fig. 1. A timeline of growth and key activities undertaken by LIBSENSE before (2016–2017) and during the AfricanConnect2 program (2018–2019).
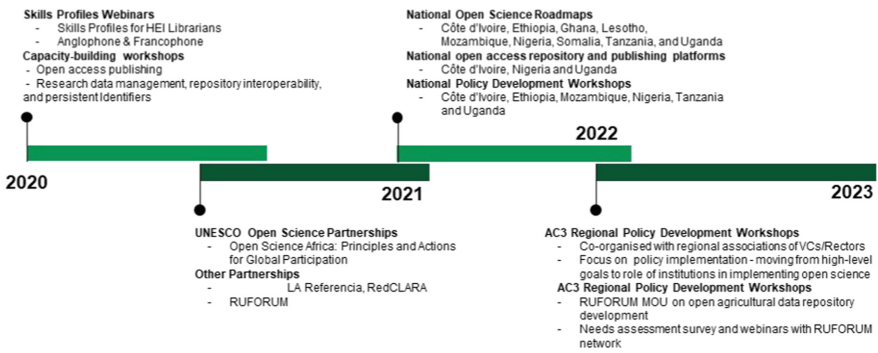
LIBSENSE Timeline (2020 - 2023)

Fig. 2. A timeline of further development and key activities undertaken by LIBSENSE during the AfricanConnect3 program (2020–2023).
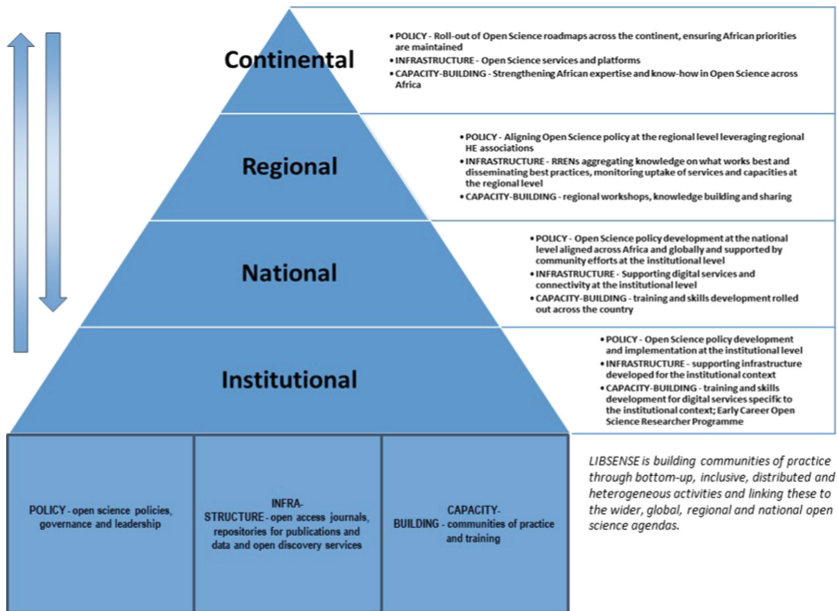

Fig. 3. A schematic of the bottom-up/top-down approach to addressing the LIBSENSE open science agenda across Africa.

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, Table 1 below captures one potential view of an AT analysis of the LIBSENSE initiative.

Table 1. An AT analysis of LIBSENSE

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

(continued)

Table 1. (*continued*)

Level/AT Elements	Regional/Continental Level activity system	National Level activity system	Institutional Level activity system
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

<div align="right">(<i>continued</i>)</div>

Table 1. (*continued*)

Level/AT Elements	Regional/Continental Level activity system	National Level activity system	Institutional Level activity system
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 librarian associations	Librarian consortia; NREN focal actors; providers of CPD; academics and researchers; ECRs; Senior research and education executives; institutional IT providers

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.

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Critical ICT4D: The Need for a Paradigm Change

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Abstract. ICT for Development (ICT4D) research has evolved significantly in the course of its history. Originally characterized by a technology-transfer vision, positing technology as intrinsically "good" and desirable for development, it subsequently entered a phase of problematization of the very notion of "development", as well as the ability of ICTs to contribute to it. Against this backdrop, we highlight the need for a paradigm change that sees Critical ICT4D – *a vision that constructively problematizes the core assumptions of ICT4D research* – at the core of theorizing, designing and executing research on ICTs for development. With the idea of Critical ICT4D, we introduce a way of thinking that takes stock of the adverse effects of ICTs on its intended beneficiaries, at the same time developing routes to imagining and building fairer technologies in contexts of structural vulnerability.

Keywords: ICT4D · Critical Research · paradigm · digital harm · surveillance

1 Introduction

The birth of the ICT4D field can be traced to the early introduction of computers in the so-called "developing countries" (Heeks, 2014). Initially lean and unproblematic, the core assumptions of the ICT4D field pertained both to the nature of "development" and to the role that ICTs could play within it. "Development" was associated with ideas of progress, prosperity and modernization, soon shifting from the economistic logic of growth to a more encompassing, human-centered Senian perspective (Akpan, 2003). Along similar lines, ICTs were seen as intrinsically able to spur so-called "development" processes, and to participate in the betterment of conditions for people in situations of vulnerability (Akpan, 2003; Heeks, 2014).

All of this was, however, to be questioned with the field's evolution. Over the last two decades, the core assumptions on which the ICT4D field was built were problematized: ideas of "development", originally associated with progress and prosperity, became linked to notions of coloniality and illicit appropriation (Escobar, 2011; Qureshi, 2015). The association of ICTs with "development" became confronted with adverse

digital incorporation, encompassing the multiple forms of harm that people incur by being included in, and not excluded from, digital systems (Heeks, 2022). And the term "developing countries", initially adopted as a staple for contexts of socio-economic vulnerability, has been exposed in its colonial undertakings (Qureshi, 2015).

Against this backdrop, we highlight the need for a paradigm change in the way we theorize, design, and execute ICT4D research. We introduce Critical ICT4D – *a vision that constructively problematizes the core assumptions of ICT4D research* – as a route to generate research that positions the field within historical relations of power, reflects on the socio-political context of ICT4D measures, and transcends technological solutionism to account for ICT-induced harm. By problematizing assumptions of "development" as a destined "better" way for all countries and communities, and of ICTs as an intrinsic catalyst for achieving it, *Critical ICT4D* offers a way of thinking that openly deals with structural harm and injustice, in the pursuit of the construction of fairer engagements between humans and ICTs (cf. Heeks, 2022; Masiero, 2022).

This paper offers the foundational bases for a theorization of Critical ICT4D. First, we review the key building blocks of ICT4D history, which provide the rationale for the concept's elaboration. Second, we define critical ICT4D and illuminate the key conceptual elements at the heart of this notion. Third, we suggest themes of interest for Critical ICT4D, arising at the intersection with Critical Data Studies and cognate disciplines illuminating perverse effects of technology adoption. We conclude with ideas for advancing a Critical ICT4D research agenda.

2   Building Blocks of ICT4D History

In this section we summarize two building blocks of ICT4D history. These coincide with the rise and fall of two assumptions that built the rationale for the initial establishment of ICT4D as a field of research: first, that "development" is an inherently positive process that has good impacts on its beneficiaries. Second, that ICTs contribute positively to development. The questioning of these assumptions illuminates the colonial roots of superimposed "development" processes and unpacks the harmful effects these can have on people.

