THE AFRICAN JOURNAL OF INFORMATION AND COMMUNICATION (AJIC)

ISSUE 33, 2024

RESEARCH ARTICLES

Published by the LINK Centre
University of the Witwatersrand (Wits)
Johannesburg, South Africa
https://www.wits.ac.za/linkcentre

ISSN 2077-7213 (online version)
ISSN 2077-7205 (print version)

The African Journal of Information and Communication (AJIC)

Issue 33, 2024

Published by the LINK Centre, School of Literature, Language and Media (SLLM), Faculty of Humanities, University of the Witwatersrand (Wits), Johannesburg, South Africa
https://ajic.wits.ac.za

Editors

Managing Editor: Ntsibane Ntlatlapa, Associate Professor, LINK Centre, University of the Witwatersrand, Johannesburg, ntsibane.ntlatlapa@wits.ac.za
Corresponding Editor: Lucienne Abrahams, Director, LINK Centre, University of the Witwatersrand, PO Box 601, Wits 2050, Johannesburg, South Africa, witslinkcentre20@gmail.com
Publishing Editor: Chris Armstrong, Research Associate, LINK Centre, University of the Witwatersrand, Johannesburg, chris.armstrong@wits.ac.za

The African Journal of Information and Communication (AJIC) is a peer-reviewed, interdisciplinary, open access academic journal focused on the myriad dimensions of electronic and digital ecosystems that facilitate information, communication, innovation and transformation in African economies and in the broader Global South. Accredited by the South African Department of Higher Education and Training (DHET), *AJIC* publishes online, free to the user, under a Creative Commons licence, and does not impose article processing charges. *AJIC* is indexed in Scientific Electronic Library Online (SciELO) SA, the Directory of Open Access Journals (DOAJ), Sabinet African Journals, and Wits University WIReDSpace, and is hosted on the Academy of Science of South Africa (ASSAf) Khulisa Journals platform.

Peer-Reviewing

AJIC acknowledges with gratitude the following peer reviewers of submissions to this issue: Busola Ajibola, Vicky Bronstein, Kathleen Diga, Alan Finlay, Sibukele Gumbo, Sagwadi Mabunda, Kgopotso Magoro, Isayvani Naicker, Ntsibane Ntlatlapa, Scott Timcke, Melody Musoni, and Chikezie Uzuegbunam.

Production

Sub-editing: LINK Centre
Proofreading: Linda Van de Vijver
Desktop-publishing: LINK Centre

AJIC is published by the LINK Centre, School of Literature, Language and Media (SLLM), Faculty of Humanities, University of the Witwatersrand (Wits), PO Box 601, Wits 2050, Johannesburg, South Africa. The LINK Centre is based at the Wits Tshimologong Digital Innovation Precinct, 41 Juta Street, Braamfontein, Johannesburg, https://www.tshimologong.joburg

ISSN 2077-7213 (online version)
ISSN 2077-7205 (print version)

Past issues of *AJIC*, and its precursor *The Southern African Journal of Information and Communication (SAJIC)*, are available at https://ajic.wits.ac.za/issue/archive and https://www.wits.ac.za/linkcentre/sajic

CONTENTS

RESEARCH ARTICLES

RESEARCH ARTICLES

Non-compliant health record-keeping in South Africa: Judicial responses, and progress towards a digital remedy

Omowamiwa Kolawole
Postdoctoral Fellow, Dalla Lana School of Public Health, University of Toronto; and Researcher, Open African Innovation Research (Open AIR) network
https://orcid.org/0000-0002-8144-8733

Abstract
Numerous South African public health facilities fail to meet their record-keeping obligations as required by law. One of the impacts of this non-compliant medical record-keeping is, as this study found, the undermining of medical negligence claims. The study reviewed numerous South African medical negligence court cases in which an absence of comprehensive, reliable patient records was central to the court's judgment. The research also examined progress towards, and challenges facing, the South African government's efforts to improve medical record-keeping through implementation of a national, digital Health Patient Registration System (HPRS) comprising online electronic medical records (EMRs) linked to unique personal identifiers. Based on the study findings, this article concludes with a call for the South African courts to take steps to compel the state, and public health facilities, to meet the record-keeping requirements contained in the country's applicable legal-regulatory and policy instruments.

Keywords
health care, records, medical negligence claims, court proceedings, judicial decisions, electronic medical records (EMRs), Health Patient Registration System (HPRS), South Africa

DOI: https://doi.org/10.23962/ajic.i33.18892

Recommended citation
Kolawole, O. (2024). Non-compliant health record-keeping in South Africa: Judicial responses, and progress towards a digital remedy. *The African Journal of Information and Communication (AJIC), 33,* 1-19. https://doi.org/10.23962/ajic.i33.18892

1. Introduction

Proper health record management is an intrinsic aspect of quality health care delivery. Numerous stakeholders and scholars have identified shortcomings in record-keeping by South Africa's public health entities (Malakoane et al., 2020; Marutha & Ngulube, 2012). These shortcomings have numerous potential negative consequences for health care delivery. One such consequence, which is the focus of this study, is that medical negligence claims cannot be accurately assessed in the absence of reliable records. In 2021, the South African Law Reform Commission (SALRC) published a Discussion Paper entitled *Medico-Legal Claims*, which explored "the challenges faced by the public health sector due to the escalation in claims for damages based on medical negligence, the increasing financial implications for the fiscus, and medical negligence case law" (SALRC, 2021, p. 1). This SALRC paper pointed to record-keeping as one of the core deficiencies requiring urgent remedy (SALRC, 2021). According to the paper:

> There are problems with record keeping, information management and filing across the board. The importance of good record-keeping is self-evident, but several respondents [...] and commentators raise concerns about inadequate record keeping at state health establishments […] (SALRC, 2021, p. 165)

This article reports on the findings of my research into South African medical negligence legal cases in which the court's consideration of the facts in question was undermined by lapses in health record management.

In section 2, I set out the methodology followed in conducting the review of the relevant South African case law. In section 3, I set out the South Africa policy and legal-regulatory instruments that require, indirectly or directly, the collection and storage of reliable health records. In section 4, I turn to the heart of the article: the findings regarding South African cases in which the judicial decisions pointed to deficiencies in medical record-keeping. Section 5 then sets out the current state of South Africa's implementation of online electronic medical records (EMRs) via the Health Patient Registration System (HPRS). Section 6 provides conclusions.

2. Methodology

An initial scoping review was conducted to explore the nature and practice of medical negligence litigation in South Africa and to identify the various factors that have led to the marked increase in claims in the country. A further review was conducted to contextualise the effects of increased medico-legal litigation on the South African health care system. Drawing from the literature on the causes and effects of increased

medical negligence claims in South Africa, a systematic case law review was carried out, examining medical negligence claims in South Africa from 1994 to January 2022. The search for relevant cases was primarily conducted in the online repository of the Southern African Legal Information Institute (SAFLII),[1] as well as LexisNexis, Juta, PubMed, EBSCOhost, and Google Scholar (to check for any cases not stored in the SAFLII repository). The SAFLII repository was used as the primary data source largely because it is open access and publicly accessible. The cases found served as the primary data source for analysis and examination to better understand the relevance of poor record management to poor health care delivery and subsequent legal action.

The cases examined were limited to those involving the South African public health system at either the national or the provincial level. This focus on the public health system was based on the findings of the SALRC (2021) paper, which highlighted poor health record management as a particular challenge in the public health system. Furthermore, the various laws and regulations discussed in the paper are interventions to address the challenge of poor record management in the South African public health system. Initially, a total of 1,232 cases considering medical negligence claims against the public health system were found. From this corpus, I selected the cases where a non-biomedical concern was raised—either in support of the claim of negligence, or by the courts in their adjudication. This narrowing of the criteria led to 89 cases being found to be relevant. Among these cases, 10 were identified in which poor health record management was raised as an issue affecting either the care provided or the ability of the court to properly adjudicate the matter. These cases were subsequently analysed to generate the findings that are set out in this article.

3. South African policy and legal-regulatory instruments relevant to medical records

Constitution, 1996

While the South African Constitution of 1996 does not directly provide for health records, the rights that it enshrines are central to the tenets of health record management (RSA, 1996a). Section 27(1)(a), in the Constitution's Bill of Rights, provides for the right to access health care services, which section 27(2) mandates that the state must provide for by taking "reasonable legislative and other measures, within its available resources, to achieve the progressive realisation" of the right.[2] Here, there is a constitutional stipulation that all "reasonable" and affordable measures must be taken in support of the realisation of South Africans' right of access to health care. The constitutional guarantee of access to information is also relevant. Section 32 of

1 https://www.saflii.org
2 Sect. 27, Constitution, 1996.

the Constitution, also in the Bill of Rights, guarantees the right of everyone to "(a) any information held by the state; and (b) any information that is held by another person and that is required for the exercise or protection of any rights". Also relevant is section 14 of the Constitution, which provides for the right to privacy,[3] which is a central tenet in the management of health records. These provisions make the South African public health system, as an extension of the state, bound by the duty to provide the patient records in its possession on demand, especially when the demand is being made in a bid to facilitate the protection of the rights of the health user, as is the case with a medical negligence claim. The latter is itself guaranteed in section 34 of the Constitution, which protects the right to access the courts to seek legal redress.

White Paper, 1997

The White Paper for the Transformation of the South African Health System, made public by the national Department of Health (DoH) in 1997, provides policy objectives that form the core principles of a unified National Health System (DoH, 1997). Chapter 6 identifies the lack of reliable health information as a major obstacle to the ability to properly plan and deliver health services in the country. It identifies the existence of a fragmented and incompatible health information system as a challenge to the ability to have a coordinated national health information system.[4] Furthermore, it states that the health information systems being used are largely uncoordinated and not sufficiently comprehensive.

The challenge of lack of ease of use is attributed to the predominance of manual, paper-based data collection and storage. The inadequate computerisation of data collection, collation, and storage is pointed to as a limitation to be addressed. Accordingly, a key goal established by the White Paper is the development of a comprehensive National Health Information System.[5] The White Paper states that, in order to create and consolidate this system, there needs to be significant improvement in the management of health facility records.[6] The White Paper proposes that the system should be nationally coordinated, with an overall parent system that is user-friendly, to support the effective delivery of health services at all levels.[7]

National Health Act (NHA), 2003

The National Health Act No. 61 of 2003 (NHA) establishes a framework for the responsibilities and duties of each level of government in the fulfilment of health services for the South African populace. The NHA regulates the interactions and

3 Sect. 14, Constitution, 1996.
4 Chap. 6, White Paper, 1997.
5 Chap. 21, White Paper, 1997.
6 Chap. 21, White Paper, 1997.
7 Chap. 6, White Paper, 1997.

interdependence between health provision at the national, provincial and local levels. With respect to health record management, section 13 of the NHA provides that

> [s]ubject to the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), and the Promotion of Access to Information Act, 2000 (Act No. 2 of 2000), the person in charge of a health establishment *must* ensure that a health record containing such information *as may be prescribed* is created and maintained at that health establishment for every user of health services. (emphasis added)

This section of the NHA places a duty on every South African public health facility to have mechanisms for the creation and storage of patients' health records. On the specifics of how health records are to be maintained at the health facility, section 17(1) states:

> The person in charge of a health establishment in possession of a user's health records must set up control measures to prevent unauthorised access to those records and to the storage facility in which, or system by which, records are kept.

Section 17(2) outlines the numerous actions that would constitute breaches of the obligation set out in section 17(1), with conviction for performing such a breach punishable by a fine and/or imprisonment for up to one year. In furtherance of the recognition of the need for a systemic approach to the collation and management of health records, the NHA mandates, in section 74, a coordinated "national health information system", which ought to include health data from across the country:

> (1) The national department must facilitate and co-ordinate the establishment, implementation and maintenance by provincial departments, district health councils, municipalities and the private health sector of health information systems at national, provincial and local levels in order to create a comprehensive national health information system.
> (2) The Minister may, for the purpose of creating, maintaining or adapting databases within the national health information system contemplated in subsection (1), prescribe categories or kinds of data for submission and collection and the manner and format in which and by whom the data must be compiled or collated and must be submitted to the national department.

This must be read in conjunction with section 47 of the Act, which places an obligation on all health facilities to ensure compliance with requirements and standards as they may relate to facilities and services such as "health technology", equipment, and the delivery of health services, which are all relevant to the gathering and storage of patient health records. Section 47(3) mandates the Office of Standards Compliance

and the Inspectorate for Health Establishments to "monitor and enforce compliance with the quality requirements and standards contemplated in subsection (1)".

DHMIS Policy, 2011

The District Health Management Information System (DHMIS) Policy, finalised by the national DoH in 2011, seeks to consolidate the lessons learnt in the implementation of health information systems and to chart a course for addressing challenges that have arisen from their implementation (DoH, 2011). The policy seeks uniformity in the implementation and use of the DHMIS through streamlined processes and unified norms and standards. Citing the DoH's obligations in terms of the NHA, the policy mandates

> establishment, implementation and maintenance of the information systems by provincial departments, district health councils, municipalities and the private health sector at national, provincial and local levels in order to create a comprehensive national health information system.[8]

The policy sets out the requirements for users of the DHMIS at all levels of health care provision in South Africa. The policy mandates the proper collection and management of service delivery data by health facilities as crucial to the DHMIS.[9]

Normative Standards Framework, 2014

The National Health Normative Standards Framework for Interoperability in eHealth, gazetted by the national DoH in 2014, was formulated in accordance with the provisions of section 74(1) and (2) of the NHA (DoH, 2014). The framework prescribes the use of an interoperable patient information system (PIS), and mandates sufficient budgetary allocation to ensure the creation and maintenance of a foundational national eHealth infrastructure that enables secure health information exchange and shared clinical repositories.[10]

Standard Operating Procedure, 2016

The Standard Operating Procedure for Filing, Archiving and Disposal of Patient Records, published by the national DoH in 2016, provides guidance to staff of

8 Introduction, DHMIS Policy, 2011.
9 Para. 3.2, DHMIS Policy, 2011.
10 Para. 1(e), Normative Standards Framework, 2014.

primary health care facilities on how to properly and safely store patient records (DoH, 2016). The document states that its primary purposes are

> to give guidance to staff in Primary Health Care facilities on the procedures to follow to ensure that patient records[11] are stored safely and filed in a systematic and orderly manner so that [they] can be retrieved in the most efficient manner possible [and to] give guidance to staff on archiving and disposal of patient records to ensure that there is sufficient space available for filing of patient records.[12]

The document lays out the procedure for ensuring that these records are stored in an orderly and systematic manner that facilitates efficient retrieval. It places responsibility for ensuring that all records are properly kept, with adequate security measures, on provincial health departments.[13] The regulations address the proper procedure for filing patient records (regulation 6), handling patient records (regulation 7), archiving the records (regulation 3), disposing of records (regulation 8), and the proper conditions and requirements for the storage of records (regulation 4).

National Guideline for Patient Records, 2017

Also in 2017, the national DoH released the National Guideline for Filing, Archiving and Disposal of Patient Records in Primary Health Care Facilities (DoH, 2017). The guideline refers to the requirements of the Constitution, the National Archives and Records Service of South Africa Act 43 of 1996, the Promotion of Access to Information Act 2 of 2000 (PAIA), the Protection of Personal Information Act 4 of 2013 (POPIA), and provincial instruments on archives and records. The guideline does not, however, refer to the NHA of 2003.

In setting out the responsibilities of employees in the health system, the guideline envisages the predominant use of physical copies of records, while recognising that an electronic record system may be used "where it is in place".[14] A focus on paper-based record-keeping and storage is found in paragraph 6.1, which specifies the need for "shelves or cabinets that are made of coated metal".[15] However, paragraph 6.4 does provide for both physical and electronic records, with the electronic records to be saved and backed up based on the stipulations of the software application being used.[16]

11 The Standard Operating Procedure uses "patient records" as the operative term—different from the NHA, which refers to "health records".
12 Introduction, Standard Operating Procedure, 2016.
13 Regulation 3, Standard Operating Procedure, 2016.
14 Para. 5.4, National Guideline for Patient Records, 2017.
15 Para. 6.1, National Guideline for Patient Records, 2017.
16 Para. 6.4, National Guideline for Patient Records, 2017.

Norms and Standards Regulations, 2018

In accordance with section 90(1A) of the NHA, the national DoH gazetted the Norms and Standards Regulations Applicable to Different Categories of Health Establishments in 2018 (DoH, 2018). Regulation 6 requires health establishments to have accurate records for health system users, and to ensure that these records are adequately protected and managed, and kept confidential, in accordance with the provisions of the NHA.[17] The health records to be maintained must also include all relevant biographical data of the health user, together with all relevant information related to their examination and health interventions. In terms of the regulations, patient health records must always be secure.[18]

National Digital Health Strategy, 2019

Published by the national DoH in 2019, the National Digital Health Strategy for South Africa 2019–2024 builds on the eHealth Strategy of 2012 (DoH, 2012) and includes, as one of its nine strategic goals, the use of a unique identifier linked to an EMR, accessible across all levels of the health system, for each patient using the system (DoH, 2019). The strategy sets the goal of establishing, by the end of 2024, the necessary integrated information architecture, via the aforementioned HPRS, for a robust and integrated electronic health record system. The HPRS is, in turn, central to the national government's efforts to establish a National Health Insurance (NHI) system.[19]

HPCSA Guidelines, 2022

The Health Professions Council of South Africa (HPCSA) Guidelines on the Keeping of Patient Records, which were revised in 2022, set out the best practices for the collection and management of health records (HPCSA, 2022). In February 2023, the body reiterated the importance of proper health record management and the ethical principles and professional conduct expected in their management. The Council noted, in its 2020/21 Annual Report, that "a concerning number of complaints lodged against practitioners were related to medical records" (HPCSA, 2023).The guidelines specify that accurate record-keeping is required in instances of, inter alia, litigation and orders of the court.[20]

4. Judicial decisions pointing to lapses in health record management

Despite the various laws and regulations discussed above, which dictate how health records are to be maintained, various court cases have demonstrated instances where public health facilities have failed to meet their obligations. These failures, and the

17 Sect. 6, Norms and Standards Regulations, 2018.
18 Sect. 6(1C), Norms and Standards Regulations, 2018.
19 Executive Summary, National Digital Health Strategy, 2019.
20 Para. 9.3, HPCSA Guidelines, 2022.

effects of these failures on healthcare delivery and health system accountability, are discussed below by examining the judicial decisions resulting from the court cases in question.

In *Mbola obo M v Member of the Executive Council for Health, Eastern Cape*,[21] an integral issue in the patient's claim required support from medical records. In the absence of those records, the plaintiff remained adamant, and the veracity of her claims had to be tested on trial during cross-examination. While the defendant tried to use the absence of records as proof that the plaintiff was in fact never at the medical facility, the court noted, in its 2018 judgment, that there were lapses in the record management process and that, in fact, "several stop gaps to preventing wrong information from being recorded were missed due to human error and not following due process".[22] As noted by the court:

> It further emerged whilst she [the plaintiff] was being cross examined that the entries on the referral book and the Road to Health Card did not match. According to her it did often happen, in an emergency situation such as the observation of jaundice symptoms, to forthwith make a referral without insisting on the production of the Road to Health Card or the noting of a clinic attendance.[23]

Here, the importance of medical records in establishing the sequence of events that occurred and the facts of the case became apparent. A similar conclusion was drawn by the court in the case of *M obo M v Member of the Executive Council for Health of the Gauteng Provincial Government*.[24] In this case, the medical experts called to examine the facts of the case and to determine the merits of the claim of medical negligence refused to make pronouncements because of the absence of hospital records. The court observed, in its 2018 judgment on the case, as follows:

> The [HPCSA] guidelines […] emphasise the importance and crucial nature of patients' records, in particular in the case of minor children, such as occurred in the present matter. […] Indeed, several of the expert witnesses involved in this matter have expressed utter frustration of not having available the hospital records, and therefore not being able to assist the court. In my view, the frustration was well-grounded, particularly where no acceptable and plausible explanation was advanced for the absence of such records.[25]

21 (4521/18) [2018] ZAECMHC 67 (6 December 2018).
22 Para. 23, *Mbola obo M v Member of the Executive Council for Health, Eastern Cape*.
23 Para. 24, *Mbola obo M v Member of the Executive Council for Health, Eastern Cape*.
24 (2014/32504) [2018] ZAGPJHC 77 (20 April 2018).
25 Para. 42, *M obo M v Member of the Executive Council for Health of the Gauteng Provincial Government*.

It its judgment, the court pointed out that the obligation to provide quality health care also includes the duty to "create, maintain, keep and store her medical records"[26] and that their absence unwittingly makes adjudication unduly difficult.[27]

When the necessary medical records are not present, it will often be necessary to rely heavily on the statement of the plaintiff, as occurred in the case of *NN obo ZN v MEC for Health, Eastern Cape Province*.[28] As the court noted in its 2017 judgment on the case:

> The plaintiff was not subjected to any meaningful cross-examination. The reason for this is not far to seek: there was [a] paucity of records from which the monitoring of the birth process could be gleaned. Not even the version suggested in the plea was put to the plaintiff. It became clear, at this stage of the trial, that the defendant would no longer persist in its contention that the treatment meted out to the plaintiff and her baby had not been negligent. This is evidenced by the following interaction between the Court and the defendant's counsel:
> […]
> "MR DUKADA: No, the question, M'Lord, relates to whether she's able to recall what assessment were done.
> COURT: And you've got a version in relation to that?
> MR DUKADA: The version is simple, there's no version because of the records, M'Lord. That is the problem. We don't have the records."[29]

The importance of health records was re-emphasised later in the same judgment, where the court noted the following statement by the defence counsel when asked if the absence of medical records disadvantaged the defence arguments:

> It does because we don't know what happened. For example, we don't know if the m[other] took [the] baby home and came back, if there was infection, if there were seizures, if there was hypoglycaemia we don't know what happened to bring that child back again. And that's where the disadvantage is for us.[30]

26 Para. 40, *M obo M v Member of the Executive Council for Health of the Gauteng Provincial Government*.
27 Para. 40, *M obo M v Member of the Executive Council for Health of the Gauteng Provincial Government*.
28 (CA 470/2017) [2020] ZAECBHC 14 (17 June 2020).
29 Para. 12, *NN obo ZN v MEC for Health, Eastern Cape Province*.
30 Para. 22, *NN obo ZN v MEC for Health, Eastern Cape Province*.

Accordingly, the court found as follows:

> […] [C]ounsel for the defendant, quite correctly so in my view, conceded that the absence of records demonstrative of appropriate care meted out by the relevant hospital employees to Z, rendered the case hard to defend.[31]

In the case of *Madida obo M v MEC for Health for the Province of Kwa-Zulu Natal*,[32] the court noted, in its 2016 decision, that the failure to properly collate and store health records could, in terms of the NHA, result in criminal charges:

> In terms of ss 13 and 17 of the National Health Act 61 of 2003 the defendant's employees have a statutory duty to preserve and protect such hospital and medical records. *Failure to do so opens the defendant's employees to criminal prosecution* and liable on conviction to a fine or to imprisonment for a period not exceeding one year or to both such fine and imprisonment.[33] (emphasis added)

The court further specified that the duty to keep proper health records also includes prohibiting the alteration of records, except where an alteration that is made is adequately specified and justified in the record. As noted by the court:

> Errors may be corrected but the date of the change must be entered, and the correction signed in full. The original record must remain intact and fully legible. Additional entries at a later date must be dated and signed in full. The guidelines[34] also provide for the retention of health records, which must be stored in a safe place and if stored electronically then safeguarded by passwords.[35]

Nevertheless, in this case, the core issue addressed by the court was the complete lack of the provision of records by both the defendant and the health care facility where the plaintiff received care. In this case, the only records that could be referenced by both parties were those provided by the plaintiff from her own personal records. The court noted with dismay the defendant's failure to produce the necessary records: "How else does one begin to fix the recurring and costly problem of missing records if one cannot unravel why they are missing or unavailable?"[36]

31 Para. 24, *NN obo Z v MEC for Health, Eastern Cape Province*.
32 (14275/2014) [2016] ZAKZPHC 27 (14 March 2016).
33 Para. 10, *Madida obo SSM v MEC for Health for the Province of KwaZulu-Natal*.
34 HPCSA Guidelines of 2008.
35 Para. 11, *Madida obo SSM v MEC for Health for the Province of KwaZulu-Natal*.
36 Para. 13, *Madida obo SSM v MEC for Health for the Province of KwaZulu-Natal*.

In *AD obo KLO v MEC for Health for the Province of KwaZulu-Natal*,[37] the court drew attention to the recurring problem, in KwaZulu-Natal Province, of incomplete medical record-keeping:

> [I]t is [a] disturbing fact that in more than one of these medical negligence cases that have come before this court, involving the current defendant, incomplete records are produced in respect of a crucial stage of the labour of plaintiffs.[38]

In another KZN Province case, *PS obo AH v MEC for Health for the Province of KwaZulu-Natal*,[39] the court noted with disapproval, in its 2017 judgment, as follows:

> The medical records (all of which emanate from the possession of the defendant) are not models of clarity. Some appear to be incomplete. Some are very difficult to read. Where entries are unclear or cryptic, and open to interpretation, the experts were left to draw their own conclusions because none of the defendant's staff who were involved in the activities which the documents purport to record was called either to give an account of what happened (if the witness had any recollection of it), or to explain the record keeping and what conclusions ought to be drawn from some of the entries which could have done with explanation.[40]
> […]
> At the end of the trial, the hospital file relating to this matter was miraculously found. There is still no clear explanation for all of this.[41]

In *Khoza v Member of the Executive Council for Health and Social Development of the Gauteng Provincial Government*,[42] it was found that health records had been altered. In its 2015 judgment, the court expressed a fear that the alterations were the result of a deliberate attempt to falsify the records. As noted by the court in this case, the inability to ascertain the intent behind the alteration of the records was primarily due to the poor handling of the records, which the court noted was common at the health facility that provided care to the plaintiff. In another case involving the same health facility, *Ntsele v MEC for Health, Gauteng Provincial Government*,[43] the court noted that all clinic notes and files involving the patient had gone missing with no

37 (8700/2013) [2019] ZAKZPHC 13 (13 March 2019).
38 Para. 18, *AD obo KLO v MEC for Health for the Province of KwaZulu-Natal*.
39 (14197/2014) [2017] ZAKZPHC 37 (24 August 2017).
40 Para. 10, *PS obo AH v MEC for Health for the Province of KwaZulu-Natal*.
41 Para. 27, *PS obo AH v MEC for Health for the Province of KwaZulu-Natal*.
42 (2012/20087) [2015] ZAGPJHC 15; 2015 (3) SA 266 (GJ); [2015] 2 All SA 598 (GJ) (6 February 2015).
43 (2009/52394) [2012] ZAGPJHC 208; [2013] 2 All SA 356 (GSJ) (24 October 2012).

explanation offered. In *Ntsele* the court pointed to a pattern of lack of accountability by the health system and its officers, even when there had been a demonstrable lapse in the execution of their duties, particularly with regard to record-keeping. The court stated as follows:

> The custodians of the clinic and hospital records were not called to explain the reason why these records are missing or lost. No explanation or reason was proffered regarding the attempts made if any, of finding or recovering the missing or lost records.[44]

In *Madida obo M v MEC for Health for the Province of Kwa-Zulu Natal*,[45] the court noted that instances of poor health record management were sufficiently common as to warrant systemic remedial intervention.

In all the cases examined above, the failure to properly keep health records led to the court taking judicial notice of the systemic failure, and also buttressed the legal claims of the patients against the public health system. In all these cases, entities of the public health system were found guilty of medical negligence and ordered to pay damages.

5. South African progress towards a national EMR system

In the SALRC Discussion Paper of 2021 that was cited earlier in this article, one of the Commission's core proposals, titled "Record keeping", included the following specified requirements (2021, p. 351):

> 4) Proper system of record keeping supported by a state-owned information technology system. The same system and technology should be used in all provinces and the national department.
> 5) Reporting system supported by the same system and technology to enable data sharing and a centralised data base. The information to be reported and the manner of reporting should be determined at national level and the guidelines should be followed by all provinces.

As seen above in section 3 of this article, in the review of South African policy and legal-regulatory instruments relevant to medical records, the core South African national government strategy—implementation of a national, universal EMR system via the HPRS—is in line with the record-keeping remedy that the SALRC proposes. However, the roll-out of the EMR and the HPRS faces numerous challenges. At present, in mid-2024, the HPRS is in varying stages of development across the nine

44 Para. 117, *Ntsele v MEC for Health, Gauteng Provincial Government*.
45 (14275/2014) [2016] ZAKZPHC 27 (14 March 2016).

provinces. In a September 2023 written reply from the Minister of Health to an MP's question in the National Assembly, it was stated that "a fully-fledged EMR will take approximately 5 years",[46] i.e., it will only be completed in about 2028—significantly later than the 2024 deadline set by the National Digital Health Strategy published in 2019.

Numerous studies make the case for EMRs (Ayaad et al., 2019; Lin et al., 2019). It has been found that paper-based health records are insufficient for meeting the requirements of high-quality documentation and communication (Yu et al., 2013). Successful EMR interventions have been found to enable easier access to information, improved decision-making, and more rapid delivery of health care services (Makeleni & Cilliers, 2021). Among other things, EMRs, when properly maintained, are able to highlight issues that may be missed when relying upon paper records—especially if those paper records are held at a health facility different from the one where a patient is seeking care (Makeleni & Cilliers, 2021).

Critical work has been done that makes the case for EMR interventions as viable and necessary in the South African context (Katurura & Cilliers, 2018), while also seeking to understand the challenges to their uptake (Popela et al., 2019). It is clear that the successful implementation of EMRs in public health systems requires strong government funding and leadership (Ohuabunwa et al., 2016). Studies such as that of Makeleni and Cilliers (2021) have evaluated EMR implementation in specific South African public health facilities where EMRs have been piloted and/or fully built into operations. The study found that more than a quarter of the South African EMR systems in operation were stand-alone applications that could not share information with other systems (Makeleni & Cilliers, 2021). EMR interoperability, allowing for a smooth process of information-sharing across provinces and medical facilities, was thus still considerably limited.

As several health systems scholars have pointed out, the success of EMR interventions is greatly dependent upon the existing organisational culture (Munir & Kay, 2003; Sood et al., 2008). Additionally, there are, of course, significant challenges in uptake when health workers are overworked, underpaid, and serving in under-resourced and under-staffed public health facilities. Such workers will naturally be resistant to any new system perceived as cumbersome and adding complications to their already difficult jobs. As Saleem et al. (2011) explain, when an electronic medical management system does not fully match the needs of health care workers, "paper workarounds" tend to emerge. A 2016 study conducted at South Africa's Khayelitsha Hospital in greater Cape Town found that, despite the hospital's incorporation of a

46 Question 2575, Internal Question Paper No. 27 (1 September 2023). https://pmg.org.za/files/RNW2575-230922.docx

n EMR system, 15% of the records for trauma cases were missing or incomplete, with some missing information on vital signs, and many not recording the patients' time of arrival (Ohuabunwa et al., 2016). Such findings highlight the fact that EMR systems are not, on their own, a remedy for problems in health record management. The means to ensure compliance and accountability are also required.

6. Conclusions

Democratic South Africa has been the site of numerous instances of judicial intervention in support of health rights and the measures necessary to actualise such rights (Heywood, 2009). Accordingly, with respect to the management of health records, the South African courts must once again show the required judicial courage, and maximise their constitutionally granted powers in respect of socioeconomic rights (Bilchitz, 2003). The courts must hold the state and its health system accountable for delivery on the record-keeping provisions in the legal-regulatory and policy instruments set out in this article.

Such action by the courts would be in line with the school of thought that posits that the act of a court compelling state action is not inherently wrong in and of itself. What is of consequence is the nature of the remedies that the court feels entitled to make and is able to enforce (Wiles, 2006). Flowing from this, rather than compelling specific actions that are best left to the state's administrative powers, the judiciary should act as an arbiter of accountability, holding the state accountable for the interventions that it has committed to making, and the timelines that it has set. Such an approach would comply with the principles of both progressive realisation and reasonableness—the two elements of the litmus test for court influence on state action (Wilson & Dugard, 2011).

The task of judicial enforcement of the implementation of proper health record management in the South African public health system is, therefore, two-fold. First, the courts must be willing to enforce the existing legal instruments that penalise the failure to properly store and manage health records. Here, erring health facilities, managers, and/or workers ought to be held to account—for their roles in failing to comply and/or failing to ensure compliance with procedures required by law and/or regulation. Second, the courts ought to hold the state accountable for its own stated goals with respect to the implementation of an interoperable national EMR system in terms of the National Digital Health Strategy published by the national DoH in 2019.

At the same time, government delivery on policy requires the executive branch to make the necessary budgetary allocations, provide clear timelines for action, and adhere to the timelines. The role of the legislature in providing parliamentary oversight is

also important. This critical task is necessary to hold the executive accountable. It is therefore imperative that the South African state, Parliament, and the courts all play their roles in ensuring compliant health record-keeping for the benefit of users of the public health system.

Acknowledgements
The author thanks Prof. Caroline Ncube, holder of the DST/NRF SARChI Research Chair in Intellectual Property, Innovation and Development, Department of Commercial Law, University of Cape Town,[47] whose input helped to shape this article; and Associate Prof. Jill Olivier in the School of Public Health, Faculty of Health Sciences, University of Cape Town, whose guidance helped shape this article. The author is also grateful for assistance, during the finalisation of this article, from colleagues in the Open African Innovation Research (Open AIR) network.[48]

Funding
Partial funding for this research was provided through the Health Systems Research Initiative (HSRI) in the UK, a collaboration between the UK MRC, ERSC, DFID and the Wellcome Trust. Grant number: MR/P004725/1. Partial funding was also provided through the DST/NRF SARChI Research Chair in Intellectual Property, Innovation and Development Postdoctoral Fellowship programme, Department of Commercial Law, University of Cape Town (Grant 115716). Any opinion, finding and conclusion or recommendation expressed in this article is that of the author and none of the funders accept any liability in this regard.

Data availability
The data supporting the results of this study is available, upon written request, from the author at ookolawole@gmail.com.

AI declaration
AI was not used in the writing of this article.

Competing interests
The author has no competing interests to declare.

References

Auditor-General South Africa. (2023). *Medico-legal claims (health sector): Briefing document on the medico-legal claims affecting the health sector 2022–23.* Prepared for Standing Committee on Public Accounts. https://static.pmg.org.za/231108SCOPA_-_Briefing_note_2023_11_08_Medico-legal_claims.pdf

Ayaad, O., Alloubani, A., ALhajaa, E. A., Farhan, M., Abuseif, S., Al Hroub, A., & Akhu-Zaheya, L. (2019). The role of electronic medical records in improving the quality of health care services: Comparative study. *International Journal of Medical Informat*ics, *127*, 63–67. https://doi.org/10.1016/j.ijmedinf.2019.04.014

47 https://law.uct.ac.za/ip-chair
48 https://openair.africa

Bilchitz, D. (2003). Towards a reasonable approach to the minimum core: Laying the foundations for future socio-economic rights jurisprudence. *South African Journal on Human Rights*, *19*(1), 1–26. https://doi.org/10.1080/19962126.2003.11865170

Department of Health (DoH). (1997). White Paper for the Transformation of the Health System in South Africa. https://www.gov.za/sites/default/files/gcis_document/201409/17910gen6670.pdf

DoH. (2011). District Health Management Information System (DHMIS) Policy: A Long and Healthy Life for All South Africans. https://knowledgehub.health.gov.za/elibrary/district-health-management-information-system-dhmis-policy

DoH. (2012). eHealth Strategy South Africa 2012–2016: A Long and Healthy Life for All South Africans. https://www.isfteh.org/files/media/southafrica_ehealth_strategy_2012-2016.pdf

DoH. (2014). National Health Normative Standards Framework for Interoperability in eHealth in South Africa. *Government Gazette* No. 37583, Notice No. 314, 23 April 2014. https://www.gov.za/sites/default/files/gcis_document/201409/37583gen314.pdf

DoH. (2016). Standard Operating Procedure for Filing, Archiving and Disposal of Patient Records. https://knowledgehub.health.gov.za/system/files/elibdownloads/2019-07/National%2520standard%2520operating%2520procedure%2520filing%2520archiving%2520and%2520disposal%2520of%2520patient%2520records.pdf

DoH. (2017). National Guideline for Filing, Archiving and Disposal of Patient Records in Primary Health Care Facilities. https://www.medbox.org/document/national-guideline-for-filing-archiving-and-disposal-of-patient-records-in-primary-health-care-facilities

DoH. (2018). Norms and Standards Regulations Applicable to Different Categories of Health Establishments. *Government Gazette* No. 41419, Notice No. 67, 2 February 2018. https://www.gov.za/sites/default/files/gcis_document/201802/41419gon67.pdf

DoH. (2019). National Digital Health Strategy for South Africa 2019–2024. https://www.health.gov.za/wp-content/uploads/2020/11/national-digital-strategy-for-south-africa-2019-2024-b.pdf

Hall, M. (2023). Coding case law for public health law evaluation. In A. C. Wagenaar, R. L. Pacula & S. Burris (Eds.), *Legal epidemiology: Theory and methods* (2nd ed.). Wiley.

Hall, M. A., & Wright, R. F. (2008). Systematic content analysis of judicial opinions. *California Law Review*, *96*, 63–122. https://doi.org/10.15779/Z38R99R

Health Professions Council of South Africa (HPCSA). (2022). Guidelines for Good Practice in the Healthcare Professions. https://www.hpcsa.co.za/Uploads/professional_practice/ethics/Booklet_9_Keeping_of_Patient_Records_Review%20Draft_vSept_2022.pdf

HPCSA. (2023, February 20). Patient records – HPCSA ethical principles and professional conduct. https://www.hpcsa-blogs.co.za/patient-records-hpcsa-ethical-principles-and-professional-conduct

Heywood, M. (2009). South Africa's Treatment Action Campaign: Combining law and social mobilization to realize the right to health. *Journal of Human Rights Practice*, *1*(1), 14–36. https://doi.org/10.1093/jhuman/hun006

Katurura, M. C., & Cilliers, L. (2018). Electronic health record system in the public health care sector of South Africa: A systematic literature review. *African Journal of Primary Health Care & Family Medicine*, *10*(1), 1–8. https://doi.org/10.4102/phcfm.v10i1.1746

Kumar, M., & Mostafa, J. (2020). Electronic health records for better health in the lower- and middle-income countries: A landscape study. *Library Hi Tech*, *38*(4), 751–767. https://doi.org/10.1108/LHT-09-2019-0179

Lin, Y. K., Lin, M., & Chen, H. (2019). Do electronic health records affect quality of care? Evidence from the HITECH Act. *Information Systems Research*, *30*(1), 306–318. https://doi.org/10.1287/isre.2018.0813

Makeleni, N., & Cilliers, L. (2021). Critical success factors to improve data quality of electronic medical records in public healthcare institutions. *South African Journal of Information Management*, *23*(1), 1–8. https://doi.org/10.4102/sajim.v23i1.1230

Malakoane, B., Heunis, J. C., Chikobvu, P., Kigozi, N. G., & Kruger, W. H. (2020). Public health system challenges in the Free State, South Africa: A situation appraisal to inform health system strengthening. *BMC Health Services Research*, *20*, 1–14. https://doi.org/10.1186/s12913-019-4862-y

Marutha, N. S., & Ngulube, P. (2012). Electronic records management in the public health sector of the Limpopo Province in South Africa. *Journal of the South African Society of Archivists*, *45*, 39–67.

Munir, S. K., & Kay, S. (2003). Organisational culture matters for system integration in health care. In *AMIA Annual Symposium proceedings* (pp. 484–488). American Medical Informatics Association.

Ohuabunwa, E. C., Sun, J., Jubanyik, K. J., & Wallis, L. A. (2016). Electronic Medical Records in low to middle income countries: The case of Khayelitsha Hospital, South Africa. *African Journal of Emergency Medicine*, *6*(1), 38–43. https://doi.org/10.1016/j.afjem.2015.06.003

Popela, I., Zuva, T., & Appiah, M. (2019). Factors that influence the adoption of electronic patients records management systems in South Africa. In *2019 International Multidisciplinary Information Technology and Engineering Conference (IMITEC)*, Vanderbijlpark, South Africa (pp. 1–9). IEEE. https://doi.org/10.1109/IMITEC45504.2019.9015918

Republic of South Africa (RSA). (1996a). Constitution of the Republic of South Africa, 1996.

RSA. (1996b). National Archives and Record Service of South Africa Act No. 43 of 1996.

RSA. (2000). Promotion of Access to Information Act No. 2 of 2000 (PAIA).

RSA. (2003). National Health Act No. 61 of 2003 (NHA).

RSA. (2013). Protection of Personal Information Act No. 4 of 2013 (POPIA).