The term "development" has few definitions in published ICT4D research. Akpan (2003) defines it as "the fulfillment of the necessary conditions for the realization of the potential of human personality, which translates into reductions in poverty, inequality, and unemployment. (It is also) the increasing satisfaction of basic needs such as food". Basic-needs definitions were common in the early days, signaling a shift from an economistic view to a Senian capabilities approach (Sen, 2001; Robeyns, 2009). What was overarching, in early-day definitions, was the focus on "development" as an overwhelming force of modernization, a top-down solution for how to catch up with the "developed". A connected discourse held for the role of ICTs in development. As argued in Brown and Grant (2010), the *for* in ICT4D is not only a preposition, but an expression of intent to use ICT4D to generate positive outcomes in the so-called developing world. This is what led early ICT4D research to center on combating the digital divide, conceived as "the gap between demographics and regions that have access to modern information and communications technology (ICT), and those that don't or have

restricted access" (UN, 2002). Defined in terms of different technologies over time, early ICT4D research was informed by the fight to close the digital divide, linking ICT access with the opportunity for economic prosperity.

Strong in their tenets, both assumptions have, however, experienced a crumbling turn in the last two decades. Initially hailed as a beacon of progress and prosperity, "development" has been exposed as a colonial paradigm, resulting in disempowerment and exploitation of development subjects, dispersal of communities and their ways of life and being, and perpetuation of oppression on them (Escobar, 2011). Bringing such a paradigm to "developing" countries is a hegemonic process that, rather than challenging existing hegemonies of power, reinforces them, leaving beneficiary narratives systemically silenced in the light of magnification of governments and humanitarian agencies. The hegemonic discourse of development, development aid, and development goals is nowadays so deeply established in international organizations, ministerial levels of Western countries, and an army of well-funded NGOs and foundations, that questioning its discursive legitimacy seems like an existential threat to international politics.

The assumption that saw ICTs as a route to achieving "development" went down a parallel route. Technology was seen as a neutral force that, through generous offering of Western countries, will 'fix' the development gap. However, Heeks (2022) highlighted how "adverse digital incorporation" enables "a more-advantaged group to extract disproportionate value from the work or resources of another, less-advantaged group". If inclusion in a digital system can be harmful, and result in the perpetuation of extractive and surveillant dynamics (Taylor and Broeders, 2015; Akbari, 2022), ICTs have little scope for remaining upheld as a "magical" route to "development", and are instead to be studied in the light of the harm they can, and do, cause to recipients. Fusions of ICT4D research with fields related to critical data studies have illuminated this point, leading to question previously established logics of ICT for development (Masiero, 2022; Schoemaker et al., 2023).

It is in this landscape that a call for the construction of new research paradigms arises. Born as a byproduct of information systems-led technology enthusiasm, ICT4D is traversing a historical phase where it is called, morally and epistemically, to come to terms with the harm that the uptake of digital technologies can cause on people. Our suggestion of a turn to Critical ICT4D is a direct acknowledgement of the need for such a paradigm shift.

3   The Anatomy of Critical ICT4D

Over the last decade, decolonial approaches - which delink the production of knowledge from Western science and values - have become prominent in ICT4D outlets, challenging the pre-established hegemony of Western theories as a means to make sense of technology in vulnerable contexts (Khene and Masiero, 2022). Among many approaches, decolonial research is central in combating epistemic violence, a term that refers to violence exerted on knowledge through knowledge (Galvan-Alvarez, 2010). With Western theories elevated as paradigms to understand technology-induced dynamics across space and time, decoloniality invites a turn to approaches generated from local contexts, using Indigenous concepts and terminology to make sense of dynamics at the local level (Tsibolane and Brown, 2016).

It is against the backdrop of decoloniality, and of its implications for research in our field, that we propose Critical ICT4D as a novel paradigm to research ICTs for development. By paradigm we mean, with Guba and Lincoln (1994), a set of assumptions that inform the researchers' mindset, hence shaping the way research is conceived, designed, and executed. Defined as *a vision that constructively problematizes the core assumptions of ICT4D research,* Critical ICT4D is introduced as an approach that questions the very tenets on which our field was built, with a view of understanding technology-induced harm in order to challenge its production. Built upon three key conceptual components - reflection, problematization and construction - the notion of Critical ICT4D proposes a way to look directly into adverse digital incorporation, its histories and politics, for the purpose of imagining fairer, justice-enacting engagement of ICTs with people and society.

The conceptual components of Critical ICT4D can be articulated as follows. We invite all researchers, policy makers, aid workers, and similar to *reflect* on the histories and narratives of target populations, the deep-routed socio-political background of development programs, and the power relations integrated in or induced by such measures. By *problematization* we mean, with Chatterjee and Davison (2021), a process in which the researcher questions assumptions, not taking previously established findings for granted. Crucial to the conception of Critical ICT4D is the stock-taking of the crisis of the core assumptions on which the field was built. As noted above, Critical ICT4D stems from questioning their validity, mirrored by harms that "development" and the technologies built for it have induced (Taylor and Broeders, 2015; Masiero, 2022).

At the same time, it is a *constructive* problematization that is proposed here. Constructiveness, as a conceptual building block of Critical ICT4D, is indivisible from reflection and problematization: indeed, the purpose of questioning "tech for good" assumptions in vulnerable contexts is that of understanding the harm generated by technology engagement, with a view of overcoming its causes and production. In other words, Critical ICT4D problematizes ideas of technology as a force of good by engaging in the study of harm and dissecting the causes of its generation to challenge it. The constructive component, in which justice-enacting engagement of technologies with society and people are imagined, is a substantial element of Critical ICT4D, and the one that translates it from research to action.

4   Critical ICT4D: Emerging Research Themes

A research agenda informed by a Critical ICT4D paradigm can cover multiple themes, grouped by being at the intersection of historical and socio-political aspects of North-South technology transfer, tech-induced harm and the possibility for just engagement spaces for tech-driven programs. For illustrative purposes, two themes that such an agenda can entail are presented here in terms of (a) vulnerability scoring and (b) digital humanitarianism. In particular:

– *Vulnerability scoring.* Processes of datafication, defined by Mayer-Schönberger and Cukier (2013) in terms of "the rendering of existing processes into data", are central to the making of social protection schemes that identify recipients to assign them the correct entitlements. In converting recipients of social protection schemes into

machine-readable data, processes of vulnerability scoring are instrumental: these are processes that assign either a category (e.g. below- or above-poverty-line) or a numerical score to households, to determine their eligibility for certain development programs. Instances include India's Public Distribution System (PDS), a food subsidy scheme reserved to below-poverty-line (BPL) households, and Colombia's Sisbén, a system that assigns a 0–100 vulnerability score to households based on the cross-checking of existing databases. In both schemes, a logic of scoring-for-development is *problematized* by the injustices infused in it: India's datafied PDS has resulted in the exclusions of many entitled households (Muralidharan et al., 2020), and Colombia's Sisbén has deprived people of agency on their own income data (Lopez, 2022). While both instances problematize the scoring-for-development logic, Critical ICT4D does so in a *constructive* way: it studies injustice in order to overcome it, devising technologies that allow vulnerability appraisal by protecting people's agency and cautioning against unjust sorting and exclusion. Critical ICT4D also engages with the narratives and discourses attached to the introduction and management of such systems to populations, their design, management, and accountability models, and especially their power-laden systems that might be built on already existing asymmetric social relations.