Sood, S. P., Nwabueze, S. N., Mbarika, V. W., Prakash, N., Chatterjee, S., Ray, P., & Mishra, S. (2008, January). Electronic medical records: A review comparing the challenges in developed and developing countries. In *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS 2008)* (pp. 248–248). IEEE. https://doi.org/10.1109/HICSS.2008.141

South African Law Reform Commission (SALRC). (2021). *Medico-legal claims.* Discussion Paper 154 – Project 141. https://www.saflii.org/za/other/ZALRC/2022/9.pdf

Tsegaye, T., & Flowerday, S. (2021). A system architecture for ensuring interoperability in a South African national electronic health record system. *South African Computer Journal*, *33*(1), 79–110. https://doi.org/10.18489/sacj.v33i1.838

Wiles, E. (2006). Aspirational principles or enforceable rights? The future for socio-economic rights in national law. *American Universtiy International Law Review*, *22*(1), 35-64.

Williams, F., & Boren, S. A. (2008). The role of the electronic medical record (EMR) in care delivery development in developing countries: A systematic review. *Informatics in Primary Care*, *16*(2), 139–145. https://doi.org/10.14236/jhi.v16i2.685

Wilson, S., & Dugard, J. (2011). Taking poverty seriously: The South African Constitutional Court and socio-economic rights. *Stellenbosch Law Review*, *22*(3), 664–682.

Wright, G., O'Mahony, D., & Cilliers, L. (2017). Electronic health information systems for public health care in South Africa: A review of current operational systems. *Journal of Health Informatics in Africa*, *4*(1), 51–57.

Yu, P., Zhang, Y., Gong, Y., & Zhang, J. (2013). Unintended adverse consequences of introducing electronic health records in residential aged care homes. *International Journal of Medical Informatics*, *82*(9), 772–788. https://doi.org/10.1016/j.ijmedinf.2013.05.008

Zharima, C., Griffiths, F., & Goudge, J. (2023). Exploring the barriers and facilitators to implementing electronic health records in a middle-income country: A qualitative study from South Africa. *Frontiers in Digital Health*, *5*, 1207602. https://doi.org/10.3389/fdgth.2023.1207602

Risks of generative artificial intelligence (GenAI)-assisted scams on online sharing-economy platforms

Julie Reid
Professor, Department of Communication Science, University of South Africa (UNISA), Pretoria
https://orcid.org/0000-0002-7082-7834

Abstract
The prevalence of scams proliferating via online platforms has been identified as an emerging societal problem resulting in large-scale financial losses for victims. Online scams typically rely for their success on the generation of fake but convincing user profiles to conceal the identities of the scammers from the people being tricked into parting with their money. The increasing sophistication of generative artificial intelligence (GenAI), which can produce outputs indistinguishable from real content, thus carries the risk of being adopted by fraudsters to assist in the enactment of online scams. This article considers the risks of the potential uptake and use of GenAI applications by online scammers operating in the sharing economy, with a focus on homestay-marketplace platforms and, in particular, the largest such platform, Airbnb.

Keywords
online scams, fraud, artificial intelligence (AI), generative artificial intelligence (GenAI), sharing economy, homestay-marketplace platforms, Airbnb

DOI: https://doi.org/10.23962/ajic.i33.18162

Recommended citation
Reid, J. (2024). Risks of generative artificial intelligence (GenAI)-assisted scams on online sharing-economy platforms. *The African Journal of Information and Communication (AJIC), 33,* 1-21. https://doi.org/10.23962/ajic.i33.18162

1. Introduction

Recent years have seen significant advancement in the sophistication, accessibility, and adoption of technologies rooted in artificial intelligence (AI) and machine learning. This growth trend is projected to continue in the immediate future. The extensive range of AI applications includes systems designed for the prevention and detection of criminal activity. Conversely, the technology also carries the risk of being misused to facilitate crime, with the potential for criminal exploitation increasing concomitantly with the expanding capabilities and adoption of AI tools. Some AI-facilitated threats emerge as an extension of pre-existing criminal activity, whilst others are novel, and such threats can, for the most part, be generated by using AI tools that are openly available to the public.

Recent explorative research efforts have sought to identify and pre-emptively anticipate potential threats from AI-assisted crime (Caldwell et al., 2020; Cross, 2022; King et al., 2020; Wach et al., 2023). Such studies have tended to focus broadly on crime in general and on AI in general, without a specific focus on the crime and AI sub-sets. The focus of this article is on the crime sub-set of online scams and, in relation to online scams, the specific threats posed by generative AI (GenAI). In many cases, online scams are enabled by the digital distribution of a message that involves some form of trickery or misrepresentation, where scammers falsely advertise services or products, or impersonate someone they are not, with the goal of financially or personally exploiting victims (Brooks, 2023). Given the increasing sophistication of GenAI, and the fact that its outputs are becoming impossible for human users to detect as not real (Miller et al., 2023; Nightingale & Farid, 2022), I discuss the implications thereof, and whether this technology could lead to an expansion of online scam operations.

Whether operating as social media sites, sharing-economy platforms, or e-commerce marketplaces, the central premise of several big tech online platforms is that they allow users to connect with one another online for the purpose of value exchange, with that exchange being either social or commercial. In many cases, these digital platforms have become ubiquitous and central to contemporary life, generating global user bases measured in billions. The prevalence of online scams that proliferate via popular big tech platforms has been identified as an emerging societal problem and has drawn the attention of lawmakers. For example, in the UK, Members of Parliament have argued that online platforms ought to be required to protect their users from fraudulent advertisements and scams (Thomas, 2022), and bankers have called on social media companies to reimburse victims of online fraud, accusing them of profiting from the scams proliferating on their platforms (Clark, 2023).

Social media users have been lured into scams via platforms such as Facebook, Instagram, and WhatsApp (Clark & Wood, 2023), often incurring considerable financial losses while enduring emotional anguish. Equally, users of sharing-economy and e-commerce websites have also been lured into scams through the false representation of various services or products, as is discussed in more detail below.

In this article, I consider the potential uptake of GenAI applications by scammers for use in acts of deceptive speech online on homestay-marketplace platforms, with a specific focus on Airbnb.

2. Objectives, definitions, and methodology

A great deal of existing literature and public debate is focused on the ethical and social ramifications of AI, and on regulating and controlling its civil uses, including, for example, in the education sector (Zawacki-Richter et al., 2019) and digital content creation (Hermann, 2021). AI-assisted crime, as a distinct phenomenon, has yet to be broadly recognised as an important area for study (King et al., 2020). Nonetheless, a limited collection of recent research studies has considered the potential of AI to assist bad actors in committing crimes (see Caldwell et al., 2020; Cross, 2022; King et al., 2020). Since the widespread adoption of AI tools available for public use is still a recent development, the field of studies of AI-assisted crime is symmetrically young. Understandably, the problem has several facets and possible use-case scenarios for the adoption of AI in crime that have yet to be investigated or critiqued by literature. This article aims to contribute to filling this research gap, to a limited degree, by foregrounding the possible uptake of GenAI by online scammers in the realm of one type of online sharing-economy platform: homestay marketplaces.

Definitions of AI are contested (García-Peñalvo & Vázquez-Ingelmo, 2023), and the term is applied in many contexts that do not result in the production of content. In this article, I concentrate specifically on GenAI—or, more specifically, on openly available machine-learning technologies that produce content (text, images, audio, or video) directed by prompts or inputs of the user via a front-end user interface.

Crime includes a broad range of criminal acts, including scams. A scam is a form of fraud that is achieved through trickery that results in financial gain for the perpetrator and financial loss for the victim. Scams have proliferated on online sharing-economy platforms, with such scams typically relying on varying degrees of misrepresentation for their success.

The purpose of this study was to explore the extent to which GenAI holds the potential to be adopted as a new tool by scammers to assist their activities. The contribution made by this study can only be classified as speculative, as there is, at present, no empirical evidence available to measure the adoption and use of GenAI by scammers in acts of deceptive speech online. Measurements of the adoption of

GenAI by online scammers might be provided in future reports by monitoring or law enforcement agencies that collect victim reports, but these are yet to be compiled or published. Also, while technologies for the detection of GenAI content are under development and could possibly be of use in research in future, these are currently lagging in developmental progress relative to GenAI applications (Heikkilä, 2023). Currently, research efforts aiming to perform direct measurements of scammer-produced online content would be hampered in the identification of such content for inclusion in a data corpus since AI-generated material is often indistinguishable from genuine content (Miller et al., 2023; Nightingale & Farid, 2022).

Accurate measures of the quantity and frequency of online scams are also difficult to establish since the domain in question is extremely broad, presumably present on the platforms of all large online-intermediary platform firms. For example, scams involving deceptive communications proliferate via email (Isacenkova et al., 2014) and text messaging (McCormick, 2023) campaigns, and on Facebook (Shah, 2023), Instagram (Clark & Wood, 2023; Stouffer, 2022), YouTube (Patel, 2023), Uber (Dent, 2022), Lyft (Holmes, 2019; Kerr, 2019; Turkos, 2019), Airbnb (Fergusson, 2021), Crewbay (Gillespie, 2023), Tinder (Ropek, 2022), Grindr (Igual, 2018; Igual, 2023; Sekudu, 2023), Amazon (Jones, 2023; Walsh, H., 2023; Wood, 2023), Trustpilot (Marsh, 2023), Tripadvisor (Giuffrida, 2018; O'Neill, 2018; Tripadvisor, 2023), Booking.com (Low & Fakim, 2023; Mann, 2019; Vahl, 2022) and several others. The enforcement and crime prevention authorities of various countries release periodic reports detailing indicators such as fraud reportage statistics and gross losses (ABS, 2023; Brooks, 2023; Mzekandaba, 2023; UK Finance, 2022). Such reports, while conducted sporadically, depending on the resources and research capacity employed by each country's investigative agencies, and while unable to provide a combined global measurement, nonetheless indicate that the proliferation of online fraud and scams is enormous.

The insights offered in this article are informed by the examination of a dataset that I collected for a separate research project, which investigated the structure of mediated communicative practices used by scammers to lure victims via Airbnb.[1] The methodology comprised a netnographic thematic qualitative content analysis of 600 units of user-generated content in which victims related their personal experience of being scammed via Airbnb. Units of analysis were sourced from the public submissions blog Airbnbhell.com, the open-access archive of the Better Business Bureau, TikTok,

1 The earlier study mentioned here culminated in a book manuscript, entitled *Delusive Speech in the Sharing Economy: Scam Inc.* (Taylor and Francis, New York), the publication of which is forthcoming at the time of writing.

and YouTube. Selected findings emanating from this dataset are discussed narratively below. Desktop research for the earlier study focused on contextualising Airbnb within the broader sharing economy and e-commerce spheres, and included scrutiny of news media reports of scam proliferation on other platforms such as Booking.com, Uber, Grindr, and Facebook Marketplace. The findings of the earlier study did not extend to exploring the potential adoption of GenAI by scammers in their deceptions.

3. Literature review and contextualisation of the problem

Much of the public discourse on GenAI has, to date, been centred on ChatGPT, created by OpenAI in 2018 and released for public use in November 2022 (Marr, 2023). A generative model built on transformer architecture, ChatGPT uses deep-learning and machine-learning algorithms to produce conversational and human-like text responses. GenAI chatbots are not a new concept, but ChatGPT does represent a watershed moment in the history of GenAI due to its superior mimicry of human-like conversations on a variety of topics that appear natural (Alawida et al., 2023; Ooi et al., 2023).

Through the testing of ChatGPT, Alawida et al. (2023) demonstrated how the chatbot can be manipulated by adversarial users in its response to cybersecurity questions to potentially orchestrate attacks by assisting in the development of polymorphic malware that can continually evolve, thus evading antivirus software. Other studies have explored the possibilities of ChatGPT being used "by adversaries to create social engineering attacks, phishing attacks, automated hacking, attack payload generation, malware creation, and polymorphic malware" (Gupta et al., 2023), and to generate harmful, inappropriate, offensive, or incorrect text and information (Liu et al., 2023). Risks associated with GenAI tools like ChatGPT have also been identified in terms of the manipulation of individual persons (Eliot, 2023). Due to its ability to generate convincing human-like texts and to propagate false information, GenAI may be used to influence or manipulate people's behaviour, perceptions, and emotions (Wach et al., 2023).

In addition to textual outputs, GenAI technologies also provide the capabilities for the production of video, audio, and pictorial outputs that may be used by bad actors for nefarious purposes. Voice-cloning software can be used, for example, to extract funds from victims when a scammer uses the application to clone the voice of a loved one claiming to be in trouble. Such was the case with a father in the US city of Philadelphia who became the victim of a voice-cloning attack when he believed that he heard the voice of his adult son, who said that he had been arrested and urgently required USD9,000 for a lawyer (Rushing, 2020). Helmus's (2022) assessment of the risks posed by GenAI emphasises how deepfake content could be used to manipulate elections through the distribution of disinformation, to exacerbate social divisions, and to undermine sources of legitimate information, including professional

journalism. Deepfake video content could conceivably sway election outcomes if, for example, at the time of closely contested elections, deepfake videos are generated that portray candidates engaged in illicit or nefarious activities to damage their reputations (Helmus, 2022).

Deepfake images can easily be produced on websites such as Generated.photos, UnrealPerson.com, and ThisPersonDoesNotExist.com, which generate unique, extremely detailed, and life-like images of human bodies, torsos, and headshots. While such images do not represent a real person, they can potentially be used by bad actors in conjunction with aliases to publish inauthentic user profiles on any number of online platforms. Cross (2022) investigates how GenAI images can be used in the facilitation of romance scams. Such scams are a fast-growing fraud category (Cross, 2023). In the US, the Federal Trade Commission (FTC) reported over 56,000 victims suffering losses of over USD547 million in romance fraud in 2021, an 80% increase on reported losses for the previous year (FTC, 2022). In the United Kingdom, romance fraud increased by 73% in 2021 relative to 2020, with GBP30.9 million lost (Clark, 2022).

Referred to by a variety of names including romance-baiting, pig-butchering, or cryptorom, online romance scams involve a high level of communicative deception on the part of the scammer, who typically employs a fake identity and alias. The victim is lured into what appears to be a genuine relationship via an online platform with the scammer who poses as a romantic interest. After rapport and trust are established, the scammer lures the victim into performing money transfers or depositing investments into fake cryptocurrency exchanges (Cross, 2023). Once the victim realises that they have been scammed, the effect can be devastating due to what has been termed the "double hit" of victimisation (Whitty & Buchanan, 2012). Not only does the victim lose money, but they must also grieve for the loss of what they believed to be a genuine relationship.

Prevention messaging and advice promoted by law enforcement and fraud monitoring agencies typically encourages users to protect themselves by verifying the identity of their online love interest by performing a reverse image search of profile pictures and images using tools such as Google Images or TinEye (Cross, 2022). Such actions may reveal whether an image has been plagiarised from an authentic source in an act of identity theft for the purpose of creating a fake profile. However, many deepfake images, and wholly synthesised images, cannot be tracked by such reverse-search tools, with the result that such tools have the potential to create the mistaken

impression that an image is genuine, thus increasing the vulnerability of a potential romance scam victim (Cross, 2022).

In addition to romance scams, there are several other online domains where the successful perpetuation of scams relies on acts of deception that rest on the generation of fake profiles and identities. The COVID-19 pandemic and lockdowns generated an explosion of internet pet scams, especially prevalent in Australia (May, 2022). Long-term lockdowns in some areas, a shortage of real animals, and the psychological need for company amid the isolation of extended lockdowns created a climate ripe for pet scammers online. The lockdown restrictions made it difficult for purchasers to see pets in-real-life before buying them, so acquiring them online seemed like a logical option. Scammers using fake identities and aliases took payments for animals that did not exist, via online marketplaces, classified ad websites, and even professional-looking websites that scammers set up to pose as legitimate breeders (through plagiarising the pet images, testimonials, or content of legitimate pet selling sites). Pet scams reported to the Australian consumer body surged by almost 1,000% in 2020, and gross losses exceeded AUD4.2 million in 2021 (ACCC, 2022; Kennedy, 2022).

Users of Facebook, Instagram, and WhatsApp report losing vast sums of money, sometimes amounting to an individual's life savings, after being ensnared by fake investment advertisements or by fraudster impersonators via these platforms (Clark & Wood, 2023). Scammers publish fake profiles advertising their services as freelancers on hiring platforms such as Fiverr and Upwork, often offering low prices to entice buyers. Such scammers will direct their clients to pay upfront outside of secure payment portals via Venmo or other payment systems, subsequently disappearing with the money, but without delivering the services paid for (Cudd, 2022). Facebook Marketplace allows sellers and buyers of consumer items to connect with one another directly, minus a "middleman". Scammers on the platform use various tactics of deception, which include the advertising of counterfeit, defective, or entirely fictious items; fake giveaways constructed to steal confidential personal information; and forged payment receipts displaying a supposedly successful payment for an item (Shah, 2023).

Recent studies have found that AI-generated faces are now largely indistinguishable from human faces (Miller et al., 2023), and that AI-synthesised face images are routinely perceived to be more trustworthy than real ones (Nightingale & Farid, 2022). The degree of sophistication and ease of use of such technologies offer a potential boon for online scammers across the entirety of the digital realm.

4. Scams on Airbnb that could be assisted by GenAI

An online homestay-marketplace platform, Airbnb's business model is two-sided, matching guests/travellers with hosts (property owners). Airbnb facilitates potential value creation on both sides of the exchange. Guests can gain access to cheaper accommodations relative to hotels, while hosts can earn income from otherwise underused space. Founded in 2007 and with more than 8 million property listings on its platform as of June 2024, Airbnb is the largest online homestay-marketplace platform, and provides more rooms worldwide than the top five hotel chains combined (Airbnb, 2024; Gallagher, 2018; Hartmans, 2017; Stone, 2018). Airbnb earns revenue by charging a flat commission from hosts for every booking made via the platform, as well as a percentage of the booking amount as a transaction fee on each confirmed booking (Walsh, C. et al., 2020). Airbnb is populated entirely with user-generated content. Property listings are produced by host users, reviews are authored by host users and guest users, and the platform provides a private messaging service similar to those found on social media apps such as Instagram or Facebook.

Several types of scams proliferate on Airbnb, all of which involve deceptive communication at the first point of contact on the platform between the guest user and the host user (the homestay rental advertiser). In going through the primary data collected—the aforementioned 600 units of user-generated content in which victims discussed being scammed via Airbnb—I identified three scam modalities in which scammers' fraudulent behaviours could potentially be assisted by the use of GenAI:

- bait-and-switch scams;
- fake-listing scams; and
- fake host-review scams.

Bait-and-switch scams

Bait-and-switch is widely recognised as a fraudulent activity whereby a company or business advertises a product well below its market price with the aim of substituting it with inferior or more expensive alternatives at the time of purchase (CFI, 2023). This type of fraud has been reconfigured by scammers on homestay-marketplace platforms. A scammer "host" will publish an attractive-looking accommodation listing at a price lower than competitors in the same region. The listing often does not represent a real property and is fake. The fake property listing is, in this case, the "bait".

Prior to the introduction of openly available GenAI technologies, such property listings were predominantly constructed as a collection of user/scammer-generated content, which involved the authorship of fictional property descriptions, plagiarising property images from elsewhere on the internet (often from real estate agent websites),

and plagiarising images of real persons (often from social media) for use as a fake profile image (along with an alias) to conceal the scammer's identity. The production of an inauthentic property listing would therefore require scammers to manually source or plagiarise relevant material. However, with the introduction of free-to-use GenAI applications, all such fake content can be produced much more quickly and easily, and at much greater scale. Importantly, prior to GenAI, users could use reverse-search applications to test the progeny of property images or host profile images, thus exposing a property listing as fake. But, as discussed above, wholly synthesised images cannot be traced by reverse-search tools, meaning that reverse-search tools may falsely identify an image as authentic (Cross, 2022).

On viewing the inauthentic listing, a guest user will reserve the property and pay for the booking. Close to the arrival time of the guest, and often just before or just after check-in time, the guest will receive a message from the "host", explaining that the property is suddenly unavailable due to an unforeseen emergency, such as a blockage in the plumbing. The scam host then explains to the guest that an alternative property is available and asks the guest to relocate to the alternative property. In this moment, the scammer now relies on the guest's natural feelings of panic and desperation.

Fearing being stranded without a place to stay, the guest is often left with little option but to accept the offer of an alternative property. This second property, comprising the "switch", is often sub-par, e.g., unsanitary, unsafe, and/or lacking in the amenities included in the original fake listing. Therefore, the guest pays for a premium property but stays in a rental that is not worth the amount paid.

Airbnb allows hosts to choose the cancellation policy for their listing from several alternatives. The "flexible" cancellation policy option allows guests to cancel up to 24 hours before check-in and receive a full refund, while the "strict" cancellation option requires guests to cancel within 48 hours of booking and at least 14 days before check-in. Under the "strict" option, hosts will be reimbursed 50% for all nights if guests cancel between seven and 14 days before check-in. The host will receive 100% of the lodging booking charge for all nights if the guest cancels after that. (There are also "moderate" and "firm" options of less severity than the "strict" option, but less flexible than the "flexible" option.) (Airbnb, n.d.-a). Airbnb's intention is to protect honest and genuine hosts from frivolous and unreliable guests, but scammers use the strict option to their advantage. The scammer waits until check-in time before switching the guest to the sub-par property, so that under the strict cancellation policy it is already too late for the guest to cancel the booking, and the host receives 100% of the booking fee. The guest is left with little recourse and no rights of redress since, according to the Airbnb system, the guest has "checked in" and the stay has proceeded as planned (Fergusson, 2021).

One Airbnb user—whose written account is included in the aforementioned 600-item dataset that I collected—described her bait-and-switch experience in Paris as follows:

> I received an email that my Airbnb flat wasn't accessible 10 minutes before arriving on site. I was offered a different flat in exchange which was 7 km from the original one. I took it and spent the night there.

The following morning this same user was again switched to another alternative location by the host, of which the user wrote:

> When entering the location, I found a tiny room without daylight, dirty cupboards as if just installed, and so small that opening the only sofa for sleeping meant not having space left to move anymore. I felt very uneasy because of this unprofessional treatment. When I saw the dirt on the cupboard I had had enough and booked a hotel nearby.

Another Airbnb user booked a penthouse apartment in the US city of San Diego two months ahead of a planned trip. The online listing for the property indicated that it had several luxurious amenities, including a swimming pool and outstanding views. In recounting what happened, the user wrote the following:

> About an hour before checking in, the host cancelled, and I was offered another Airbnb. It did not have a view like the penthouse did. I went to the address [of the alternative property] the host provided to find out they had a very strict policy against Airbnb in the building. They only lease to corporate clients and when I showed them the pictures they confirmed it was their building. They were pissed. I had been baited with the pictures and the view. They tried to switch me to another lesser property claiming maintenance issues. These bait and switch artists should be arrested for fraud.

The bait-and-switch scam finds nuance in the multiple-listings scam, where the advertised property is real but is listed multiple times. Bait-and-switchers list the same property with slightly different descriptions but at drastically different prices, thus charging varying prices for the same property. These multiple listings can all be placed on Airbnb or can be placed on several homestay-platform platforms, e.g., Airbnb, Booking.com, Hotels.com, or VRBO. If one guest books the property at a cheaper price and a second person books it at a higher price, the scam host will cancel the initial guest's booking. But the host will wait until the original guest arrives to check in before informing them of the cancellation, at which point the host will attempt to switch the first guest to the alternative sub-par property that is not equal in value to the property originally booked.

Fake-listing scams

In this second scam category, the property offered via the platform is entirely fictional. The published listing is constructed using the same tactics of deception as used for bait-and-switch, but is not connected to an alternative actual property. As with bait-and-switch, the scam "host" uses an alias together with a fake profile picture. The guest reserves and pays for the booking, but when arriving for check-in at the address listed on the booking confirmation, they discover that the property does not exist.

The scammer again makes use of Airbnb's "strict" cancellation policy (as explained above) and will not notify the guest that anything is amiss, waiting until the check-in time to be assured of earning the full booking fee despite the non-existence of the property advertised. While the guest may apply to Airbnb for a refund, these refunds are subject to a case review by Airbnb, which includes contacting (or attempting to contact) the "host", all of which takes time. Even if a refund is approved, this can take up to 15 days to clear in the guest's bank account (Airbnb, n.d.-b), which is of little use to the guest needing to make a same-day booking to replace the cancelled Airbnb. Because same-day reservations are more expensive than booking in advance, the reimbursement is unlikely to cover the inflated cost of the new booking, meaning that even a refunded guest suffers financially.

In the words of an Airbnb user travelling to Dublin:

> I found a great apartment listed normally along with lots of others on Airbnb. This listing turned out to be completely fake.

Another Airbnb user had a similar experience upon arriving in New York:

> We caught a cab and gave the driver the address of the Airbnb we booked. He pulled up to a parking lot and said, "this is it". We got out and went up and down the street trying to find the address. It was non-existent; there was no such address. It was rush-hour, 85+ degrees and we had gotten up at 4:00 AM. Needless to say, we were frantic. Then we had to find a hotel, which, obviously, was a lot more expensive.

Also in New York, a similar scenario unfolded for an Airbnb user who thought he had booked an apartment near Central Park:

> The host contacted me with information on how to receive the keys, and asked about my stay and how he could help with suggestions. After arriving at the "place" we found that the building had been torn down (the police said three years ago …), I was effectively stranded with nowhere to go; we had to book the only hotel we could find available for $500.

In Boston, an Airbnb user found himself directed to an office building by a scam host:

> I had made a reservation through Airbnb for a one-night stay at a studio apartment. I reached the address at around 6:00 PM. To my surprise, the building at the address was an office and there were no apartments. A situation had arisen where I had to spend the night on the side of the road or the lobby of this office building. I had to make last minute arrangements for an alternative stay. The last-minute arrangements cost me an additional $215. Airbnb and its hosts can leave you stranded in a foreign land without shelter, and as a result spoil your holiday by gifting you the worst mental agony.

Fake listings scams have long proliferated on Airbnb and have received a notable amount of news media attention (Conti, 2019; Temperton, 2020). In September 2023, Airbnb announced that it had successfully removed 59,000 fake listings and prevented another 157,000 from joining the platform in the 2023 year (CBS News, 2023).

Fake host-review scams

Airbnb employs a two-way reputation system of review; after the conclusion of their stay, guests review the property and the hosts, and the hosts similarly review the guests. This scenario is meant to prompt guests to respect the property of hosts, knowing that negative reviews of their behaviour could result in future booking request rejections. Equally, the system is designed to prompt hosts to deliver a satisfactory experience for guests, where multiple good reviews can result in a future increase in guest bookings and increased earnings. Investigative media reports (Conti, 2019; Temperton, 2020) and research studies (Bélanger De Blois, 2021) have tracked how scammers create fake host review networks on the platform to inflate the reviews and ratings of scam property listings with inauthentic positive feedback. This act of deception can be used to make bait-and-switch properties or fake listings appear more attractive to future unsuspecting guests.

Fake host-review networks can be engineered by a single individual or a collection of scammers working in collaboration. Scam hosts create a network of multiple fake host accounts, each connected to scam property listings. The scam hosts also open multiple fake guest accounts, and reserve stays at the properties advertised by the same scammer's fake host accounts. A fake "guest" then pays the fake "host" for a stay (both the guest and the host are the same scammer, or are scammers in cooperation), and the reservation proceeds via the platform as if a stay has actually taken place. The fake guest then publishes a positive review of the fake host and the fake host's scam listing.

The repetition of this process results in multiple positive guest reviews for scam hosts and scam listings—or, less damaging but still a scam, multiple positive reviews for actual properties that are of poor quality. As with bait-and-switch and fake-listing scams, fake host-review scams rely on the creation of multiple fake user profiles, aliases, and fake profile pictures.

Fake host-review scam networks routinely re-use the same property images, which have often been plagiarised from real property listings, across multiple fake listings in different locations and cities (Bélanger De Blois, 2021; Conti, 2019). Some Airbnb users picked up on this phenomenon.

One Airbnb user wrote that he

> […] took one of the photos of the scam apartment and scanned it through Google images; this apartment also appeared on another site with a different owner and another location.

In the words of another user:

> I found it sketcy [sic] and did research. I found out that they stole the listing information and pictures from [a competitor accommodation booking platform] and created a fake listing on Airbnb.

In another instance, an Airbnb host became aware that the images from his genuine listing had been plagiarised, and wrote as follows:

> I am a property owner in Mallorca, and it has come to my attention about two months ago that my photos have been duplicated and are being used by another host on a scam listing. I do not know this host and I have not given him permission to list my property anywhere.

5. Potential role and implications of GenAI-assisted online scams

As seen in the examples above from Airbnb, the guise of a fake profile becomes the enabler for multiple types of deception. While such scams have existed for some time and clearly pre-date the arrival of GenAI, the availability and use of increasingly sophisticated GenAI tools hold the potential to result in an acceleration of such scams online. For example, where a fake host-review network comprising 50 fake guest accounts would have previously taken a scammer days or even weeks of dedicated work to construct, the use of GenAI could reduce this production time to a few hours, meaning that the size of such networks could expand considerably.

Much of the architecture of the sharing economy relies on the user's faith in the notion of reciprocal trust. The business model of sharing-economy platforms would be unsustainable and unprofitable if the operators of these intermediary platforms were unable to convince the majority of users to trust the safety of the value exchange advertised on the platforms. In other words, to participate in the sharing economy, you must be willing to trust a stranger. For example, when hailing a car on a ride-sharing app like Uber or Lyft, the user must *trust* that the driver is a responsible vehicle operator. The user must also *trust* that the driver is not a criminal, a kidnapper, a rapist, or a murderer, which sadly has proven to sometimes be the case (Bensinger, 2019; Dent, 2022; Holmes, 2019; Kerr, 2019). If the user had reason to believe nefarious intent on the part of the driver, the user would not voluntarily enter the car nor hail the ride in the first place. The same reliance on the notion of trust applies to the business model of online homestay-marketplace platforms, because guest users are required to relocate themselves to a specified location and enter the home of a stranger.

Realising that trust and safety are central to the sustainability and profitability of its business (Airbnb, 2022; Gebbia, 2016; Zamani et al., 2019), Airbnb has established several multilayer defence mechanisms against scams (Airbnb, 2022; Ekstein, 2023; Gallagher, 2018; Jain, 2017; Walsh, C. et al., 2020), including specialist emergency response teams to assist users when things do go wrong on the platform (Carville, 2021). Such measures have had varying success, since in spite of them scams still occur on Airbnb (Conti, 2019; Fergusson, 2021; Temperton, 2020) as scammers continually adapt to defences and seek out new ways to fool the system (Ekstein, 2023).

Helmus' (2022) assessment of the risks posed by GenAI includes the argument that the technology could erode trust in institutions and authorities, if the body of deepfake content in circulation represents persons of authority committing abhorrent acts. Equally, misinformation content, which could easily be generated with the assistance of GenAI, has been linked to lower levels of trust in the legitimate news media (Ognyanova et al., 2020). Business leaders have begun to express the sentiment that GenAI could erode customer trust in the commercial sector (Hill, 2023). Some AI watchers, including AI industry leaders, have claimed that the technology poses an existential threat, has the potential to result in human extinction, and ought to be prioritised for attention alongside societal-scale risks such as pandemics and nuclear war (Roose, 2023).

While I can offer no insights on the veracity of that somewhat alarming position, I do propose that GenAI-assisted scams could conceivably pose something of an

existential threat to sharing-economy platforms. If the technology is broadly adopted by criminals to assist in the enactment of scams on digital sharing-economy platforms, and if the frequency and volume of scams accelerate as a result, a broad dissolution of consumer trust is likely.

6. Conclusions

Originally defined at a Dartmouth College workshop in 1956 (Dartmouth, n.d.), AI has gone through various phases of theorisation and development, often in spurts of advancement, followed by periods of relatively slow progress sometimes referred to as "AI winters" (Sartori & Theodorou, 2022). The most recent AI summer, beginning roughly in November 2022 with the introduction of ChatGPT, has brought GenAI into focus and elicited much public debate. Throughout 2023 and 2024, discussions ranged from the topics of whether GenAI will displace workers due to automations causing disruptions in the workforce (Ooi et al., 2023) to whether the technology could be used to impact election outcomes (Helmus, 2022). I contend that the use of GenAI has further implications beyond those that have been most prominently contested in the public domain. In this article, I have argued that the development of GenAI, as evident in the emergence of applications for the generation of deepfake images and human-like text, has the potential to increase the ability of scammers to perpetuate crimes on various online platforms, particularly on sharing-economy platforms, owing to their reliance on user trust.

As mentioned in the Introduction, certain GenAI-facilitated risks arise as a continuation of pre-existing criminal activities—which can be amplified by GenAI tools that are readily accessible to the public. The three scam categories that I have assessed here are not novel and have proliferated on Airbnb for some time. Each of the three scam categories relies on the publication of inauthentic content including aliases, fake profile images, fake property images, and fake property descriptions. Prior to the introduction of free-to-use GenAI technologies, all such inauthentic content would need to be manually produced, or sourced (plagiarised), by scammers. Now, fake content can be produced much more quickly and easily, and in larger volumes, by leveraging GenAI, resulting in a risk that scammers will adopt GenAI to significantly expand their scam operations.

Currently there is no measurement of the rate of adoption of GenAI applications by scammers who operate on sharing-economy platforms. But given that GenAI can facilitate the rapid generation of convincing false user profiles, it is reasonable to assume that online sharing-economy scammers will adopt these applications. In the short term, this could conceivably place larger numbers of online users at risk of falling victim to scams. In the longer term, a resultant wide-scale dissolution of trust in sharing-economy platforms could undermine the business model of the online-intermediary platform firms that are currently some of the most valuable firms in the global economy.

It is crucial that further research considers GenAI's numerous potential social, cultural, and economic implications in increasing detail in order to, among other things, anticipate, and mitigate where necessary, possible future outcomes. Equally, it is incumbent upon GenAI product developers to acknowledge and assume responsibility for the potential ramifications of their work (Caldwell et al., 2020).

Funding
No funding was received for this study.

Data availability
The data supporting the results of this study is available upon written request to the author at reidjbj@unisa.ac.za

AI declaration
AI was not used in the writing of this article.

Competing interests
The author has no competing interests to declare.

References

Airbnb. (2022, May 13). *Airbnb launches the Trust & Safety Advisory Coalition*. Airbnb Newsroom.https://news.airbnb.com/airbnb-launches-trust-safety-advisory-coalition/

Airbnb. (2024, August 1). *Airbnb fast facts*. Airbnb Newsroom. Retrieved August 1, 2024, from https://news.airbnb.com/about-us/

Airbnb. (n.d.-a). *Cancellation policies for your listing*. Airbnb Help Centre. https://www.airbnb.co.za/help/article/475

Airbnb. (n.d.-b). *When you'll get your refund*. Airbnb Help Centre. https://www.airbnb.co.za/help/article/1967

Alawida, M., Shawar, B. A., Abiodun, O. I., Mehmood, A., Omolara, A. E., & Al Hwaitat, A. K. (2024). Unveiling the dark side of ChatGPT: Exploring cyberattacks and enhancing user awareness. *Information*, *15*(1), 1–26. https://doi.org/10.3390/info15010027

Australian Bureau of Statistics (ABS). (2023, February 22). *13.2 million Australians exposed to scams*. [Media release]. https://www.abs.gov.au/media-centre/media-releases/132-million-australians-exposed-scams

Australian Competition & Consumer Commission (ACCC). (2022). *Targeting scams. Report of the ACCC on scams activity 2021*. https://www.accc.gov.au/system/files/Targeting%20scams%20-%20report%20of%20the%20ACCC%20on%20scams%20activity%202021.pdf

Bélanger De Blois, M. (2021). *Deceptive short-term rental operations*. [Master's thesis, McGill University, Montreal]. https://escholarship.mcgill.ca/concern/papers/08612t424

Bensinger, G. (2019, September 26). When rides go wrong: How Uber's investigations unit works to limit the company's liability. *The Washington Post*. https://www.washingtonpost.com/technology/2019/09/25/ubers-investigations-unit-finds-what-went-wrong-rides-its-never-companys-fault/

Brooks, K. J. (2023, October 6). Americans reported $2.7 billion in losses from scams on social media, FTC says. *CBS News*. https://www.cbsnews.com/news/online-fraud-losses-detection-social-media/

Caldwell, M., Andrews, J. T. A., Tanay, T., & Griffin, L. D. (2020). AI-enabled future crime. *Crime Science*, *9*(1), 1–13. https://doi.org/10.1186/s40163-020-00123-8

Carville, O. (2021, June 15). Airbnb is spending millions of dollars to make nightmares go away. *Bloomberg*. https://www.bloomberg.com/news/features/2021-06-15/airbnb-spends-millions-making-nightmares-at-live-anywhere-rentals-go-away

CBS News. (2023, September 21). *Airbnb cracking down on fake listings* [Video]. YouTube. https://www.youtube.com/watch?app=desktop&v=vOENIwhP-IE

Corporate Finance Institute (CFI). (2023). *Bait and switch*. https://corporatefinanceinstitute.com/resources/management/bait-and-switch/

Clark, J. (2022, June 29). UK victims lost £1.3bn in 2021 amid surge in online fraud, new data shows. *The Guardian*. https://www.theguardian.com/money/2022/jun/29/uk-victims-lost-13bn-in-2021-amid-surge-in-online-new-data-shows

Clark, J. (2023, May 11). Social media firms should reimburse online fraud victims, say UK bankers. *The Guardian*. https://www.theguardian.com/money/2023/may/11/social-media-firms-should-reimburse-online-fraud-victim-uk-finance

Clark, J., & Wood, Z. (2023, June 16). Victims speak out over 'tsunami' of fraud on Instagram, Facebook and WhatsApp. *The Guardian*. https://www.theguardian.com/technology/2023/jun/16/victims-speak-out-over-fraud-on-instagram-facebook-and-whatsapp

Conti, A. (2019, October 31). I accidentally uncovered a nationwide scam on Airbnb. *Vice*. https://www.vice.com/en/article/43k7z3/nationwide-fake-host-scam-on-airbnb

Cross, C. (2022). Using artificial intelligence (AI) and deepfakes to deceive victims: The need to rethink current romance fraud prevention messaging. *Crime Prevention and Community Safety*, *24*(1), 30–41. https://doi.org/10.1057/s41300-021-00134-w

Cross, C. (2023). Romance baiting, cryptorom and 'pig butchering': An evolutionary step in romance fraud. *Current Issues in Criminal Justice*, *36*(3), 334–346. https://doi.org/10.1080/10345329.2023.2248670

Cudd, G. (2022). *Fiverr scams: What they are & how to avoid them.* Don't Do It Yourself. https://ddiy.co/fiverr-scams-how-to-avoid/

Dartmouth College. (n.d.). *Artificial intelligence coined at Dartmouth*. https://home.dartmouth.edu/about/artificial-intelligence-ai-coined-dartmouth

Dent, S. (2022, July 14). *Uber sued by more than 500 women over sexual assault and kidnapping claims*. Engadget. https://www.engadget.com/uber-sued-by-more-than-500-women-over-rapes-kidnappings-assaults-092733782.html

Ekstein, N. (2023, October 2). Airbnb is fundamentally broken, its CEO says. He plans to fix it. *Bloomberg*. https://www.bloomberg.com/news/articles/2023-10-02/airbnb-is-broken-its-ceo-says-here-are-his-plans-to-fix-it

Eliot, L. (2023, March 1). Generative AI ChatGPT as masterful manipulator of humans, worrying AI ethics and AI law. *Forbes*. https://www.forbes.com/sites/lanceeliot/2023/03/01/generative-ai-chatgpt-as-masterful-manipulator-of-humans-worrying-ai-ethics-and-ai-law/

Fergusson, A. (2021, October 11). *127,183 Airbnb guest complaints expose scams, safety concerns, infestations & more*. Asher & Lyric. https://www.asherfergusson.com/airbnb/

Federal Trade Commission (FTC). (2022). *What to know about romance scams*. Federal Trade Commission Consumer Advice. https://consumer.ftc.gov/articles/what-know-about-romance-scams

Gallagher, L. (2018). *The Airbnb story*. Mariner Books.