– *Digital humanitarianism.* The term digital humanitarianism is taken to mean the assemblage of processes, means and technologies through which the practice of humanitarian work is digitized. On the one hand, digitizing humanitarian work means infusing the logic of "good datafication" into it: people on the move, such as refugees or displaced persons, can be given a unique identity and provided with aid programs, which they receive in virtue of their refugee status. On the other hand, extensive work problematizes this logic, illuminating how recipients can be profiled and policed by the very same authorities that promise them aid (Pelizza, 2020). Examples include Kenya, where double registration of people as refugees and citizens led to denial of essential rights (Weitzberg, 2020), and Bangladesh, where Rohingya refugees have been subjected to violent policing as a result of digital profiling (Martin and Taylor, 2021). While calling attention to this problematization, a Critical ICT4D vision reflects on the socio-political context of such tech-based solutions within a larger background of international migration policies and devises forms of identification that respect people's dignity, enforce their fundamental rights, and remain loyal to fundamental of humanitarian actions such as inflicting no harm.

5   Conclusion

In this paper we have set the premises for a paradigm shift in ICT4D, resulting into a vision, Critical ICT4D, which problematizes the field's main assumptions to imagine fairer human-technology engagements. While we set out a view of Critical ICT4D as an inseparable connection of reflection, problematization and constructiveness, we wish to apply this way of thinking to phenomena of interest to critical data studies, as well as cognate academic fields including surveillance studies and data justice. On the one hand we believe that the recent history of ICT4D, with the crisis of the field's main assumptions, calls for a critical approach towards the "tech-for-good" ideology: on the other, we find that criticality needs a constructive orientation, to leverage studies of

injustice and oppression in order to overcome their effects. We see Critical ICT4D, and its role in informing and executing research, as a route to restoring epistemic justice, where the voices of oppressed recipients are accounted for in imagining just technology-informed systems.

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Antifascist ICT4D: The Need for an Agenda of Liberation

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Abstract. The field of ICT4D has witnessed a crisis of its core assumptions in terms of usability of ICTs within development, as well as the meaning of "development" itself. Such a *pars destruens* (deconstructing the main assumptions of the field) should in our view be accompanied with a *pars construens* which embraces *antifascism*, an element of liberation movements opposing violently oppressive ideas and systems, as a core value. In this paper we set the epistemological basis for an antifascist view of ICT4D, positioning such a view in history and illuminating the contribution of antifascism to the core idea of "making a better world" that inspires ICT4D research. We contribute to the existing literature by spelling out antifascist values in relation to ICT4D, and articulating these with respect to research objects and philosophies that the field embraces.

Keywords: ICT4D · antifascism · research paradigm · oppression · liberation

1 Introduction

The field of ICT4D has undergone a substantial philosophical transformation over the last two decades. Efforts to trace the genesis of the field position its birth in the late 1980s, with the establishment of the Information Technology for Development journal in 1986 and the first IFIP 9.4 Conference on the Social Implications of Computers in Developing Countries in 1988 (Walsham, 2017). The early days of the field relied, with greater degrees of explicitness over time, on two core assumptions: first, that "development" was to be seen as a positive, overarching goal of progress and prosperity, shifting from a growth-centered to a human perspective (Akpan, 2003; Walsham and Sahay, 2006). Second, that ICTs were intrinsically able to participate in "development", plying connectivity to the opportunity of achieving goals in terms of education, health and income (Sen, 2001). A "tech-for-good" agenda inspired the early days of the field, dictating the themes of early publications (Masiero, 2022).

Both assumptions have, however, experienced a crumbling turn over the last two decades. The idea of "development", initially seen as an overarching goal, became exposed in its colonial and potentially harmful undertakings: Escobar's (2011) notion of post-development illuminated the shortcomings of the "development" ideology, with

its impacts on populations made to receive, rather than participate in, interventions on themselves (Qureshi, 2015). The idea of ICTs as a "carrier" of development became faced with *adverse digital incorporation* (Heeks, 2022): that is, the diverse ways in which being incorporated in digital systems becomes harmful, rather than beneficial to users (Pelizza, 2020; Akbari, 2022). In this landscape, ICT4D research finds itself at the crossroads between the rise and fall of its founding assumptions, becoming faced with the intellectual dilemma of coming to terms with the crisis of its values and the need to regenerate its activities in the light of this.

In this paper, we propose a view of present and future ICT4D research that is inspired and shaped by the values of antifascism. By *antifascism* we mean, with Gentili (2014), an element of liberation movements opposing violently oppressive ideas and systems, where opposition results in affirmative ideas of liberation. We proceed as follows: we first outline the value crisis of ICT4D, with ideas of "tech-for-good" crumbling in the light of data-induced harm perpetrated on people through ICT interventions. We then outline the values of antifascist ICT4D following Gentili's (2014) view of antifascism as an assertive philosophy, where liberation is built upon deliberate dismantling of infrastructures of oppressive power. We conclude by sketching out a thematic agenda for antifascist ICT4D, embracing themes of data-induced harm and illuminating how resistance technologies can contribute to fighting its effects.

2   Making a Better World with Antifascist ICT4D

Born as a subfield of the Information Systems discipline (Walsham, 2017), the ICT4D field arose in the light of the early uptake of computers in the so-called "developing countries" (Qureshi, 2015). Early ideas of "tech-for-good", informed by technology's potential to "repair" substantial issues in the lives of beneficiaries, became over time confronted with a different reality: one in which adverse digital incorporation, meant as the negative effects of being incorporated in (rather than excluded from) digital systems, deeply affected the intended recipients of ICT4D interventions (Heeks, 2022). Discussed in present-day ICT4D research, adverse digital incorporation illuminates how surveillance, control and, in limit cases, violent policing (Akbari, 2022) are directly produced from people's subjection to ICT systems, and become inextricable from the infrastructures of care that development programs involve (Iazzolino, 2021).

It is in the light of digitally induced harm that we propose an antifascist agenda as a core conceptual device to conduct ICT4D research today. Adverse digital incorporation makes it impossible to detach social studies of technology from digital harm: on the one hand, understanding oppression as a product of artifact politics is crucial to studying the genesis of harm as induced by datafied structures on people. On the other, conceiving antifascism as an element of movements where oppressive ideas are challenged with an affirmative vision of liberation offers a substantive way to illuminate what "making a better world" (Walsham, 2012) has meant for the field over the last decade. In what follows, we offer a research agenda inspired by antifascist ICT4D values, illuminating how such values intertwine with the purpose of constructing a "better world" in equal and fair terms.

3   Antifascist ICT4D: A Research Agenda

For Gentili (2014), antifascism is characterized by the duality of (a) opposition to violent suppression of ideas and freedom, and (b) creation of the conditions for forming societies characterized by freedom of thought and action. This duality of a *pars destruens* opposing violence, and a *pars construens* creating free societies is mirrored in multiple, recent themes of engagement of ICT4D research. In this paper we use political and human rights activism, LGBTQIA+ issues, and forced migration as themes to illustrate how an antifascist lens can be applied to ICT4D topics.

3.1   Political and Human Rights Activism

The preservation of political and human rights is central to the making of the "better world" that ICT4D research seeks to achieve. In the last two decades, social media have emerged as central to the engagement of political activism across the globe: advancing solidarity and resistance movements, social media have acted as amplifiers of ideas of freedom from authoritarian and oppressive regimes (Kamel, 2014; Joia, 2016). Applying an antifascist lens to the study of digitally mediated activism involves, on the one hand, the *pars destruens* of opposition to violent regimes suppressing freedom and liberation (Milan and Treré, 2019). A relevant example is the recent "Woman, Life, Freedom" movement in Iran: with multiple engagements of digital technologies, the movement opposes a violent regime that had sought to ply digital tools to authoritarian objectives (Akbari, 2023).