García-Peñalvo, F., & Vázquez-Ingelmo, A. (2023). What do we mean by GenAI? A systematic mapping of the evolution, trends, and techniques involved in generative AI. *International Journal of Interactive Multimedia and Artificial Intelligence*, *8*(4), 7–16. https://doi.org/10.9781/ijimai.2023.07.006

Gebbia, J. (2016). *How Airbnb designs for trust* [Video]. TED. https://www.ted.com/talks/joe_gebbia_how_airbnb_designs_for_trust/transcript

Gillespie, E. (2023, January 22). Stranded at sea: Amateur female sailors speak of sexual abuse by captains they met online. *The Guardian*. https://www.theguardian.com/society/2023/jan/23/stranded-at-sea-amateur-female-sailors-speak-of-sexual-abuse-by-captains-they-met-online

Giuffrida, A., & Wilson, A. (2018, September 12). Man jailed in Italy for selling fake TripAdvisor reviews. *The Guardian*. https://www.theguardian.com/world/2018/sep/12/man-jailed-italy-selling-fake-tripadvisor-reviews-promo-salento

Gupta, M., Akiri, C., Aryal, K., Parker, E., & Praharaj, L. (2023). From ChatGPT to ThreatGPT: Impact of generative AI in cybersecurity and privacy. *IEEE Access*, *11*, 80218–80245. https://ieeexplore.ieee.org/document/10198233

Hartmans, A. (2017, August 10). Airbnb now has more listings worldwide than the top five hotel brands combined. *Business Insider*. https://www.businessinsider.com/airbnb-total-worldwide-listings-2017-8

Heikkilä, M. (2023, February 7). Why detecting AI-generated text is so difficult (and what to do about it). *MIT Technology Review*. https://www.technologyreview.com/2023/02/07/1067928/why-detecting-ai-generated-text-is-so-difficult-and-what-to-do-about-it/

Helmus, T. C. (2022). *Artificial intelligence, deepfakes, and disinformation. A primer.* RAND. https://www.rand.org/pubs/perspectives/PEA1043-1.html

Hermann, E. (2021). Artificial intelligence and mass personalization of communication content—An ethical and literacy perspective. *New Media & Society*, 24, 1258–1277. https://doi.org/10.1177/14614448211022702

Hill, M. (2023, November 8). Generative AI could erode customer trust, half of business leaders say. *CSO Online*. https://www.csoonline.com/article/1071129/generative-ai-could-erode-customer-trust-half-of-business-leaders-say.html

Holmes, A. (2019, October 25). More than 30 women are suing Lyft, saying the company didn't do enough to protect them from sexual assault and kidnapping. *Business Insider*.https://www.businessinsider.com/lyft-lawsuit-women-claiming-lack-of-sexual-assault-kidnapping-protection-2019-10

Igual, R. (2018, April 3). Stripped & robbed: Another suspected online dating attack in Pretoria. *Mamba Online*. https://www.mambaonline.com/2018/04/03/stripped-robbed-another-online-dating-attack-pretoria

Igual, R. (2023, February 16). Four arrested over "Grindr Gang" attacks. *Mamba Online*. https://www.mambaonline.com/2023/02/16/breaking-four-arrested-over-grindr-gang-attacks/

Isacenkova, J., Thonnard, O., Costin, A., Francillon, A., & Balzarotti, D. (2014). Inside the scam jungle: A closer look at 419 scam email operations. *EURASIP Journal on Information Security*, *2014*(4), 1–18. https://doi.org/10.1186/1687-417X-2014-4

Jain, A. (2017, April 21). *What we're doing to prevent fake listing scams*. Airbnb Newsroom. https://news.airbnb.com/what-were-doing-to-prevent-fake-listing-scams

Jones, R. (2023, September 28). Up to tenth of Amazon shoppers in Great Britain 'bribed' by sellers to offer good review, poll finds. *The Guardian*. https://www.theguardian.com/technology/2023/sep/28/up-to-tenth-of-amazon-shoppers-in-great-britain-bribed-by-sellers-to-offer-good-review-poll-finds

Kennedy, L. (2022, July 4). *How to avoid getting caught up in the pet scam boom.* Choice. https://www.choice.com.au/outdoor/pets/products/articles/pet-scams

Kerr, D. (2019, October 24). Lyft is fostering a sexual assault 'epidemic,' victims say. *CNET*. https://www.cnet.com/tech/mobile/features/lyft-is-fostering-a-sexual-assault-epidemic-victims-say

King, T. C., Aggarwal, N., Taddeo, M., & Floridi, L. (2020). Artificial intelligence crime: An interdisciplinary analysis of foreseeable threats and solutions. *Science and Engineering Ethics*, *26*(1), 89–120. https://doi.org/10.1007/s11948-018-00081-0

Liu, B., Xiao, B., Jiang, X., Cen, S., He, X., & Dou, W. (2023). Adversarial attacks on large language model-based system and mitigating strategies: A case study on ChatGPT. *Security and Communication Networks*, *8691095*, 1–10. https://doi.org/10.1155/2023/8691095

Low, H., & Fakim, N. (2023, May 30). Booking.com guests turning up at family's home in Plumstead. *BBC*. https://www.bbc.com/news/uk-england-london-65726102

Mann, T. (2019, August 21). Friends arrive at £5500 'luxury' Booking.com villa to find nothing but wasteland. *Mirror*. https://www.mirror.co.uk/news/world-news/friends-show-up-5500-luxury-18976743

Marr, B. (2023, May 19). A short history of ChatGPT: How we got to where we are today. *Forbes*. https://www.forbes.com/sites/bernardmarr/2023/05/19/a-short-history-of-chatgpt-how-we-got-to-where-we-are-today/

Marsh, S. (2023, April 22). 'It can be incredibly profitable': The secret world of fake online reviews. *The Guardian*. https://www.theguardian.com/money/2023/apr/22/it-can-be-incredibly-profitable-the-secret-world-of-fake-online-reviews

May, N. (2022, September 5). Losses from 'heart-wrenching' puppy scams increase 1,000% over last two years. *The Guardian*. https://www.theguardian.com/australia-news/2022/sep/05/losses-from-heart-wrenching-puppy-scams-increase-1000-over-last-two-years

McCormick, E. (2023, April 22). Gone in seconds: Rising text message scams are draining US bank accounts. *The Guardian*. https://www.theguardian.com/money/2023/apr/22/robo-texts-scams-bank-accounts

Miller, E. J., Steward, B. A., Witkower, Z., Sutherland, C. A. M., Krumhuber, E. G., & Dawel, A. (2023). AI hyperrealism: Why AI faces are perceived as more real than human ones. *Psychological Science*, *34*(12), 1–14. https://doi.org/10.1177/09567976231207095

Mzekandaba, S. (2023, April 4). Cyber crime's annual impact on SA estimated at R2.2bn. *ITWeb*. https://www.itweb.co.za/content/JN1gPvOAxY3MjL6m

Nightingale, S. J., & Farid, H. (2022). AI-synthesized faces are indistinguishable from real faces and more trustworthy. *Proceedings of the National Academy of Sciences (PNAS)*, *119*(8), 1–3. https://doi.org/10.1073/pnas.212048111

Ognyanova, K., Lazer, D., Robertson, R. E., & Wilson, C. (2020). Misinformation in action: Fake news exposure is linked to lower trust in media, higher trust in government when your side is in power. *Harvard Kennedy School Misinformation Review*, *1*(4), 1–19. https://doi.org/10.37016/mr-2020-024

O'Neill, S. (2018, September 12). *A peddler of fake reviews on TripAdvisor gets jail time*. Skift. https://skift.com/2018/09/12/fake-reviews-tripadvisor-jail-italy/

Ooi, K-B., Tan, G. W-H., Al-Emran, M., Al-Sharafi, M. A., Capatina, A., Chakraborty, A., Dwivedi, Y. K., Huang, T-L., Kar, A. K., Lee, V-H., Loh, X-M., Micu, A., Mikalef, P., Mogaji, E., Pandey, N., Raman, R., Rana, N. P., Sarker, P., Sharma, A., Teng, C-I., Wamba, S. F., & Wong, L-W. (2023). The potential of generative artificial intelligence across disciplines: Perspectives and future directions. *Journal of Computer Information Systems*, 1–32. https://doi.org/10.1080/08874417.2023.2261010

Patel, A. (2023, February 14). *Analysis of YouTube USDT crypto scams*. Withsecure. https://labs.withsecure.com/content/dam/labs/docs/WithSecure_Analysis_of_USDT_crypto_scams_on_YouTube.pdf

Roose, K. (2023, May 30). A.I. poses 'risk of extinction,' industry leaders warn. *The New York Times*. https://www.nytimes.com/2023/05/30/technology/ai-threat-warning.html

Ropek, L. (2022, July 23). *What is 'pig butchering,' the crypto scam that's flooding the FBI's phone lines?* Gizmodo. https://gizmodo.com/what-is-a-pig-butchering-crypto-scam-1849316921

Rushing, E. (2020, March 9). A Philly lawyer nearly wired $9,000 to a stranger impersonating his son's voice, showing just how smart scammers are getting. *The Philadelphia Inquirer*.https://www.inquirer.com/news/voice-scam-impersonation-fraud-bail-bond-artificial-intelligence-20200309.html

Sartori, L., & Theodorou, A. (2022). A sociotechnical perspective for the future of AI: Narratives, inequalities, and human control. *Ethics and Information Technology*, *24*(1), 1–11. https://doi.org/10.1007/s10676-022-09624-3

Sekudu, B. (2023, March 13). Joburg LGBTQIA+ community still targeted by "Grindr Gang" after 13 reports of attacks in 8 months. *News24*. https://www.news24.com/life/relationships/dating/joburg-lgbtiq-community-still-targeted-by-grindr-gang-after-13-reports-of-attacks-in-8-months-20230313

Shah, P. (2023, May 12). *Facebook Marketplace's dirty dozen: The 12 most common scams and how to avoid them.* Android Police. https://www.androidpolice.com/avoid-facebook-marketplace-scams/#mailing-items

Sthapit, E., & Björk, P. (2019). Sources of distrust: Airbnb guests' perspectives. *Tourism Management Perspectives*, *31*, 245–253. https://doi.org/10.1016/j.tmp.2019.05.009

Stone, B. (2018). *The upstarts: Uber, Airbnb, and the battle for the new Silicon Valley*. Back Bay Books.

Stouffer, C. (2022, August 26). *12 Instagram scams to know and avoid in 2023*. Norton. https://us.norton.com/blog/online-scams/instagram-scams#

Temperton, J. (2020, November 2). I stumbled across a huge Airbnb scam that's taking over London. *Wired*. https://www.wired.co.uk/article/airbnb-scam-london

Thomas, T. (2022, March 8). Internet scams to be included in UK online safety bill. *The Guardian*.https://www.theguardian.com/money/2022/mar/08/internet-scams-now-included-in-uk-online-safety-bill

Tripadvisor. (2023). Tripadvisor review transparency report. https://www.tripadvisor.com/TransparencyReport2023

Turkos, A. (2019, September 17). Why I'm suing Lyft. *Medium*. https://aturkos.medium.com/why-im-suing-lyft-6a409e316d1f

UK Finance. (2022). *Over £1.2 billion stolen through fraud in 2022, with nearly 80 per cent of app fraud cases starting online*. https://www.ukfinance.org.uk/news-and-insight/press-release/over-ps12-billion-stolen-through-fraud-in-2022-nearly-80-cent-app

Vahl, S. (2022, 3 August). Booking.com scam: Tourists descend on north London private home. *BBC*. https://www.bbc.com/news/uk-england-london-62407046

Wach, K., Duong, C. D., Ejdys, J., Kazlauskaitė, R., Korzynski, P., Mazurek, G., Paliszkiewicz, J., & Ziemba, E. (2023). The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT. *Entrepreneurial Business and Economics Review*, *11*(2), 7–30. https://doi.org/10.15678/EBER.2023.110201

Walsh, C., Saxena, D., & Muzellec, L. (2020). AirBnB: Managing trust and safety on a platform business. *The Irish Journal of Management*, *39*(2), 126–134. https://doi.org/10.2478/ijm-2020-0004

Walsh, H. (2023, April 21). Facebook fake review groups targeting Amazon, Google and Trustpilot. *Which?* https://www.which.co.uk/news/article/facebook-still-infiltrated-by-fake-review-factories-aTTJ24L5vYyJ

Whitty, M., & Buchanan, T. (2012). *The psychology of the online dating romance scam*. University of Leicester. https://www.scribd.com/document/296206044/The-Psychology-of-the-Online-Dating-Romance-Scam-copypasteads-com

Wood, Z. (2023, June 18). Social media sites failing to curb 'cottage industry' of fake reviews, Amazon says. *The Guardian*. https://www.theguardian.com/money/2023/jun/18/amazon-social-media-platforms-fake-online-reviews

Zamani, E. D., Choudrie, J., Katechos, G., & Yin, Y. (2019). Trust in the sharing economy: The AirBnB case. *Industrial Management & Data Systems*, *119*(9), 1947–1968. https://doi.org/10.1108/IMDS-04-2019-0207

Zawacki-Richter, O., Marín, V., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(39), 1–27. https://doi.org/10.1186/s41239-019-0171-0

Intersections between civic technology (civic tech) and governance in Nigeria and South Africa

Melissa Zisengwe
Programme Associate, People Powered, Cape Town
https://orcid.org/0000-0002-1363-9714

Abstract
This study explores the drivers and impact of the civic technology ("civic tech") ecosystems in Nigeria and South Africa, with a focus on civic tech actors' engagement with governance matters in the two countries. Framed by a social accountability conceptual framework and based on data collected from an African civic tech database and interviews with civic tech players in both countries, the research explored the work of 26 initiatives in each country. Based on the content in the civic tech database, it was found that, in both countries, civic tech initiatives' foci could be grouped into five categories: (1) citizen engagement and participation; (2) accountability and transparency; (3) service delivery and government responsiveness; (4) improving and/or helping government; and (5) policy. The emphases among these foci were found to be largely similar between the two countries, with the exception of the fourth category of focus—improving and/or helping government—which was significantly more prominent in the work of the South African initiatives than in the work of their Nigerian counterparts. A similar difference was identified in the findings from the interviews with Nigerian and South African civic tech actors. The South African interviewees identified, to a greater extent than the Nigerian interviewees, a collaborative ethos that was bringing government entities and civic tech actors together to jointly implement projects, including projects that had been fully integrated into the operations of government departments.

Keywords
civic technology (civic tech), governance, digitisation, social accountability, open data, Nigeria, South Africa

DOI: https://doi.org/10.23962/ajic.i33.18883

Recommended citation
Zisengwe, M. (2024). Intersections between civic technology (civic tech) and governance in Nigeria and South Africa. *The African Journal of Information and Communication (AJIC), 33,* 1-26. https://doi.org/10.23962/ajic.i33.18883

1. Introduction

Civic technology ("civic tech") is a phenomenon that can be said to manifest when a networked civic community adopts digital and related approaches to improve governance (Gilman, 2017; Rumbul et al., 2018). Harnessing digital tools and platforms, civic tech actors are able to participate in governance by, inter alia, enabling citizen engagement focused on improved accountability and transparency of government activities.

The civic tech community emerged in the early 2000s and was influenced by open governance and information freedom advocacy networks, and by the shifts in democratic governance fostered by digital technology (Chatwin & Mayne, 2020; McGee et al., 2018; Rumbul et al., 2018; Skaržauskienė & Mačiulienė, 2020). According to Zhang et al. (2022), the civic tech ecosystem is international, cross-industry, and interdisciplinary. The international civic tech community has grown rapidly in varying contexts, with over 7,500 initiatives documented in the international Civic Tech Field Guide (Stempeck, 2023). In the African context, the African Civic Tech Atlas online database, collated and hosted by the Civic Tech Innovation Network (CTIN), currently documents over 240 initiatives from 30 African countries (CTIN, n.d.).

While an increasing number of studies are exploring civic tech, the research often focuses on Western contexts. (Aragón et al., 2020; Duberry, 2022; Sun & Yan, 2020). There is limited research focused on understanding the evolution of civic tech in Africa. The study on which this article is based was an attempt to contribute to filling this research gap. This article provides findings from a study of civic tech's contribution to governance in Nigeria and South Africa. This study's core research question was: How does the emergent civic tech community contribute to governance in Nigeria and South Africa?

2. Background and context

Governance is a process that includes relationships, collaborations, and activities entered into by government institutions, civil society organisations (CSOs), and other stakeholders to improve citizens' lives. Good governance requires efficient, accountable institutions that promote development, human rights, and respect for the rule of law, and that also ensure citizen participation and engagement in issues affecting them (Keping, 2017; Kaur & Sitlhou, 2017; Makara, 2018; Nyaranga et al., 2019; Waddington et al., 2018; Yimer, 2015). Governance has gained prominence due to the complexity of societal challenges and the realisation that other stakeholders can help governments address these challenges. Government institutions and other actors have recognised that outside knowledge and expertise are required to deal with ineffectiveness and inefficiencies in governance caused by weaknesses in government (Makara, 2018).

In contemporary society, digital technologies offer the potential to increase efficiency, transparency, responsiveness, and public trust, directly impacting the quality of governance. Digitalisation and the data revolution create opportunities for non-governmental actors and citizens to engage and improve governance (Bjerde & Demirgüç-Kunt, 2021). According to Gritsenko and Indukaev (2021), using digital technologies in democratic governance is commonly associated with promises of increased administrative efficiency and citizen empowerment. Asongu and Nwachukwu (2016) contend that improved governance is achieved through digital technologies that enable social convergence for better participation and information-sharing.

The last two decades have witnessed a wave of technologists, CSOs, NGOs, communities, and other actors innovating for governance and societal issues. These actors have been building websites, portals, platforms, and mobile apps to enable citizens across the globe to organise campaigns, sign petitions, monitor their representatives, track parliamentary activities, propose ideas, and draft legislation or constitutions (Poblet & Plaza, 2017). These actors are often at the forefront of open government advocacy and "open data" strategies to promote citizens' participation and increase transparency.

Narrowly and clearly defining civic tech can be contentious due to its broad scope of stakeholders, focus areas, and forms, and because the civic tech phenomenon can also go by other names, including civic innovation, tech for good, civic crowdsourcing, and community technology (Knutas et al., 2023). Many scholars offer conceptions of civic tech (see, for example, Chatwin & Mayne, 2020; Duberry, 2022; Gilman, 2017; McGee et al., 2018; McNutt et al., 2016; Poblet & Plaza, 2017; Rumbul et al., 2018; Skaržauskiene & Mačiulienė, 2020; Yoshida & Thammetar, 2021; Zhang et al., 2022). For this study, civic tech was conceived of—based on both the available literature and the findings of the study—as the creation, adoption, and use of digital technologies and other methodologies by non-governmental actors (such as CSOs, NGOs, social enterprises, civic hacker groups, and individuals) to enhance democratic governance through focusing on one or all of the areas: citizen engagement and participation; accountability and transparency; service delivery and government responsiveness; improving and/or helping government; and policy. This study's conception of what constitutes a civic tech initiative was also broad, as it included initiatives that had resulted from collaborations and learning between civic (tech) actors and government institutions, and even government-run initiatives inspired or provoked by civic tech actors.

Civic tech can help with many facets of civic life, like community organising, public participation, crowdfunding, transportation, and social equity (Network Impact, 2015). Civic tech organisations have developed reporting and data-sharing platforms to facilitate accountability and transparency, citizen empowerment, and participation in governance, and to enable grassroots advocacy.

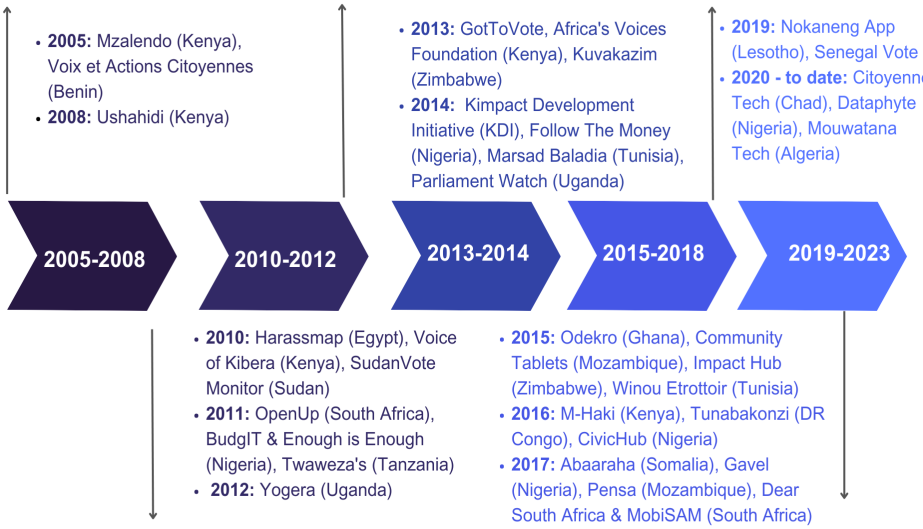
The earliest African civic tech initiatives, such as Mzalendo in Kenya and Voix et Actions Citoyennes in Benin, were launched in 2005. But the movement's rise to prominence is usually traced to 2008, when Kenyan bloggers and software developers created Ushahidi, an online platform for active citizens to report post-election violence in that country (Couve et al., 2018, p. 5; Rotich, 2017). The Arab Spring in North Africa, and other online movements that followed, further catalysed civic tech in Africa. Ushahidi remains one of the most critical developments, as it engendered and benchmarked the African civic tech movement (de Rochegonde, 2020).

Between 2005 and 2017, many African countries saw the introduction of civic tech platforms, with notable developments in North Africa (Egypt, Tunisia, Algeria), West Africa (Benin, Nigeria, Senegal, Ghana, Burkina Faso), Central Africa (Democratic Republic of the Congo, Chad), East Africa (Kenya, Uganda, Somalia Sudan), and Southern Africa (South Africa, Mozambique, Zimbabwe, Lesotho).

South African civic tech only began picking up around 2014 (Bosch & Roberts, 2021). Since then, there has been an increase in civic tech organisations, with the establishment of notable initiatives and organisations such as MobiSAM, amandla.mobi, OpenUp, Grassroot, GovChat, Lungisa, and Wazimap (Roberts, 2021). Through partnerships between civic tech organisations and government entities, South Africa has implemented open data projects including Vulekamali and Municipal Money.

In West Africa, Nigeria leads the civic tech community. Key Nigerian civic tech organisations and initiatives include BudgIT, Enough is Enough (EiE), Connected Development's Follow The Money (FTM) and Uzabe initiatives, CivicHub, Dataphyte, the Centre for Journalism Innovation and Development's Udeme initiative, the Public and Private Development Centre's Budeshi initiative, Shine Your Eye, iTakeActions, and Gavel.

Figure 1: Key developments in African civic tech, 2005-2023



Note. Source: Researcher.

Rumbul (2015) points out that large foundations often support civic tech actors, and trusts are interested in supporting a burgeoning sector focused on using technology for the public good. African civic tech projects use and create a variety of technological tools for their initiatives, ranging from low-tech options such as USSD, to online platforms like WhatsApp, Facebook, and Twitter, to high-tech solutions like artificial intelligence (AI) and blockchain.

African civic tech is often transnational. For example, civic tech organisations OpenUp, Open Cities Lab, Code for Africa, Charter Africa, and BudgIT work in several countries. Tech hubs such as Co-Creation Hub (ccHub) (Nigeria, Rwanda), Ihub (Kenya), Impact Hub (Zimbabwe), and Wennovation (Nigeria) play an enabling role in the movement, as they often incubate and support civic tech projects (Mbugua, 2018). In recent years, the African Union's Women, Gender, and Youth Directorate (WGYD), in collaboration with GIZ and the African Union, has supported 29 civic tech organisations through the African Union Civic Tech Fund (AU, 2024; CTIN, 2024).

3. Conceptual framework: Social accountability

The social accountability framework was found to be suitable for this study because it can enable an understanding of the relationship between civic tech and governance. Almén and Burell (2018) and Brummel (2021) contend that social accountability is often rooted in development discourse focused on citizenship embedded in alternative and participatory democratic models. Often, social accountability stems from citizen engagement, and citizen demands for accountability and improved governance (Ruppen & Brugger, 2022). Social accountability involves actions that citizens can take beyond elections to increase accountability; it relates to notions of voice, political participation, and empowerment; and it relies on citizen engagement.

Social accountability is a concept that can be positioned as connected to the fields of both governance and civic tech. For instance, Khene et al. (2021), in their case study of South Africa's MobiSAM civic tech initiative, use the social accountability concept to explain the power and knowledge dynamic involved in civic tech projects focused on citizen engagement and participation, and accountability. Wakabi and Grönlund (2015) use a social accountability framework in their Ugandan study of motivations for engagement between citizens and government officials using digital technology. Pade-Khene et al. (2017) discuss the push to use digitally innovative approaches to help developing countries monitor social accountability, with these approaches often including civic technologies.

Brinkerhoff and Wetterberg (2015) argue that social accountability can be viewed in either normative or instrumental terms. In this study, I chose the instrumental perspective, based on the three instrumental goals that Brinkerhoff and Wetterberg set out: "increasing the effectiveness of service delivery, improving the quality of governance and democracy, and increasing citizen empowerment" (Brinkerhoff & Wetterberg, 2015, p. 275). Consideration of these three goals assisted me in my interpretation of the data in the civic tech database, in my interviewing, and in my interpretation of the data from my interviews.

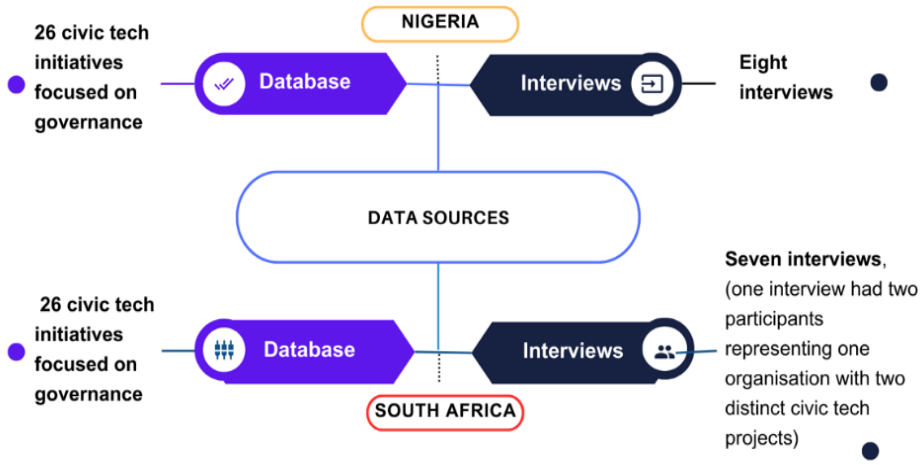
4. Methodology

This research adopted a qualitative approach. Data was collected in the period August 2022 to January 2023 from the contents of the aforementioned African Civic Tech Atlas database and from semi-structured interviews with civic tech actors in Nigeria and South Africa. CTIN, the entity that runs the African Civic Tech Atlas database, is a project of the School of Governance, University of the Witwatersrand (Wits), Johannesburg. The database began in 2018 as an online, publicly available directory of civic tech South African projects and innovators, and was expanded in 2019 to include the rest of Africa.

Twenty-six civic tech initiatives focused on governance were identified in each country, and I interviewed 15 civic tech actors representing 15 organisations: eight in Nigeria and seven in South Africa (Figure 2). I used a non-probability purposive sampling method to select the participants. The database was used to identify and recruit experts. I also used snowball sampling, whereby I asked confirmed participants to suggest additional possible respondents for me to contact. All the interviews were conducted remotely, via Zoom, according to an interview guide (see Appendix). Two of the South African participants were interviewed together.

The interview transcripts were coded using the ATLAS.ti qualitative data analysis software. To provide uniformity and anonymity, participants were assigned codes. The Nigerian participants were coded as NI01 to NI08, while South African participants were assigned the codes SA01 to SA07.

Figure 2: Data sources



The themes set out in the findings sections below emerged from consideration of the literature, the database contents, and the interview transcripts.

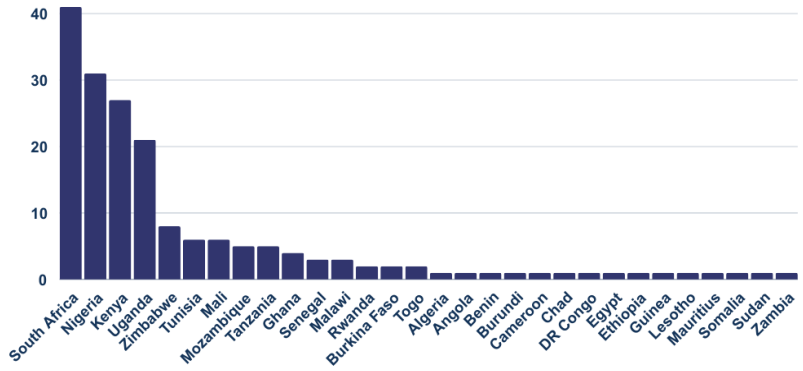
5. Findings

The findings are now presented in three sub-sections: (1) the African civic tech movement; (2) Nigerian civic tech and governance; and (3) South African civic tech and governance.

The African civic tech movement

At the time of my analysis in 2023, the African civic tech database contained 189 projects working across 30 countries. Figure 3 shows the 30 countries represented in the database.

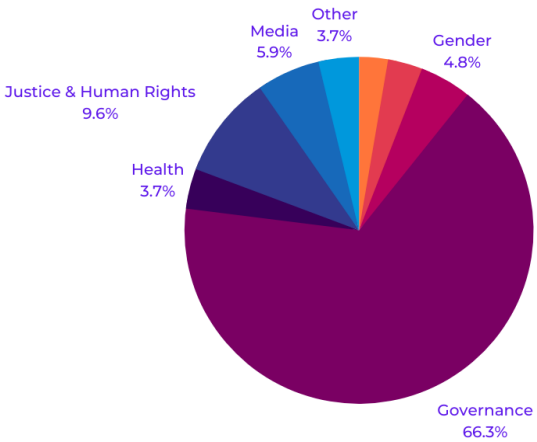
Figure 3: African countries with a civic tech presence



Note. Source: Researcher, based on data in African Civic Tech Atlas database.

A significant majority (66.3%) of the initiatives in the database were found to have, in general terms, a focus on governance matters (Figure 4).

Figure 4: African civic tech projects' general focus areas



Note. Source: Researcher, based on data in African Civic Tech Atlas database.

I then sought to determine the core issues present in the work of the civic tech entities focused on governance matters. Four broad issue areas were identified (Figure 5): government failure; lack of, or poor, service delivery; lack of transparency and accountability; and lack of platforms and tools.

Figure 5: Governance issues addressed by African civic tech

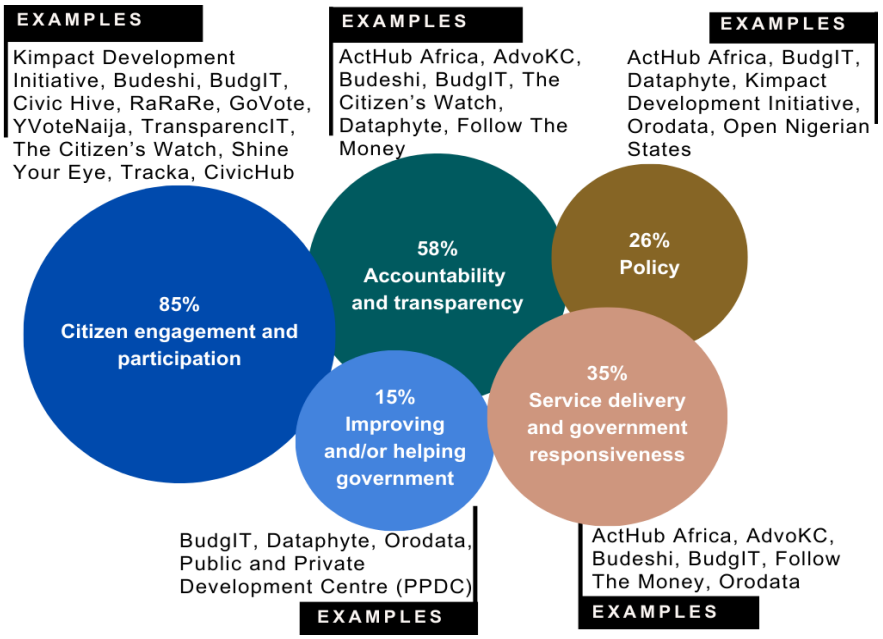
Note. Source: Researcher, based on data in African Civic Tech Atlas database.

Nigerian civic tech and governance

Focus areas

Analysis, via the database, of the descriptions, missions, and vision statements of the 26 identified Nigerian initiatives found that their work was primarily focused on five governance elements (see Figure 6 below): citizen engagement and participation (85% of the initiatives); accountability and transparency (58%); service delivery and government responsiveness (35%); improving and/or helping government (15%); and policy (26%). Most of the initiatives were focused on two or more of these elements.

Figure 6: Governance foci of the 26 Nigerian civic tech organisations



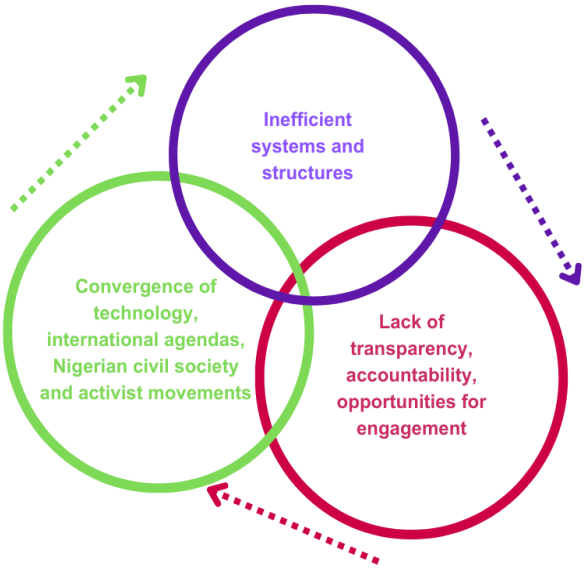
Note. Source: Researcher, based on data in African Civic Tech Atlas database.

Drivers of Nigerian civic tech's work on governance matters

In the Nigerian participants' interview responses, the drivers of the country's civic tech organisations' work on governance matters fell into three interconnected core themes (Figure 7):

- inefficient systems and structures;
- lack of transparency, accountability, opportunities for engagement; and
- convergence of technology, international agendas, Nigerian civil society, and activist movements.

Figure 7: Drivers of Nigerian civic tech's work on governance matters



Note. Source: Researcher.

Inefficient systems and structures

The participants were generally in agreement that a key driver of Nigerian civic tech was inefficiency in government systems and structures caused by the slow pace of innovation and technology adoption. NI01 pointed to the fact that the Nigerian government was still using many analogue processes, which created bottlenecks and slow service delivery. This also introduced an additional challenge: a lack of data to measure and monitor progress on governance issues. In the words of participant NI02:

> I've seen some acceleration of technology in almost every facet of society from business, philanthropy, and media. However, the adoption of technology in government, or governance, has been slow. And the growth of technology, especially the internet, has not influenced engagement between government and citizens as it should.

Participant NI06 saw the drivers of Nigerian civic tech in terms of government failures in key areas:

> And the more crucial those areas are, the more likely it is to find that some civic tech organisation is providing services and has stepped up to fill this gap or to watch and critique the actions of governments. So that's the issue, government's failings.

Participant NI07 said that Nigerian civic tech existed because of "the absence of governance".

Lack of transparency, accountability, opportunities for engagement
In the words of participant NI03:

> The reason is very simple: we want democratic accountability […] if the people are going to get the benefits of democracy, there has to be accountability. So we are at the forefront of the advocacy, for example, when that money does come in. Does it go into the pockets of a few people, or does it go to solve the problems of that poor woman whose farmland has been wiped out by the floods? Or does it go to solve the challenges of that poor farmer whose crops are no longer yielding because of droughts or because of new diseases that we're not used to before? Does this solve those people's problems, and what about those whose problems are not solved? [There] need to be people who stand up and try to fill that gap and bridge it between governance and the people.

According to participant NI04:

> If you take it from service delivery to budget transparency or election, electoral integrity, even violence against journalists and civil society organisations and anti-corruption generally, I think it mostly sparked these civic tech interventions in different forms.

Participants NI05 and NI06 stated that most civic tech organisations were a reaction to ongoing corruption.

Convergence of technology, international agendas, Nigerian civil society, and activist movements
According to NI08:

> The history of Nigeria is filled with civic actors and activists driving governance. So, it is only natural that technology makes their work easier and more accessible. It's easier to use technology for advocacy that drives to see good governance. Having technology just advances that work. So many of these springing up that you're seeing of civic tech organisations are offsprings of organisations that have existed and been driving advocacy and our conversations around good governance. Technology just becomes a tool that allows that work to be amplified.

Participants NI02, NI04, NI05 and NI07 pointed to increased internet access, the closing of civic space, the emergence of tech opportunities, and the international

development and philanthropic agenda as key catalysts for the development of civic tech. In the words of NI02:

> [International] civil society and philanthropy groups have also shaped and pushed the civic tech community forward because they also focused on systematic issues such as fiscal accountability, transparency and accountability, efficiency, digital rights, and social justice over the years. And [international funders] are looking for how we apply technology to this dynamic changing world. And I think that led to these organisations backing civic tech projects.

In the words of NI04:

> They are catalysed by good donor funding and various collaborative ecosystems within the country. Those instruments of donor partnership or funding the issues themselves demand the need for civic technology; for instance, a country that has some 734 local governments and 36 states and billions of dollars annually you spend to solve challenges of infrastructure or other development needs, and you don't see the results. So those issues, you automatically drive or call for some kind of civic technology intervention where donor funding comes in and funds it. How do you reach a country of 200 million people? How do you get citizens to use these tools if you don't have funding or the financing drive to do it, especially where you are combating government propaganda and conducting some authoritarian or intolerant side of government.

According to NI05:

> We have a growing generation who are born into the internet, unlike my generation who were born before the spread of the internet. There has been suppression of information in Nigeria because of the oppression by the military guys in governance. So there was a generation who found it difficult to express themselves because of the fear of brutality. But now there's that explosion of a generation who are tech savvy, who understand the internet and how to easily engage more and need information at the tip of their fingers. We wanted them to get interested in governance, social accountability, and fighting corruption. We have been forced again to create those tools for them to engage easily.

Nigerian civic tech's contributions to improved governance

Several participants argued that the work of initiatives and organisations such as Tracka, Udeme, Budeshi, and Dataphyte had collectively strengthened the work of the Independent Corrupt Practices Commission on fighting corruption within the budget and procurement ecosystem. Participant NI08 stated that the government was now more proactively sharing procurement data through e-government

initiatives. Participants believed their work had been influential in ensuring that the government shares accurate and necessary data. A BudgIT Foundation report (2020) points to notable shifts towards government open data. NI08 stated that while the government had initially been unresponsive to civic tech efforts (due to rigid government structures and endemic corruption), state entities were beginning to take on issues such as opening up public data and steps to improve the International Budget Partnership (IBP) scores. (The IBP ranks over 120 countries based on the extent of openness and accountability in their national budget processes.)

Participants NI03, NI04, NI07, and NI08 stated that the civic tech community had had notable success in influencing government to improve electoral systems. NI08 pointed out that, for the 2023 elections, the Independent National Electoral Commission (INEC) had established a system enabling it to publish election results online in real-time. NI08 attributed this INEC provision to, in part, the work of civic tech organisations in creating platforms and advocating for free and fair elections. Participants pointed to the work of Enough is Enough, GoVote, and YvoteNaija, which were engaged in advocacy, encouraging and enabling citizens to register to vote and participate in the elections, educating citizens about their electoral rights and responsibilities, and encouraging INEC to review electoral policies to ensure inclusivity.

NI07 explained that civic tech had significantly increased the chances and channels for citizens to ask politicians questions. Previously, government and public officials would relay what they had done regarding governance without providing any evidence, and citizens had no channels or basis for measuring or questioning government statements. The Tracka civic tech initiative was enabling citizens to monitor the implementation of government projects and to give feedback on these projects, to ensure service delivery in their communities. Participants also said that the work of civic tech organisations has encouraged better behaviour in parliamentarians.

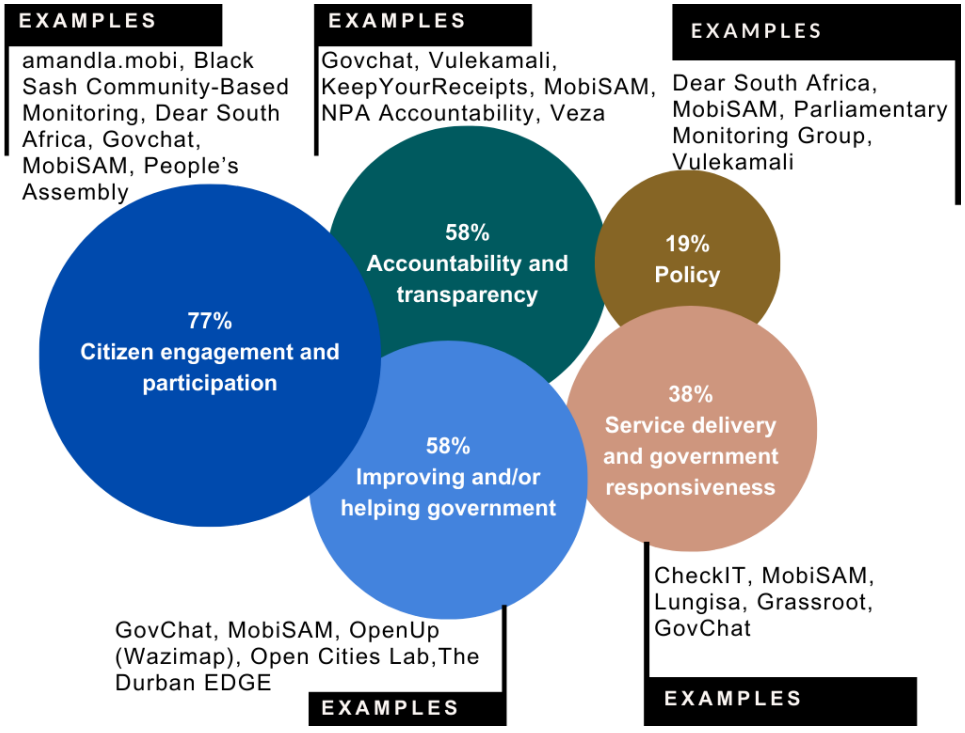
However, there was consensus that while there was a noticeable pattern of Nigerian civic tech having a positive influence on government, there was at the same time a lack of acknowledgement of this reality from the government. Nevertheless, several participants indicated that there had been recent signs of a slow but significant shift, with government entities now becoming more interested in collaborating with civic tech actors. For example, civic tech organisations Dataphyte and BudgIT were now partnering with government departments. BudgIT had connected the Kano, Lagos, Anambra, and Kogi States to the Open Budget System Portal, and BudgIT was providing technical support to all 36 Nigerian states' finance and budget directors on the use of citizens' budgets, through the States Fiscal Transparency, Accountability and Sustainability (SFTAS) project (BudgIT Foundation, 2020). It was also said that some Nigerian civic tech organisations were providing training and upskilling to civil servants.