At the same time, the *pars construens* of antifascism notes how human rights movements exist to create free societies from the ashes of oppression. The engagement of technologies in the Black Lives Matter movement, sparked by the murder of George Floyd in 2020, has illustrated the importance of solidarity in building societies free from police violence, in which social media played an important coordinative role (Wade et al. 2021). In the rise of #MeToo, the movement born in 2017 with a view to build awareness of sexual harassment, collective action has been largely channeled through social media: beyond denouncing harassment, such an action fosters liberation from it through the upholding of societal rules (Boyd et al. 2022). Contended between authoritarianism and resistance, social media offer an important example of how an antifascist lens, with its duality of opposition and liberation, can unpack important dynamics of ICT4D research.

3.2   LGBTQIA+ Issues

Despite efforts made regarding LGBTQIA+ rights over the last decades, progress in many places seems to have slowed down, or even regressed. As we write this piece, legislation has been passed in Uganda introducing the death penalty or life imprisonment for "certain same-sex acts" (The Guardian, 2023). From such rights-denying laws to conversion therapy for gay people and the "don't say gay" bill and book bannings in Florida, it is clear that LGBTQIA+ rights are under attack in many places. In the US alone, 555 anti-trans bills have been introduced in 2023 "that seeks to block trans people from receiving basic healthcare, education, legal recognition, and the right to publicly

exist" (Trans Legislation Tracker, 2023). In a study conducted at the Williams Institute at UCLA it was found that transgender people are over four times more likely than cisgender people to be victims of violent crimes such as rape, sexual assault, and aggravated or simple assault (Flores et al. 2021).

In the light of the violence perpetrated through such acts and laws, an antifascist lens denounces, on the one hand, the violent suppression of rights that such legislation entails. It is, at the same time, in the remit of antifascism to create the societal conditions for such violent actions not to be enabled, and for such oppressive laws not to be passed and implemented. In the light of Uganda's same-sex acts criminalization bill, Wyers (2023) has called organizations who collect, manage, and share personal data to take responsibility measures in handling these, so as to safeguard people's right to freedom and, indeed, to life in the light of oppressive law. Responsible data management strongly mirrors the *pars construens* of antifascism: it takes stock of the violent effects of data-based oppressive policies on vulnerable people, at the same time devising tools to overcome it.

3.3 Migration and Refugees

According to the UNHCR, 103 million people are forcibly displaced worldwide, a number that has rapidly increased over the last decade (UNHCR, 2022). War, climate disasters, famine, and more causes lead to large groups of people being forced to relocate to survive. ICT4D research has engaged the role of ICTs as routes connecting refugees to host societies: Gomez et al. (2016; 2017) have studied the sense of belongingness fostered by ICT-based connection, also involving the ability for forced migrants to maintain connection with home countries (Vannini et al. 2020). At the same time, research has illuminated the perverse effects of connectivity over migrants: the datafication of refugee identities, as well as tracings enabled through mobile devices and data fumes, has resulted in capture, deportation and even death for people in the course of migration (Newell et al. 2016; Pelizza, 2020).

An antifascist lens sees an important application to the study of datafied migration. The duality of a *pars destruens* and a *pars construens* is again present: on the one hand, technologies of datafication are denounced as oppressive tools, which convert the migrant into bundles of data that make them traceable by policing authorities. On the other, digital technologies also create scope for liberation, with the creation of solidarity movements (Pelizza et al. 2021) through which migrants associate, creating the conditions for liberation. The duality of oppression and liberation framed in an antifascist perspective again configures itself as a research paradigm that can unpack important aspects of ICT4D research.

4 Conclusion

This paper has taken stock of the identity crisis of the ICT4D field, born in the light of "tech-for-good" assumptions which were disattended by failures over time. Against this backdrop, we have advanced an antifascist view of ICT4D as a route to "making a better world" by challenging violent oppression, through a paradigm that affirms liberation as a

political act with which digital technologies are impregnated. With an agenda centered on activism, LGBTQIA+ issues, and migration issues in an ICT-based surveillance space, we have provided conceptual glimpses of the shape that an antifascist ICT4D paradigm can take. As we advance this research-in-progress work, we expect to contribute to the existing literature by further articulating such a paradigm, around topics that - including AI, blockchains, smart cities, infrastructures of care and surveillance - permeate the current landscape of ICT4D, combining awareness of digital harm with a clear liberation agenda.

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What Future for Technological Utopianism? Exploring Technology and Control in Utopian Fiction

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Abstract. We draw on perspectives in the philosophies of technology to consider how the conceptual designs of desired, future social systems evident in utopian fictions might help us to better speculate on how today's technological developments may shape future societies. Drawing on a sample of late-19th through 21st century utopian fictions, we explore how utopian societies depend on technology to meet their social goals, how they address risk and uncertainty arising from technology developments, and what philosophical assumptions about technology underlie these utopian societies. Each utopia is first read holistically to understand the overall intention and coverage of the author's societal and technological views and then examined in detail in analytical categories related to technology benefits, risks, outcomes, and societal control mechanisms. Our preliminary findings suggest four possible technological paths, following Feenberg (2003) – instrumentalism, determinism, substantivism, and critical theory. Each path may give rise to utopia, each with its own implications for how human actors could control technology's influence on their societies. We posit the philosophical contradictions and overlaps between these paths to utopia, providing insights for examining today's technologies and the dreams and nightmares they inspire. Through this inquiry, we hope to better understand whether and how technological developments might be directed through our institutions and practices for enhanced societies in the future(s).

Keywords: Utopia · Philosophy of Technology · Critical Theory

1   Introduction and Motivation

The nearly unimaginable developments in information and computer technologies (ICTs) over the last 20 years, including globa38lization of the Internet, high-performance cloud computing, ubiquitous mobile phone access, and artificial intelligence (AI), have fueled both dreams of a technologically enriched future and nightmares of technologically-devastated human societies. Most recently, the enthusiastic embrace of generative AI language processors (e.g., chatbots like ChatGPT) has been matched by a cacophony of voices raising concerns about mass unemployment and the obsolesce

of human knowledge and skills. These concerns go far beyond questions of how ICTs might be developed and deployed, furthering desirable futures while mitigating undesirable outcomes, to whether meaningful societal control over such AI developments will even be possible once the technology is "unleashed" by its developers.

Considering the extent to which technology increasingly mediates every aspect of modern life and that there are technologies with the potential to cause global, catastrophic harm [5], tackling these how and whether questions is critically important and urgent. Answers lie in part in our sociotechnical histories, to be exposed through the rich studies of sociotechnical developments that IS scholars, following Latour's actor-network methods [30, 31], have undertaken [20].

Answers may lie in the possible futures that humans will construct. These latter answers are unknowable, though we have philosophical and methodological approaches that can inform current actions and increase the likelihood of desirable futures. The field of future studies provides such methods [2, 11, 46], and a cadre of IS researcher have advocated their use in the information systems field for this purpose [7, 21, 34].

In this research our goal is to complement such historical analyses and futures studies approaches by drawing from perspectives in the philosophy of technology [14–17, 40] and by taking a less-traveled road: an examination of technology in future societies. There are, of course, no future societies available for empirical study. Instead, our objects of study are non- or not-yet-existing societies that are "described in considerable detail" and intended to be "considerably better" than the ones in which we are currently living. These are the societies that Lyman Tower Sargent [44] defines as utopias, and their descriptions are found in utopian fiction. We seek to explore how utopian societies depend on technology to meet their social goals, how they address risk and uncertainty of societal outcomes arising from technology developments, and what philosophical assumptions about technology underlie their attempts to control its outcomes to further societal goals. Through this inquiry, we hope to better understand whether and how technological developments might be directed through our institutions and practices towards enhanced societies in the future(s).