South African civic tech and governance

Focus areas

Analysis of the 26 identified South African civic tech organisations' descriptions, missions, and vision statements found that the foci of their work could be grouped into the same five areas (Figure 8) as those identified in the work of the Nigerian initiatives—citizen engagement and participation (77% of initiatives); accountability and transparency (58%); improving and/or helping government (58%); service delivery and government responsiveness (38%); and policy (19%). As discussed below in section 6 ("Analysis and conclusion"), these percentages are largely similar to those found in Nigeria, with the exception of the percentage for the improving and/or helping government focus area—where the South African percentage seen here (58%) is significantly higher than the 15% Nigerian percentage seen above. (It should, of course, be noted that these percentages are based on my qualitative interpretation of the content available in the African Civic Tech Atlas database on the 26 selected initiatives in each country, and thus the percentages represent qualitative interpretations of tendencies rather than precise quantitative measures.)

Figure 8: Governance foci of the 26 South African civic tech organisations



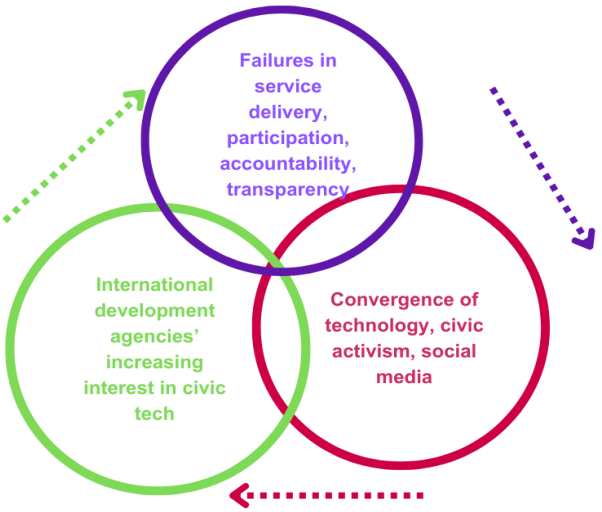
Note. Source: Researcher, based on data in African Civic Tech Atlas database.

Drivers of South African civic tech's work on governance matters

In the South African participants' interview responses, the drivers of the country's civic tech organisations' work on governance matters fell into three interconnected core themes (see Figure 9 below):

- failures in service delivery, participation, accountability and transparency;
- convergence of technology, civic activism, social media; and
- international development agencies' increasing interest in civic tech.

Figure 9: Drivers of South African civic tech's work on governance matters



Note. Source: Researcher.

Failures in service delivery, participation, accountability and transparency

The consistent thread across the interviews with SA01, SA04, SA05, SA06, and SA07 was that most governance-focused civic tech organisations were driven by a desire to address poor service delivery, lack of government transparency and accountability, access to data, and failure to include and engage citizens in decision-making. According to SA04:

> The main issue is reach; it has always been a problem. For municipalities, the biggest issue was whenever they were communicating with their residents, they would use pamphlets which sometimes were distributed, and some notices would be put at community halls; nobody goes to a community hall unless there is a reason to go there. It seemed like the people that benefited from the calls to action by municipalities were usually politically affiliated because if you are politically affiliated, you or your representative are aware of the announcements.

In the words of SA06:

> I think persistent challenges relating to poor service delivery issues mean that civic tech organisations play a pivotal role in connecting the public with their representatives so that they can express their concerns with their MPs and other representatives in their constituencies. The tools that we make available, and the data, help them in advocacy efforts. I think the bottom line is persistent challenges on service delivery issues. I think the lack of transparency has led to the development of our tools. Part of what drove some of the tools we've developed was to broaden the space around public participation, get a wider view, encourage the youth to participate, etc.

Convergence of technology, civic activism, social media
According to SA07:

> I do think that because of the political environment and the civil service culture here, a lot of organisations like ours emerge from, but also thrive on the fact that there are a lot of people with development and technology training who want to do good. I think [developing technologies for social good] fuels the South African civic tech ecosystem here.

International development agencies' increasing interest in civic tech
Some participants suggested that the international development agenda had influenced the development of civic tech. They believed that because the development agencies had discovered the use of civic tech interventions in combatting corruption and building transparency, accountability, civic empowerment, and governance elements, there has been an increase in funding opportunities. At the same time, global success stories of civic tech were said to be inspiring local South African organisations. In the words of SA02:

> I think people here started to get excited about using their skills and building technology for something good that connected them to international funding and then development agenda, which opened the pipeline for funding.

South African civic tech's contributions to governance
Participant SA01 was of the view that evidence on corruption collected by the civic tech and civil society community had significantly motivated government to build platforms such as Vulekamali,[1] the South African National Treasury's online budget data site. While the platform was the result of a partnership between the

1 https://vulekamali.gov.za

National Treasury and the Imali Yethu alliance of civil society organisations, the platform was developed by OpenUp. In this case, OpenUp was acting as a service provider for the government and Imali Yethu. According to SA04, the open-source Vulekamali platform had become a powerful accountability mechanism for the national government:

> The main issue is that when people need to make their case, they do not know that budgets are available and can be questioned. Creating these civic tech platforms gives the person the power to argue for improving their lives. It helps a lot with accountability. But it also helps a lot to look like targeted service delivery.

Also, some local governments, such as Makhanda Municipality and the City of Cape Town, had begun to implement and/or replicate tools and systems within government that had initially been introduced by the civic tech community. In Makhanda, collaboration between Rhodes University, local CSOs, community members, and the municipality resulted in MobiSAM,[2] a platform for citizens to log service delivery issues with the municipality. In the case of the City of Cape Town, it was pointed out that the city had, in an effort to increase accountability and transparency, and public engagement, established an Open Data Portal[3] to release public data in numerous topical areas. According to participant SA07:

> the city has been heavily influenced by the civic tech community, and open data work in particular, and how [civic tech actors] implement some of their work.

SA07 pointed to civic tech's success in getting municipalities to institutionalise public engagement with municipal Integrated Development Plans (IDPs). As a result, municipalities such as the City of Johannesburg and the Cape Agulhas Local Municipality had established new methods—including social media, government portals, and emails—that were succeeding in prompting citizens to engage their municipality on IDP matters. Participant SA07 also highlighted the value being provided to South African government entities by civic tech interventions focused on service delivery. For example, MobiSAM, Lungisa,[4] and GovChat[5] were all enabling citizens to report service delivery issues and connect with national, provincial, and local government representatives. In a similar vein, SA04 pointed to the success of civic tech entity Grassroot in enabling community organising on issues such as power outages and the maintenance of public toilets.

2 https://mobisam.net
3 https://www.capetown.gov.za/City-Connect/All-City-online-services/open-data-portal
4 https://civictech.africa/initiative/lungisa
5 https://www.govchat.org

Participant SA06 pointed to how civic tech was improving the conduct of parliamentarians. The People's Assembly[6] and Parliamentary Monitoring Group (PMG)[7] platforms were providing citizens with digital tools to track legislative proceedings, track the movements of elected representatives, and participate directly when public inputs were requested.

In addition, government entities were said to be collaborating with civic tech organisations in order to create tools and to increase government employees' digital capacities. For instance, the government had collaborated with Open Cities Lab, MobiSAM, and OpenUp. In the latter example, OpenUp partnered with the national Department of Cooperative Governance (CoGTA) to create the DCOG Monitoring Tool (OpenUp, 2022). The tool was a digital form management system developed to help local and district municipalities improve their form management and provide more transparent oversight of these processes. Previously, data had been collected manually, leading to slow responses, incorrect information, and incomplete forms, thus contributing to inefficiencies. The tool provided multi-tier reporting, which reduced the risks of inconsistency and inaccurate reporting (OpenUp, 2022).

Participant SA03 noted a significant shift in the mindset of many South African government entities, towards a "sense of collaboration in the development of technology for social good by the government":

> While traditionally there is an antagonistic relationship between government and civil society in the governance space, some civic tech organisations have managed to build relationships with government. This is due to government's […] limited technical capacity. Therefore, they [government] have engaged civil society [civic tech organisations] in the production of technology [that] is fundamentally different.

Participants highlighted the importance of civic tech entities working in collaboration with government. In the words of SA01, "working with government enables civic tech actors to determine what government is willing and able to give to citizens and how civic tech could help them hold government accountable".

6 https://www.pa.org.za
7 https://pmg.org.za

6. Analysis and conclusion

As seen in the findings presented above, several similarities were found between the work of civic tech organisations in Nigeria and South Africa. However, the findings also revealed some significant differences.

Governance foci of civic tech initiatives

We saw above, in Figures 6 and 8, that the elements of governance being focused on by the 26 selected civic tech entities in each country were essentially the same. In both countries, I found evidence of the following five foci: citizen engagement and participation; accountability and transparency; service delivery and government responsiveness; improving and/or helping government; and policy. As seen in comparative Table 1 below, there was only one focus area where a significant difference in focus was found: improving and/or helping government, which only 15% of the studied entities were found to be focused on in Nigeria, compared to 58% in South Africa. (As noted above, these percentages represent tendencies based on my qualitative analysis of the content in the civic tech database, not precise quantitative measures.)

Table 1: Governances focus areas: Comparison

Governance focus area	% of Nigerian civic tech initiatives (n=26) with this focus	% of South African civic tech initiatives (n=26) with this focus
citizen engagement and participation	85%	77%
accountability and transparency	58%	58%
service delivery and government responsiveness	35%	38%
improving and/or helping government	**15%**	**58%**
policy	26%	19%

The South African civic tech initiatives' stronger focus on improving and/or helping government was also seen in the interview responses set out above. Several of the South African interview participants pointed to a spirit of collaboration between the civic tech movement and government entities in that country. These collaborative efforts included both internal government systems and government-to-citizen initiatives such as GovChat (which began as a civic tech project but was eventually adopted by the government), Vulekamali, MobiSAM, and Municipal Money. The nature of the collaboration on these tools had varied. For example, Vulekamali and Municipal Money were government tools developed and maintained by civic tech actor OpenUp. In these and other instances, a civic tech organisation was contracted as a service provider to create internal tools for government departments, and to train

government employees in the necessary technical skills.

In contrast, the Nigerian participants indicated a slower pace of collaboration between civic tech actors and government institutions. However, as we saw above, some participants had noted a recent shift in some government departments, leading to organisations such as Dataphyte and BudgIT partnering with government departments. BudgIT was, for example, collaborating with numerous state governments on the Open Budget System Portal and the SFTAS project (BudgIT Foundation, 2020). And some Nigerian civic tech organisations were providing training to upskill civil servants.

Drivers of civic tech work on governance matters

As seen above in Figures 7 and 9, which are compared in Table 2 below, numerous overlaps, and no substantive differences, were found in the thematic analysis of the interview data on drivers of civic tech work on governance matters in the two countries.

Table 2: Drivers of civic tech work on governance matters: Comparison

Nigeria	South Africa
• inefficient systems and structures • lack of transparency, accountability, opportunities for engagement • convergence of technology, international agendas, Nigerian civil society and activist movements	• failures in service delivery, participation, accountability, transparency • convergence of technology, civic activism, social media • international development agencies' increasing interest in civic tech

Civic tech contributions to improved government functions

We saw above, in the findings from the thematic analysis of the interview data, that there was a stronger sense among the South African participants than among their Nigerian counterparts that the work of civic tech was managing to directly improve the work of government institutions. The Nigerian participants tended to emphasise indirect influence on the activities of government departments, with direct collaborations still relatively rare (though increasing) between civic tech and government entities. The South African civic tech actors identified a spirit of trust and collaboration between government and civic tech, as exemplified by numerous joint implementations of projects that were now fully integrated into government functions.

Conclusion: Civic tech and social accountability

As stated in section 3 above, this study was to a great extent guided and framed by the instrumental approach to social accountability as set out by Brinkerhoff and Wetterberg (2015), who frame social accountability activities as "increasing the effectiveness of service delivery, improving the quality of governance and democracy, and increasing citizen empowerment" (Brinkerhoff & Wetterberg, 2015, p. 275). As seen in the findings, both the Nigerian and South African civic tech movements aspire to be, and are to a great extent succeeding in being, instrumental agents of social accountability in their respective countries.

Acknowledgements

This article draws on data collected during the author's Master's studies at the LINK Centre, University of the Witwatersrand, Johannesburg. The author is grateful for the supervision of Mark Burke and Dr. Lucienne Abrahams.

Funding

This study was not supported by any funder.

Data availability

The ethical clearance granted was on the basis that interview data would be accessible only to the researcher. This data can only be made available to other researchers subject to secondary ethical clearance, and based on a written request to the author at zisengwe.melissa@gmail.com. However, the African Civic Tech Atlas database is publicly available on the Civic Tech Innovation Network (CTIN) website, https://civictech.africa

AI declaration

AI was not used in the writing of this article.

Competing interests

The author was previously employed by CTIN, and curated the African Civic Tech Atlas database, and thus was professionally associated with some of the interviewees.

References

African Union (AU). (2024, April 12). *The African Union launches the second edition of the AU Civic Tech Fund* [Press release]. https://au.int/en/pressreleases/20240412/african-union-launches-second-edition-au-civic-tech-fund

Almén, O., & Burell, M. (2018). Social accountability as social movement outcome: Protests in a Chinese city. *Social Movement Studies*, *17*(6), 716–735. https://doi.org/10.1080/14742837.2018.1521716

Aragón, P., Garcia, A., Le Dantec, C. A., Flores-Saviaga, C., & Saldivar, J. (2020). Civic technologies: Research, practice and open challenges. In *CSCW '20 companion: Companion publication of the 2020 Conference on Computer Supported Cooperative Work and Social Computing* (pp. 537–545). https://doi.org/10.1145/3406865.3430888

Asongu, S. A., & Nwachukwu, J. C. (2016). The role of governance in mobile phones for inclusive human development in Sub-Saharan Africa. *Technovation*, *55–56*, 1–13. https://doi.org/10.1016/j.technovation.2016.04.002

Bjerde, A., & Demirgüç-Kunt, A. (2021, March 30). Digitalization and data can vastly improve public service delivery for citizens. *World Bank Blogs*. https://blogs.worldbank.org/europeandcentralasia/digitalization-and-data-can-vastly-improve-public-service-delivery-citizens?deliveryName=FCP_19_DM99928

Bosch, T., & Roberts, T. (2021). South Africa digital rights landscape report. In T. Roberts (Ed.), *Digital rights in closing civic space: Lessons from ten African countries*. Institute of Development Studies. https://doi.org/10.19088/ids.2021.010

Brinkerhoff, D. W., & Wetterberg, A. (2015). Gauging the effects of social accountability on services, governance, and citizen empowerment. *Public Administration Review*, *76*(2), 274–286. https://doi.org/10.1111/puar.12399

Brummel, L. (2021). Social accountability between consensus and confrontation: Developing a theoretical framework for societal accountability relationships of public sector organizations. *Administration & Society*, *53*(7), 1046–1077. https://doi.org/10.1177/0095399720988529

BudgIT Foundation. (2020). *Annual report 2020: Impact in unprecedented times*. https://budgit.org/wp-content/uploads/2022/09/2020_Annual_Report.pdf

Chatwin, M., & Mayne, J. (2020). Improving monitoring and evaluation in the civic tech ecosystem. *JeDEM – eJournal of eDemocracy and Open Government*, *12*(2), 216–241. https://doi.org/10.29379/jedem.v12i2.598

Civic Tech Innovation Network (CTIN). (n.d.). African Civic Tech Atlas. https://civictech.africa/databases

CTIN. (2024, May 2). African Union Civic Tech Fund (AUCTF) 2.0. https://civictech.africa/auctf-2-2

Couve, P., Gbetoglo, E., Grange, J., Kalonji, C., Mukuku, F., Sbouai, S., Gandigbe, L., Osé Coliko, A., Orembo, E., Gichanga, M., & Kasongo, A. (2018). *Civic tech in Africa: People and technology dynamising our democracies*. CFi Media Development. https://cfi.fr/en/news/civic-tech-africa-people-and-technology-dynamising-our-democracies

de Rochegonde, A. (2020, November 4). *Des civic tech en Afrique contre la colère et l'impuissance*. *Stratégies*. https://www.strategies.fr/actualites/medias/4052143W/des-civic-tech-en-afrique-contre-la-colere-et-l-impuissance.html

Duberry, J. (2022). AI and civic tech: Engaging citizens in decision-making processes but not without risks. In *Artificial intelligence and democracy: Risks and promises of AI-mediated citizen–government relations* (pp. 195–216). https://doi.org/10.4337/9781788977319

Gilman, H. R. (2017). Civic tech for urban collaborative governance. *PS: Political Science & Politics*, *50*(3), 744–750. https://doi.org/10.1017/s1049096517000531

Grandvoinnet, H., Aslam, G., & Raha, S. (2015). *Opening the black box: The contextual drivers of social accountability*. World Bank. https://doi.org/10.1596/978-1-4648-0481-6

Gritsenko, D., & Indukaev, A. (2021). Digitalising city governance in Russia: The case of the "Active Citizen" platform. *Europe–Asia Studies*, *73*(6), 1102–1124. https://doi.org/10.1080/09668136.2021.1946013

Kaur, N., & Sitlhou, L. (2017). Governance of development assistance: Issues and challenges. *Indian Journal of Public Administration*, *63*(2), 252–264. https://doi.org/10.1177/0019556117699731

Keping, Y. (2017). Governance and good governance: A new framework for political analysis. *Fudan Journal of the Humanities and Social Sciences*, *11*(1), 1–8. https://doi.org/10.1007/s40647-017-0197-4

Khene, C., Siebörger, I., Thinyane, M., & Simuja, C. (2021). Power participation in digital citizen engagement in South African local government: The case of MOBISAM. ArXiv.org. https://doi.org/10.48550/arXiv.2108.09798

Knutas, A., Siemon, D., Tylosky, N., & Maccani, G. (2023). Contradicting motivations in civic tech software development: Analysis of a grassroots project. ArXiv.org. https://doi.org/10.48550/arxiv.2302.03469

Makara, S. (2018). Decentralisation and good governance in Africa: A critical review. *African Journal of Political Science and International Relations*, *12*(2), 22–32. https://doi.org/10.5897/AJPSIR2016.0973

Mbugua, M. (2018). Mind the gap: Bridging the divide between tech hubs and civic tech. Making All Voices Count. https://www.makingallvoicescount.org/blog/mind-gap-bridging-divide-tech-hubs-civic-tech

McGee, R., Edwards, D., Anderson, C., Hudson, H., & Feruglio, F. (2018). *Appropriating technology for accountability: Messages from Making All Voices Count*. Making All Voices Count. https://www.makingallvoicescount.org/publication/appropriating-technology-accountability-messages-making-voices-count-2

McNutt, J. G., Justice, J. B., Melitski, J. M., Ahn, M. J., Siddiqui, S. R., Carter, D. T., & Kline, A. D. (2016). The diffusion of civic technology and open government in the United States. *Information Polity*, *21*(2), 153–170. https://doi.org/10.3233/ip-160385

Network Impact. (2015). *Assessing civic tech: Case studies and resources for tracking outcomes*. Knight Foundation. https://knightfoundation.org/reports/assessing-civic-tech-case-studies-and-resources-tr/

Nyaranga, M. S., Hao, C., & Hongo, D. O. (2019). Strategies of integrating public participation in governance for sustainable development in Kenya. *Public Policy and Administration Research*, *9*(7), 56–63. https://iiste.org/Journals/index.php/PPAR/article/view/48764

OpenUp. (2022). *Annual report: March 2021-February 2022*. https://openup.org.za/annual-report/openup-annual-report-2021-2022

Pade-Khene, C., Thinyane, H., & Machiri, M. (2017, June 13). Building foundations before technology: An operation model for digital citizen engagement in resource constrained contexts. In *17th European Conference on Digital Government (ECDG 2017)*. http://collections.unu.edu/view/UNU:6206

Poblet, M., & Plaza, E. (2017). Democracy models and civic technologies: Tensions, trilemmas, and trade-offs. ArXiv.org. https://doi.org/10.48550/arXiv.1705.09015