2 Traditions in the Philosophy of Technology and Questions of Technology Control

We draw from the writings of Andrew Feenberg [14–17], whose philosophical positions overlap with the works of philosophers and social theorists whose works have inspired Information Systems (IS) researchers [7, p. 379]. We do not detail Feenberg's positions here but refer readers to Chiasson et al. [7] for discussion of Feenberg's relevance for IS futures research. Here, we briefly draw on Feenberg to clarify what we mean by the question of technology control, referred to above as how and whether questions. Feenberg posits that, "Different worlds, flowing from different technical arrangements, privilege some aspects of the human being and marginalise others. What it means to be human is thus decided in large part in the space of our tools" [15, p. 19]. He argues that the values, interests and priorities of powerful social actors usually determine these technical arrangements, allowing these actors to exercise power over others in a society. However, he also argues that technologies can be re-appropriated through democratic processes to

address a wider range of values and interests even after initial design and deployment, and the potential to do so is "rooted in the very nature of technology, with profound substantive consequences for the organization of industrial society" [15, p. 34]. Thus, to address whether technology can be controlled and how this might occur, we must also consider whose values, interests and priorities are embedded into dominant technologies and what opportunities are acted on and by whom to challenge these dominant technological arrangements.

As Feenberg [15, 16] articulates his critical theory of technology, he considers philosophical perspectives that differ in the assumptions about (i) the extent to which technology is autonomous (develops according to its own internal logic) or can be humanly controlled (is selected and developed by society to incorporate particular values, interests and social outcomes), and (ii) whether technology is socially "neutral" (universal, neither "good" or "bad") or intrinsically "value-laden" (incorporating the values and interests of select actors). Synthesizing his terminology and analysis, we consider four composite views relevant to the questions of technology control in future societies.

Instrumentalism views technology as value-neutral means to an end, which can be used for good or bad purposes at the discretion of its users [18], and hence outcomes are controllable, at least by those actors who design and deploy technology. *Determinism* adopts the instrumental perspective that technology is value-neutral but then views technology as autonomous, meaning its societal consequences develop according to an embedded logic that inevitably structures human experience and society [13], and hence is not subject to societal control once widely deployed. *Substantivism* differs from instrumentalism and determinism with the belief that technology is not value-neutral but shares with determinism the assumption that technologies change the functioning of the society according to the internal logic of technology, and going further, assumes (some) technologies distort the core values of a society and lessen human autonomy and worth. This is generally a dystopian view of technology that suggests these technologies should be suppressed to avoid their undesirable outcomes. Critical Theory (as articulated by Feenberg) shares the assumption that technology is value-laden but also assumes that technology can be (re)directed and reappropriated for other, progressive ends through collective human actions. Competing values, interests, and power are necessarily implicated in struggles over technology design and appropriation, but technologies remain open to (re)appropriation that could redirect society towards progressive ends [15–17]. Through democratic involvement in the development and deployment of technology, those who bear the substantive risks of technology outcomes can be empowered to (re)shape technology designs and uses to achieve more desirable social outcomes [17].

3   Utopian Literature, Technology and Control

Socio-technical relationships have been widely studied for societies past and present. Sometimes the studies are broad, seeking to explain the differences in social arrangements of different historical epochs at different levels of technology. This study differs as it looks to non- or not-yet-existing societies in the future through utopian fiction in order to consider technology control questions [44]. A key assumption is that we can interrogate utopian writings as a type of conceptual design for a desired, future society

that reflects desired societal values, historical circumstances, and human experiences with technology, as well as the views of the author. Herbert Simon [45], in *Sciences of the Artificial*, states that unlike science, design is concerned with how things ought to be; and he observes that descriptions of how societies and social systems *should* be refashioned have been recorded as utopias. In the early twentieth century, science fiction writer H.G. Wells promoted incorporating the analysis of utopias into the then-emerging field of sociology [33]. Utopian theorist Ruth Levitas [33] elaborated on this idea, calling literary utopias the "architectural mode" of a larger utopian design process.

Utopian fiction has evolved and varied over time, in form, in genre, in its social attitudes and concerns – and in its stance toward technology. A good overview of the evolution of utopia can be found in *The Cambridge Companion to Utopian Literature* [10], backed by other sources; see for example Jameson [23] and Moylan [37]. For science fiction-oriented views. The late nineteenth century was a golden age of utopianism. The utopias of this era tended to be optimistic about technology and its ability to deliver abundance and class equality [42]. *Looking Backward* [3] is an exemplar of this era. Then, spurred by the slaughter of World War I and the rise of totalitarian states, the literature of alternate societies after 1920 became dominated by dystopia [9]. The very idea of utopia was under fire from social critics and philosophers [39, 43], as utopia came to be associated with the failed socialist communities of the nineteenth century and the disasters of twentieth century communism [27].

However, by the nineteen-sixties and seventies, utopias started taking on new forms. Ambiguous, critical, feminist utopias arose in this era, as well as those addressing racial and gender inequality, war, and environmental crises [23]. The utopian society in *The Dispossessed* by Le Guin [23] didn't claim perfection; it acknowledged its flaws [35]. Swedish Social Democrat Ernst Wigforss answered Karl Popper's criticisms of utopia with the concept of an incremental, experimental "provisional" utopia [47]. Olin Wright's *Real Utopias* [51] sought to prove that it was possible to insert real utopian solutions into American society. Utopian fictions today are thus finding new audiences and new supporters [29, 33]. Recent examples are *Retrotopia* [19] and *Ministry for the Future* [40], both addressing climate change, but with very different views of technology. Robinson [41] seems to write from a modern, instrumentalist perspective, confident that there are technical solutions to climate change, and the social will to apply them. Greer [19] has a more critical perspective, expecting that the US will have to regress in its use of technology but that an imperfect utopia can still be reached by dialing back to freely chosen, sustainable, earlier levels of technology.

There have been a number of works on the role of technology in utopia, but only a few explore explicitly the philosophical perspectives that underlie the depiction of utopian technology [24, 25]. One notable example is Feenberg's [14] paper, "Looking backward, looking forward," which compares the change in technological worldview found in Edward Bellamy's [3] utopia *Looking Backward* to the one underlying Aldous Huxley's dystopia *Brave New World* [22]. In Bellamy's utopia, production and governance in society are technologically organized around efficiency and centralized control, but inhabitants remain free to pursue their individual lives – an instrumentalist view characteristic of the technology optimism of that time. In Huxley's dystopia, "technically rational organization prevailed throughout the society and transformed its members into

objects of technical control in every domain" [14] – a dystopian substantive view. Technology in Bellamy's utopia is value-neutral (neither good nor bad), whereas in Huxley's dystopia, it is value-laden, treating its inhabitants as parts in a machine.

4 Studying Technology Control Questions in Utopian Fiction

How might we take the conceptual designs of desired, future social systems evident in utopian fictions to better understand and speculate on how today's technological developments may control – or be controlled by – future societies? In this section we outline our research program to do so. We first selected a set of utopian fictions for study. Utopias that are simply escapist fantasies are not useful for this purpose, whereas what Mumford [38] calls "utopias of reconstruction," which are meant to depict a desired, future society and to inspire the reader to change the world in the utopian direction, are more appropriate to our study. Utopias of reconstruction serve as an engine for transforming society by combining an underlying critique of present conditions with an imaginatively reconstructed society [4, 8, 33]. The current study focuses on utopian works that were written in the United States and United Kingdom, from the late nineteenth century onward. This choice reflects the times and places that had experienced advanced technologies broadly at the industrial level. However, this scope is also a limitation to the study, missing the voices of other cultures and epochs. Another scoping decision is that utopia, designed to be a "good place," must be good for all its inhabitants; utopias designed to enslave, harm, or discriminate against any sub-group are dystopias. We considered the evolution of utopian fictions over time and through societal changes to account for the influences of the writer's historical and social context on the depiction of utopia and to select a varied array of utopias for study.

Using these criteria, we are reviewing utopian studies, histories, and critiques, for example: *The Story of Utopia* [38], *The Principle of Hope* [4], *Archaeologies of the Future* [23], *Utopia as Method* [33], and, *The Cambridge Companion to Utopian Literature* [10]. We have also identified a purposive sample of utopias representing distinctive sets of the societal, technological, and economic factors for initial analysis and methodology development. (See Table 1 for our selection.) Drawing from the philosophical foundations outlined above, we are examining how selected utopian societies depend on technology to meet their social goals – for example, abundance, equality, freedom, and individual flourishing – provided or supported by technology. We look for instrumental, deterministic, substantive, or critical theorist assumptions inferred from descriptions of the way the society develops, selects, and uses technology, and we highlight how societies address the risks and untended consequences of their technologies, as well as potential harms the utopian societies might not be seeing and are thus not prepared to cope with. Each utopian fiction is read holistically to understand the overall intention and coverage of the author's societal and technological views. Then the utopia is treated as a case study of a desired, future society to be analyzed in detail using conceptual categories (Table 2), with openness to new categories emerging throughout the study. Within each case and across utopias we examine the questions of technology control, the seen and unseen technological risks, and the presence (if any) of societal institutions and practices that direct technology towards utopian goals.

Table 1. Purposive Sample of Utopian Fiction for Analysis.

Year	Author, Title	Comments
1888	Edward Bellamy ***Looking Backward 2000–1887***	Classical, abundance and personnel fulfillment, advanced, advanced industrial production
1890	William Morris ***News from Nowhere***	Classical, fulfilling arts and craft labor, less advanced, craft technologies
1905	H. G. Wells ***A Modern Utopia***	Classical, personal fulfillment, slightly more advanced, modern technology with improvements in transportation, architecture, and managing people
1923	H. G. Wells ***Men Like Gods***	Classical, freedom and personal fulfillment, more advanced, telepathic communication
1962	Aldous Huxley ***Island***	Critical, happiness, cooperation, and spiritual fulfillment, less advanced, psychedelic drugs
1974	Ursula Le Guin ***The Dispossessed***	Critical/feminist, cooperative anarchy, space-faring but scarcity exists, disinterest in technology
1975	Ernest Callenbach ***Ecotopia***	Ecological, natural and social balance with creativity, advanced but green, sustainable technology
1987	Iain M. Banks ***Consider Phlebas***	Technology driven futuristic, freedom with abundance and personal fulfillment, AI and space-faring
2016	John Michael Greer ***Retrotopia***	Ecological, community self-sufficiency, deliberately less advanced, past tech that is proven workable

5   Preliminary Insights

In our purposive sample of utopian fiction, we found that earlier utopias typically draw on instrumentalist or determinist assumptions, both tending towards technological optimism and a blindness towards the risks and unintended consequences of technology [3, 36, 48, 49]. Later utopian fictions evolve towards the critical stance on technology, following the lead of Ursula K. Le Guin's novel, *The Dispossessed* [32]. There are also themes of restraining technological progress to avoid undesirable outcomes [6, 1, 19], for instance in utopias that emphasize ecological values such as Island [22].

Somewhat unexpectedly, in some works substantive assumptions about technology are evident, but they are not treated as dystopian; instead, the merging of the human with technology is depicted as desirable, for instance "the culture" science fiction novels of Ian Banks, in which the utopia is ruled by artificially intelligent entities and transhuman bodily modifications are commonplace and welcome [1].

The stage of detailed analysis of texts thus far has focused on *A Modern Utopia*, by H.G. Wells [48]. In this Utopia, people are generally healthier, more educated, gracious,

Table 2. Analytic categories

Category	Description
Title	Title of published work
Author	Author of publication
Date	Date of publication
Genre	Raven's taxonomy (Raven, 2015), plus topic-based grouping (e.g., "socialist," "feminist," "ecological")
Social Goals	Social Goals for utopia: e.g., abundance, equality, freedom, democracy, etc
Tech Level	Whether technology used is beyond, at, or below the level of technology when utopia was written
Technologies	Key technologies used in the utopia. They are marked "ICT" if they have an ICT component (e.g., an ICT aspect, even if embedded in another technology, e.g., bio-engineering
Tech Support	Technologies that are required by or support the Social Goals, listed above
Tech Dependency	Inferred from Social Goals/Tech Support
Social Origin Story	How utopia was founded and organized (e.g., after revolution or cataclysm, after tech advance, evolved over years, etc.)
Tech Origin Story	How utopian technology was introduced (e.g., developed, selected, discovered, etc.)
Social Control	Level of control that utopians have over social organization and way-of life in utopia
Tech Control	Level of control that utopians have over selection and use of technology
Tech Philosophy	Place on Feenberg's Matrix (Feenberg, 2003)
Risk Types Present	Risks are present, by type-of-risk, e.g., • External –outsiders destroying the utopia (e.g., by conquest) • Internal-social –social disruption from within (e.g., by revolt) • Substantivism –citizens being controlled by technology • Technical abuse –an individual or group using technology to dominate or harm others • Technical externalities – unintended consequences from using powerful/ dangerous technologies (e.g., pollution, nuclear war, biotech pandemic, etc.)
Risk Types Response	Risks are responded to, by type-of-risk
Risks Addressed	Inferred from Risk Types Present and Risk Types Response

and tolerant. The technology of this Utopia is said to be about the same level as Earth at the turn of the 20th century and is similar to rapidly developing technologies of that epoch (e.g., transportation, industrial production, communication). These technologies support

and benefit human life and society and incorporate aesthetic values. ("*Our Utopia will have, of course, faultless roads and beautifully arranged inter-urban communications, swift trains or motor services or what not, to diffuse its population…*"). Residents travel and enjoy life more, and work less hours. ("*But now that the new conditions physical science is bringing about, not only dispense with man as a source of energy but supply the hope that all routine work may be made automatic, it is becoming conceivable that presently there may be no need for anyone to toil habitually at all…*"). Utopian conditions are attributed more to social organization than to technology per se, with a single world government, well-organized production and distribution of goods, and a mixture of the best aspects of socialism and individualism allowing technology to serve people better and to evolve rapidly. *("[C]onsolidation of a great number of common public services over areas of considerable size is now not only practicable, but very desirable. In a little while heating and lighting and the supply of power for domestic and industrial purposes and for urban and inter-urban communications will all be managed electrically from common generating stations.*").

A Modern Utopia embodies an instrumental perspective in which technology can be controlled to serve beneficial societal ends. For instance, Wells depicts universal identification of residents based on thumbprints (biometrics) as beneficial ("*there is every reason for assuming it possible that each human being could be given a distinct formula, a number or 'scientific name' under which he or she could be docketed… [and] a system of other indices with cross references to the main one, arranged under names, under professional qualifications, under diseases, crimes and the like.*"). He sees this information gathering on all citizens as simply enabling more social services and achieving greater efficiency; he seems unconcerned about the potential use of this technology for social control, surveillance, or discrimination. Overall, there is little consideration for risks or unintended consequences of technology "progress", such as the possibility of widespread unemployment due to automation and inequitable access to resources that technology affords. Even technologies now viewed as dangerous and prone to abuse, such as eugenics, are described optimistically as enhancing human life. The study in progress has been uncovering many such examples of "risk blindness" in utopians of the past, which we now can see in hindsight.

6   Concluding Remarks

The questions of technology control we face today are not unique to the dazzling technologies in the current epoch. Intellectuals have long drawn on their imagination as well as their understanding of technology and society to analyze how technology can drive society towards utopia or dystopia. Optimists about technological futures continue to believe that "technology makes the world a better place" – and in some cases, "it makes the world not only a better place but also a good place" [28]. Our preliminary analysis suggests four possible technological paths that may give rise to utopia, each with implications for control and intervention. In an instrumentalist utopia, technology is primarily a tool to create improved social conditions, and it is up to humans through social institutions and organization to apply and restrict technological means "to good ends". Thus, the priority is to develop and implement the right institutions (e.g., regulatory

regimes). A deterministic utopia has a possibly blind faith in progress and accepts the internal logic of technology as the autonomous driver to shape enhanced future societies. Such societies rely on the assumption that the social values of technology designers that underlie the technology and are inherent are universally good for all (or most) of society. In both types of utopias, disparities in power and wealth are addressed so that all inhabitants share in the utopia and its technological benefits. However, both instrumental and deterministic utopias tend to be blind to unforeseen risks from technology, and this diminishes the prospects of such utopias being realized.

Our preliminary study suggests that substantive utopias are possible, that is, substantive societies are not necessarily dystopian – if humans adapt their social values to the internal logic and values of technology to create positive, post-human societies, rather than accepting human nature and society only as it exists today. Such trans-human societies embody different assumptions than instrumental and deterministic utopias about the necessity or desirability of total human control of technology. Substantive utopian views may further energize the rapid deployment and adoption of AI technologies. For instance, in medical image processing, AI algorithms are increasingly accepted as good or better, as well as faster and less expensive, than human radiologists at detecting irregularities requiring an intervention. A transhuman society in which human medical caregivers are largely replaced with algorithms, remote monitoring robotic care givers, and so on, could engender a compelling utopian society in which health care services are widely and equitably available to all, due to lower costs and ease of replication. The success of a substantive utopia still depends on recognizing risks and undesirable consequences in technology, and then selectively allowing or suppressing technical progress. A key challenge is to correctly forecast risks and mediate conflicts in values and interests, in time to avert undesirable social outcomes if a technology is diffused widely.

Finally, in critical utopias, inhabitants accept that technology contributes to a future that is imperfect, though better than the current society. Members of the society steer outcomes by democratically and collectively making trade-off decisions on design and adoption, taking into consideration the inherent risks of technology as well as its ability to meet some utopian goals. Utopia is less a destination than a journey, realized through ongoing struggles over the values and interests that shape technological developments.

As we proceed with our study, we will explore these types of future utopias evident in utopian fictions, their contradictions and overlaps, and insights for addressing today's technologies, and the dreams and nightmares they inspire. In these ways we hope to contribute to a small but growing literature in IS and in technology studies that engages speculatively with possible futures through utopian and science fiction literatures [12, 26, 50].

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Understanding Parental Perceptions of Children's Online Use in Australian Aboriginal Communities by Adapting Traditional Indigenous Practices

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Abstract. The rapid proliferation of digital media has significantly changed how children interact with the online world. However, within Australian Aboriginal communities, the impact of these technologies on children's well-being and cultural identity remains relatively unexplored. This study aims to understand parental perceptions regarding children's online use within these communities. Indigenous research methodologies emphasize community engagement, cultural protocols and reciprocal relationships between researchers and participants. By integrating these approaches into the study design, a comprehensive understanding of the complexities surrounding children's online use can be achieved while respecting the unique perspectives and voices of Aboriginal parents. This research in progress employs a qualitative approach, incorporating participatory action design research and yarning circles as key methods. Yarning circles are traditional Indigenous storytelling and knowledge-sharing forums that encourage open dialogue and collective decision-making. The data collected from the yarning circles will be analyzed thematically, identifying common themes, perspectives and concerns emerging from the discussions. The findings will shed light on parental perceptions of children's online use, which will be utilized in an appropriate intervention to bridge parents' and caregivers' knowledge gaps.

Keywords: Parental perceptions · Online behavior · Indigenous community · Indigenous research methods · Yarning · Aboriginal community · Digital inequality

1 Introduction

Indigenous Australians face a plethora of disadvantages across several key life issues, including technology domains where Indigenous Australians have less access to the internet and other digital technologies than their non-Indigenous counterparts [1]. Also, according to a government report, young people from Aboriginal communities are more

vulnerable and exposed (three times more likely than the national average) to online harms, including hate speech, discrimination, and bullying [2].

Further, many Indigenous families and communities are both uninformed and ill-equipped to deal with the growing concern of cybersecurity. Cybersecurity and cyber safety refer to the systemic and behavioral practices employed to protect individuals while they use internet-enabled devices [1]. Prior research has established that parents of minority ethnicities lack understanding about the threats their children face in the online environment [1, 3].

Digital inequality has far-reaching implications for the widening of gaps in a range of areas, including education, health, wellbeing and opportunity. In this information age of the 21st century, social inequality cannot be addressed without considering the apparent challenges of digital inequality among marginalized and vulnerable communities [4]. As already noted, Indigenous Australians are one of the groups most at risk for online abuse and attacks. Despite this, little is known about the consequences this can have in Indigenous communities, particularly where youth are involved. Additionally, little information exists about how parents can manage their children's cyber safety.

A report by the eSafety commissioner [2] highlights that Indigenous children are less likely to advise an adult/caregiver of negative experiences online, while they were reportedly more likely to engage in risk-taking behaviour than non-Indigenous children. However, the report acknowledges its limitations, stating that it did not utilise Indigenous-centred data and the survey was mainly designed for the general population and not specifically adapted for the use of Indigenous members, which is crucial when conducting research with Indigenous populations. There were inconsistencies with reporting; parents reported higher accounts of involvement with guiding children to use the internet, which was above the national average. When children were asked the same questions, they reported that their parents were below the national average—perhaps the truth could be presented somewhere in between. This report highlights the importance of research and data gathering utilizing traditional Indigenous and culturally appropriate methodologies and decolonizing research to capture the reality and truth prevailing in the more specific local context [5, 15].

Current safety practices and policies do not adequately exploit and utilize cross-cultural issues and demographic-related factors, such as Indigenous cultures, where children are more vulnerable. This situation has created a need for sensitizing Indigenous parents with actionable knowledge and skills to combat online risks to Indigenous children. While some strategies and tools exist to deal with children's cyber threats, little has considered the deeper cultural issues and unique barriers specific to Indigenous and ethnic people, such as styles of relating Indigenous-specific communication and social and emotional well-being factors. This area is one where the world needs different process models and interventions to address children's cyber safety problems.

The research is a priority area for Indigenous peoples as it helps address the issue of the existing digital inequality among the Australian Indigenous population. 'Closing the Gap' is a national Indigenous priority for Australia, and the 2020 CTG agreement mandates that Indigenous people should have an authentic say in the design of resources and services that affect them [6].

The study reported here is part of a larger project in which knowledge-sharing strategies and tools will be developed that aim to alleviate problems with Indigenous children's eSafety. The overarching project included an initial scoping review of knowledge-sharing interventions with Indigenous Australians to gather empirical evidence of the nature and outcomes of prior interventions [14]. This review showed that all the cases that reported only positive outcomes had recognized Indigenous ways of knowing, being and doing to some extent. The inclusion of performative aspects and oral traditions in Indigenous culture was particularly noteworthy.

2   Method

Understanding parental perceptions regarding children's online use is the main focus of this study. However, an appropriate research approach for our overarching project is action design research, which is a research method for generating prescriptive design knowledge through building and evaluating ensemble IT artifacts [7, 8]. This method was chosen because an immediate problematic situation is addressed, namely the digital inequality among a vulnerable section of the population [7], and the researchers propose to intervene to bring about change by carrying out the building of an IT artefact, intervention in the organization and evaluation [7, 9]. Further, elements of design science research [8] are incorporated into the project by explicating some general design principles through reflection during and following the work [9].

Yarning circles were employed in the first phase of our project to gather background knowledge of the problem situation in the field. Yarning is a seminal knowledge transfer technique that Indigenous people have used since creation. It is a culturally appropriate methodology that enables a respectful and honest interaction between researchers and participants, enabling researchers to learn and gain valuable information about the issues being discussed [10]. Yarning also breaks the formality between researchers and participants by creating a conducive interaction atmosphere of equal partnership where researchers and participants are knowers and learners [10, 11].

The research followed ethical requirements for Indigenous research, in line with the guidelines of the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) [12]. Further, the research team includes Indigenous people, and the study is conducted in collaboration with Fair Canberra Inc., an organization that advocates for inclusiveness and equitable treatment for all members of the Canberra community, including Indigenous people. These organizations have confirmed their support and will provide or arrange access to community leaders, participants, and stakeholders for the project. Constant advice, guidance and support will be received from the reference group at all stages of the research to ensure ethical cultural considerations are accounted for, and participants are treated with dignity and respect in line with their cultural identities.

2.1   Participants

The study set out to achieve its aims by undertaking qualitative research with information drawn from a cross-section of research participants from different groups and locations around Greater Canberra and Queanbeyan. Participants groups targeted in this study

were Indigenous parents, guardians or relatives with children who are active with digital technologies and online users. The research involved three yarning circles, each with 8–10 participants. This number is within the acceptable limits for yarning circles, ensuring that participants do not become anxious while waiting to contribute to the discussion [10]. Based on advice from the reference group and due to the cultural sensitivity of Indigenous people, men and women were in separate groups, and participants were people from the same cultural group.

2.2 Procedure

The process for social yarnings used in this study began with yarning to establish a rapport between the researchers and participants to make participants feel comfortable [10]. Each yarning circle lasted 45–90 min. A yarning stick was passed around the participants to indicate the next speaker and to avoid interruptions. Each session was concluded by thanking participants for their time and contribution and explaining the next steps in the process, including contact details of at least one person from the research team they could reach out to afterwards if they had any further questions.

3 Findings and Reflections

The data collection and its preliminary analysis are continuing. The groups had differing demographics, with the first group comprising parents and the second comprising mostly grandparents. Despite this difference, there were common themes shared across both groups. These themes related to safety, knowledge of technology, feelings of helplessness, concerns for child development, and the desire for further strategies and resources. Within each theme that emerged from the data collected and analyzed so far, several sub-themes are identified based on each participant's lived experience. The major thread across the participants was concern for the younger generations. Rarely was a participant overly positive about the use of technology, and rarer still was indifferent about its use.

The grandmother group were particularly concerned. They saw the internet as another invasion of their culture and heritage, with one participant attributing the online phenomena as 'disengagement from the real world'. Throughout the yarning circle, 'respect' became a key underlying issue and principle, which perhaps evolved from the years of historical experience of disrespect and treatment of the stolen generation. Most of the participants were found to be very protective about this issue and keen to ensure this respect before any possible interventions.

It was noted that the digital intrusion created some disruptions to the traditional values and practices among Indigenous communities. For example, the traditional way of passing knowledge from elders to juniors is found problematic, as in digital spaces, children are more aware and educated on digital media and often become trainers/educators for elders. Parents in Aboriginal communities place a high priority on maintaining cultural norms and traditions while utilizing technology. To guarantee their children's holistic development, they believe it is important to establish a balance between traditional Indigenous ways of life and online interaction.

Nevertheless, Indigenous parents are becoming more conscious of the digital gap and how it affects their children's education and future chances. While parents are aware of the value of digital literacy, they also face the difficulties associated with efficiently gaining access to and using technology. Some parents see protecting children online as an additional workload on top of what they are doing, which often becomes overwhelming, particularly for those with more than two children. The overall experience of this fast-changing digital transformation was expressed as the 'Commodore 64 to Chromebook era'.

Some lessons were learned in conducting this type of research with Indigenous communities. It was not easy to assemble participants for the yarning circles and for them to agree to be part of the research, as some thought they were 'over-researched' as an Indigenous population. Formation of the yarning group needed careful attention to avoid generational divide, social clans, tribes, and gender mix. A number of participants raised deep concern over growing racism online through various social media channels, particularly in the lead-up to the Voice referendum. According to them, this has put additional mental pressure on top of the existing cyber risks.

Not all of the research team are Indigenous, but yarning circles were led by an Indigenous leader/elder in the local community with extensive cultural and academic experience in this domain. During the process, Indigenous researchers led the discussions, which is important to create a conducive and fear-free environment and avoid any preconceived assumption, mistrust and lack of willingness to share information formed through the legacy of colonization and displacement.

The ongoing project is guided by a reference group that includes non-profit community organizations with members and leaders from Indigenous communities. Meetings to discuss findings and how the work continues have been educative for the non-Indigenous team members. These experiences align with what has been shown from a review of prior work. The Indigenous team members are essential to prevent others from slipping into "Western ways of thinking". At one reference group meeting one person proposed a particular type of intervention as a possibility (a booklet). An Indigenous team member immediately said "That won't work. We need to use oral communication if possible" (e.g. a podcast). The Indigenous team members were also needed to explain the context of what arose from the yarning circles. For example, the prospect of involving law enforcement officers to assist with knowledge sharing with children was treated with caution. Memories of the "stolen generation", when Indigenous children were forcibly removed from their parents, often by police officers, are still strong. One person said in one of the group discussions that a learned response by children when seeing a police officer was to "scatter" and run in different directions, so not all of them could be caught.

4   Conclusion

This research is being undertaken at a pivotal moment when online risks and behaviour among Indigenous children need urgent attention and culturally appropriate interventions that differ from mainstream off-the-shelf solutions. The project's major benefits include an in-depth understanding and consolidation of Indigenous knowledge transfer strategies and communication practices, and synthetization and filtration of Indigenous cultural

practices for future use in IT intervention design and identifying generational and parent–children gaps in dealing with cyber safety issues [13].

In parallel with the yarning circles, the project has undertaken a scoping review of knowledge-sharing interventions with Indigenous Australians [14]. The project will also thoroughly analyze existing interventions and educational resources specifically for cyber safety to identify success stories, gaps and limitations for potential adaptation for use by Indigenous and ethnic parents to protect their children from cyber risks.

Recommendations will be developed for short- and long-term strategies with a holistic and multi-disciplinary perspective and for actionable and appropriate information systems policy guidelines for the government and relevant organizations. The project's knowledge contributions will be published in scholarly journals, conferences, and seminars. Due to the direct and important societal impact, the project phase will involve a series of dissemination seminars/workshops with relevant stakeholders to create awareness among the key stakeholders, including the Indigenous parents. These seminars will provide an opportunity to receive feedback, which can be used to test and fine-tune our strategy and artefact for subsequent deliveries.

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