Roberts, T. (Ed.). (2021). *Digital rights in closing civic space: Lessons from ten African countries*. Institute of Development Studies. https://doi.org/10.19088/IDS.2021.003

Rotich, J. (2017). Ushahidi: Empowering citizens through crowdsourcing and digital data collection. *Field Actions Science Reports. The Journal of Field Actions*, *Special Issue 16*, 36–38. https://journals.openedition.org/factsreports/4316

Rumbul, R. (2015). *Who benefits from civic technology?* mySociety. https://research.mysociety.org/html/who-benefits/#start

Rumbul, R., Moulder, G., & Parsons, A. (2018). *Parliament and the people: How digital technologies are shaping democratic information flow in Sub-Saharan Africa*. mySociety. https://research.mysociety.org/html/parliament-and-the-people/#top

Ruppen, D., & Brugger, F. (2022). "I will sample until things get better – or until I die." Potential and limits of citizen science to promote social accountability for environmental pollution. *World Development*, *157*, 105952. https://doi.org/10.1016/j.worlddev.2022.105952

Skaržauskienė, A., & Mačiulienė, M. (2020). Mapping international civic technologies platforms. *Informatics*, *7*(4), 1–13. https://doi.org/10.3390/informatics7040046

Stempeck, M. (2023). *Civic tech field guide*. https://civictech.guide

Sun, Y., & Yan, W. (2020). The power of data from the Global South: Environmental civic tech and data activism in China. *International Journal of Communication*, *14*(0), 2144–2162. https://ijoc.org/index.php/ijoc/article/view/13440

Waddington, H., Stevenson, J., Sonnenfeld, A., & Gaarder, M. (2018). Protocol: Participation, inclusion, transparency and accountability (PITA) to improve public services in low- and middle-income countries: A systematic review. *Campbell Systematic Reviews*, *14*(1), 1–69. https://doi.org/10.1002/cl2.205

Wakabi, W., & Grönlund, Å. (2015). Citizen-to-citizen vs. citizen-to-government eparticipation in Uganda: Implications for research and practice. In *2015 IFIP International Federation for Information Processing* (pp. 95–107). https://doi.org/10.1007/978-3-319-22500-5_8

Yimer, M. (2015). The role of ICT for good governance and agricultural development in Ethiopia: Local evidence from Southern Ethiopia. *International Journal of Political Science and Development*, *3*(1), 30–39. https://doi.org/10.14662/IJPSD2015.001

Yoshida, M., & Thammetar, T. (2021). Education between govtech and civic tech. *International Journal of Emerging Technologies in Learning (IJET)*, *16*(4), 52–68. https://doi.org/10.3991/ijet.v16i04.18769

Zhang, W., Lim, G., Perrault, S. T., & Wang, C. (2022). A review of research on civic technology: Definitions, theories, history and insights. ArXiv.org. https://doi.org/10.48550/arxiv.2204.11461

Appendix: Interview guide

1. How are civic tech initiatives addressing governance issues?

- Civic tech has been steadily growing in Africa since Ushahidi. What do you think has been its effect on governance since then?
- In what ways do you think civic tech has enhanced/influenced governance? / How is governance benefitting from civic tech in your country?
- In terms of governance, what would you say are the top four issues you have seen Nigerian/South African initiatives tackling?
- Do you think civic tech initiatives are a result of governance issues? If yes, could you offer some examples?
- In what ways has your organisation (and others) enhanced governance in our country, e.g., what has changed in governance since your organisation and similar organisations started?
- What would you say is the impact of civic tech on governance in Nigeria/South Africa?

2. To what extent have governance issues in Nigeria/South Africa led to the emergence of civic tech initiatives?

- From your experience, what factors have led to the creation of civic tech organisations, especially those focused on governance?
- What are the key social, economic and technological factors that influence the development of civic tech in your country and how do they affect civic tech?
- To what extent is the creation of civic tech in Nigeria/South Africa tech-driven, funding driven and/or governance (solutions) driven?
- What technologies have you used and how/for what purposes or objectives?
- Do you think factors such as entrepreneurship, increased digital literacy and access, issues with public services, etc., have contributed to the creation of civic tech?

3. What are the key challenges affecting the governance-focused civic tech initiatives in Nigeria/South Africa?

- In detail, please share any specific challenges civic tech initiatives are facing in your country.
- How are the issues/factors impeding the success/uptake of civic tech in Nigeria/South Africa in the governance sector?
- What policy issues do you come across in the space that are particularly challenging? (Do policies in your country enable or constrain the development and adoption of civic tech?)

Co-design, with two South African villages, of a prototype for an e-waste management mobile app

Odwa Gazana
PhD candidate, Department of Information and Communication Technology, Cape Peninsula University of Technology, Cape Town
https://orcid.org/0000-0002-3291-2077

Thembisa Grace Ngqondi
Professor and Dean, Faculty of Informatics and Design, Cape Peninsula University of Technology, Cape Town
https://orcid.org/0000-0003-3371-3659

Abstract
Electronic waste (e-waste) contains toxic elements that, if not carefully disposed of, can harm the environment and human health. It is imperative that e-waste is handled in a correct, safe manner. The study engaged with two rural South African villages, Mantunzeleni and Mpeta in the Eastern Cape Province, to determine their current e-waste disposal practices and to co-design a cloud-based mobile application (app) for improved e-waste management. Twenty-six participants, 13 from each village, participated in the study. A focus group discussion with participants explored the communities' existing e-waste disposal behaviours, which were found to be harmful to the environment. Participants were then introduced to, and guided through, the co-design process, which resulted in development of a prototype cloud-based mobile app that would, if implemented, allow households to request the collection of e-waste items by the local municipality. The authors argue that, because of the co-design process, the app (if implemented by the municipality) will be well-suited to the needs of, and widely used by, the two target communities, who will feel a sense of ownership of the technological solution that they helped to create.

Keywords
electrical and electronic equipment (EEE), electronic waste (e-waste), environment, health, rural villages, under-resourced areas, mobile application (app), cloud computing, Eastern Cape Province, South Africa

DOI: https://doi.org/10.23962/ajic.i33.17267

Recommended citation
Gazana, O., & Ngqondi, T. G. (2024). Co-design, with two South African villages, of a prototype for an e-waste management mobile app. *The African Journal of Information and Communication (AJIC), 33,* 1-21. https://doi.org/10.23962/ajic.i33.17267

1. Introduction

Consumer products such as refrigerators, radios, electric fans, washing machines, televisions, cell phones, and computers play an important role in people's lives. The ownership of such products is widespread, in both developed and developing countries. Due to feature improvements or breakdowns, consumers frequently buy new models of these products and discard old ones (Ylä-Mella et al., 2022). The discarded goods become e-waste, which is electrical and electronic waste, including discarded consumer electronics, information and communication technology (ICT) equipment, and small and large electronic household appliances (eWASA, n.d.).

E-waste contains toxic elements such as copper, lead, cadmium, and mercury (Abalansa et al., 2021) that, if carelessly discarded, pose hazards to human health and the environment (when the toxic elements are released into the air, water, and soil) (DeVroom, 2019). People living in under-resourced settlements often lack basic services such as sanitation and access to safe water. In such communities, many people source their drinking water from rivers, streams, and dams. The sources of their water can be exposed to contamination released by e-waste (Bhat & Savale, 2019).

This study, which took place in South Africa's Eastern Cape Province, had two main aims: (1) to canvas the existing level of e-waste awareness among residents of under-resourced communities where unsafe dumping of e-waste was present; and (2) to collaborate with these residents in the design and testing of a cloud-based mobile application (app) focused on building e-waste awareness and safe management. The development of the app was guided by a co-design approach, which allows end-users to collaborate with experts to design a system based on the end-users' experiences and expectations (Slattery et al., 2020). The study participants were 26 residents of the Eastern Cape villages of Mantunzeleni and Mpeta.

Research questions

The study was guided by the following questions:

- What is the extent of residents' knowledge and awareness of e-waste?
- Which features of a cloud-based mobile app would be useful to support safe e-waste management in the villages?

2. Literature review

E-waste in Africa

African countries are often the recipients of developed countries' electrical and electronic equipment (EEE) donations, which, according to Avis (2021), African countries accept in an effort to bridge the digital divide. The EEE exported to Africa is often mislabelled as used and usable, when in fact it is e-waste (Williams & Adetuyi, 2022). As William and Adetuyi (2022) point out, such mislabelling is practised to avoid rules against transboundary trade in e-waste. Perunding Good Earth (2021) also notes that developed countries make these donations to developing countries to offload some of their e-waste. Accordingly, as Avis (2021) explains, the EEE imported into Africa increases e-waste levels on the continent. The World Economic Forum (WEF, 2021) states that developed countries export about 60% of their e-waste to Africa. The e-waste received from developed countries litters villages and towns, impacting the environment and health in those places (Bazilian, 2020).

In most African countries, there is poor handling of e-waste, and this is attributed to poor collection mechanisms, poor recycling, poor public awareness, and a lack of government policies (Godfrey et al., 2019). The result is that e-waste is often disposed of in landfills with general waste, or burnt (Sahle-Demessie et al., 2018), resulting in negative impacts on the environment and human health (Forti et al., 2020; UNEP, 2018).

In 1991, in an effort to prevent developed countries from exporting e-waste to Africa, 12 African countries negotiated and approved the Bamako Convention on Hazardous Wastes, which came into force in 1998 (Bamako Convention, 1991). The Convention requires that when African countries trade in e-waste between themselves, there must be signed consent between the countries (Kaminsky, 1992), with the signed consent stating how the receiving country will manage the imported e-waste. The Convention also prohibits the export of e-waste to Africa by developed countries (UNEP, n.d.-b). South Africa is not a signatory to the Bamako Convention but is a signatory to the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention, 1989).

The implementation of the Bamako Convention is relatively weak on the continent, due to a lack of resources (Umenze, 2019). Furthermore, Umenze (2019) states that although the Convention was initiated to protect the environment and health on the continent, developed-world e-waste is still finding its way into African countries and is not properly managed. In the *Global E-waste Monitor 2020* report, Forti et al. (2020) state that only 13 African countries have national e-waste policy, legislation, or regulation in place (Table 1).

Table 1: African nations with national e-waste policies, laws, or regulations, 2020

North Africa	West Africa	Central Africa	East Africa	Southern Africa
Egypt	Cote d'Ivoire Ghana Nigeria	Cameroon Sao Tome & Principe	Kenya Rwanda Tanzania Uganda	Madagascar South Africa Zambia

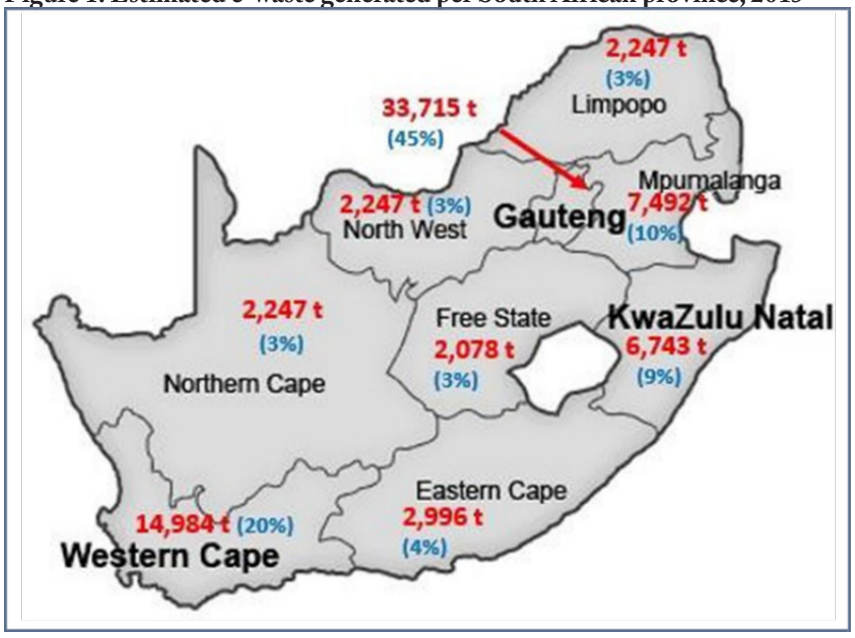
Note. Sourced from Forti et al. (2020).

Avis (2021) argues that even in the African countries that have policies, laws, or regulations in place to regulate e-waste management, e-waste is still not properly handled due to poor implementation, particularly in under-resourced rural areas.

E-waste in South Africa

South Africans' use of technology has grown significantly in recent decades (Stats SA, 2019), thus increasing the amounts of e-waste generated. According to Ludek (2024), 360,000 tonnes of e-waste are generated in the country each year; only around 12% is reclyced, with the rest dumped in landfills. Figure 1 below provides 2015 estimates for the amount of e-waste generated by each of South Africa's nine provinces.

Figure 1: Estimated e-waste generated per South African province, 2015



Note. Figure sourced from Lydall et al. (2017, p. 6).

In South Africa, the services available in urban and rural areas differ greatly. In urban areas there is access to basic services such as health, education, and sanitation. In contrast, in many rural areas, under-resourced villages have poor access to basic services. Life in these parts of the country is extremely difficult (Gazana, 2016). Technology use is quite high in both urban and rural areas. According to Jeftha (2023), South Africa is, in the African continental context, one of the countries with the highest levels of technology usage, and thus high levels of e-waste generation are also found. Meanwhile, according to Lydall et al. (2017) and Jeftha (2023), e-waste handling in the country is poor, and e-waste is often disposed of in landfills or burnt. While South Africa has policy, legal, and regulatory instruments dealing with how e-waste should be handled, much of its e-waste still ends up in landfills (Avis, 2021). Table 2 below lists South African instruments that are relevant to e-waste. A key recent instrument featured in the table is the Extended Producer Responsibility (EPR) Regulations of 2020, which came into force in 2021 and regulate how out-of-life electronic products should be handled in the country.

Table 2: South African instruments relevant to e-waste

Instrument	Details	Year
White Paper on Integrated Pollution and Waste Management	Proposes development of waste management strategy for land pollution; developed by the Department of Environmental Affairs and Tourism (now the Department of Forestry, Fisheries and the Environment).	2000
National Environmental Management: Waste Act (NEMWA)	Addresses matters such as air quality, environmental assessment, biodiversity, and waste; falls under the Department of Forestry, Fisheries and the Environment.	2008
Waste Picker Integration Guideline for South Africa	Guidelines for all stakeholders involved in waste picking processes, including those buying from pickers; developed by the Department of Forestry, Fisheries and the Environment and the Department of Science and Innovation.	2020
National Waste Management Strategy	Prioritises waste management and the establishment of a circular economy; developed by the Department of Forestry, Fisheries and the Environment.	2020
Extended Producer Responsibility (EPR) Regulations	Ensure that out-of-life EEE products are safely managed; under the Department of Forestry, Fisheries and the Environment.	2020

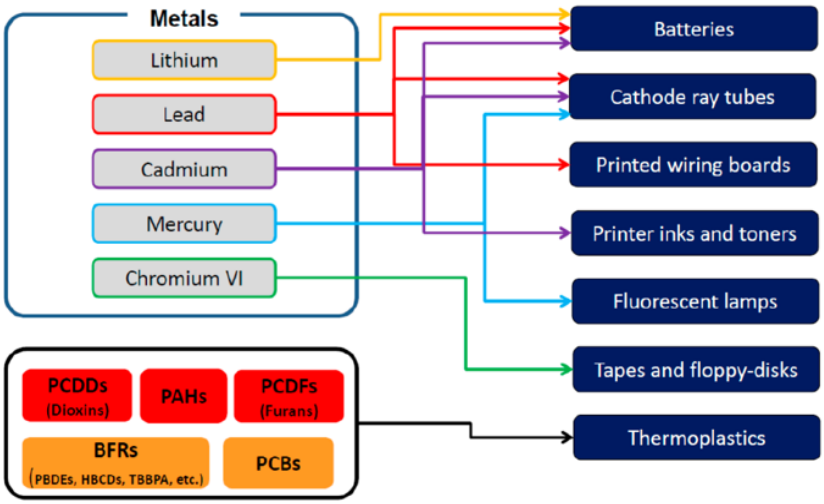
Impacts of e-waste on health and the environment

Disposing of EEE in landfills puts people's lives at risk, as the air, water, and land become contaminated. In developing countries, where people live near or work with discarded EEE, there have been cases of diseases recorded in the literature (WHO, 2021). Birth complications, developmental issues in children, brain cancer, and respiratory infections have been found in people living near e-waste dumping sites or e-waste-contaminated land (Grant et al., 2013; Ichikowitz & Hattingh, 2020).

A study done in South Africa found mercury, arsenic, and cadmium in the blood of elders and children living near dumping sites and those working in informal recycling sites (Machete, 2017). WHO (2021) has found that the foetuses and children of mothers living near e-waste dumping sites or working with discarded EEE can be exposed to diseases associated with e-waste, including, in the case of babies, through breast-feeding.

With respect to environmental risks, e-waste, when disposed of in landfills, leaches through the soil to the underground water, which ends up in drinking water in under-resourced settings. The burning of e-waste contaminates the air that people breathe, causing respiratory infections. Toxic elements found in the soil where the burning and dumping of e-waste occur include lead, copper, zinc, antimony, cadmium, and manganese (Avis, 2021; Lebbie et al., 2021). The figure below, from Lebbie et al. (2021), shows the toxic elements found where there is careless disposal of e-waste.

Figure 2: Toxins released by e-waste



Note. Figure sourced from Lebbie et al. (2021, p. 4).

Cloud computing

Cloud computing provides convenient, on-demand access to network resources (Berg et al., 2020). The network resources can be applications, network services, and/or storage systems (Berg et al., 2020). With regard to e-waste management, cloud computing can store data received from sensers and, accordingly, inform collection systems (Berg et al., 2020). Abdulazeez et al. (2018) posit that cloud computing's core advantages are that it is cost-effective and can be used by many users simultaneously. Cloud computing includes service models and deployment models.

Service models

Service models include software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) (Namasudra, 2021). SaaS enables end-users to access software applications provided via the internet. PaaS provides deployment platforms for software applications. IaaS provides virtual networking resources (Mohammed & Zeebaree, 2021). (The prototype cloud solution developed in this study was an SaaS service model, so that end-users could access it from anywhere, at any time, via their mobile phones.)

Deployment models

Deployment models include private cloud, public cloud, community cloud, and hybrid cloud (Namasudra, 2021). Private cloud deployments are owned by a single entity or organisation. Only authorised people can access the services. Advantages of the private cloud include flexibility, control, effective performance, and high security (Golightly et al., 2022). Public cloud deployments are available to the general public. Anyone can gain access to the resources, and the model contains minimal security mechanisms (Golightly et al., 2022). An example is Google Drive (Shaptunova, 2024). Community cloud deployments mimic the private model, with the difference being that the community model is owned by more than one entity. Hybrid cloud deployments are composed of two or three of the aforementioned deployment models. (The prototype cloud solution developed in this study was a private cloud model, chosen because of its high security (IBM, n.d.; Red Hat, 2019).)

3. Research design

Methodology

The research deployed the qualitative co-design methodology. A co-design session was conducted with 26 participants living in the two villages, Mantunzeleni and Mpeta, which were the focus of the study. The decision to focus on these two rural communities was based on previous observation, by the researcher (the first-listed author), that e-waste was being disposed of in the villages' landfills and next to household gardens. Items that were being disposed of in an unsafe manner included washing machines, electrical bulbs, electrical stoves, irons, cell phones, and batteries. It was also observed that e-waste was not being collected by the local municipality.

The co-design method was chosen because it allows end-users to collaborate with experts in the design phase. End-users provide the functional specifications for what they would like the system to do. Co-design emphasises designing *with* rather than *for*. Such design aims to build end-user satisfaction, adoption, and use, with the end-users feeling a sense of ownership based on their participation in the design of the system. As Burkett (2021) writes, co-design seeks to address complex social problems through incorporating the skills, knowledge, and experiences of the people impacted by the problem.

Sampling

Purposive sampling was used to choose participants from the two villages. The sampling comprised 13 residents from each village, aged 18 or older. Each participant owned, or had owned, at least one electronic item. Of the 26 participants, 14 were males and 12 were females.

Ethical clearance, permissions, and informed consent

Ethical clearance for the study was obtained from the applicable research ethics committee of the authors' academic institution, Cape Peninsula University of Technology in Cape Town.

Before the data collection began, the researcher approached the chiefs of the two villages to obtain permission for data collection to take place through interactions with residents of their villages. Consent forms explaining the study were signed by both chiefs, permitting the study to be done in their villages. One of the conventions followed by the chiefs is to call monthly meetings to update villagers on what is currently happening, or will happen, in their villages. Any developments happening in the villages are addressed in these monthly meetings. The researcher is from Mantunzeleni and knows the culture of the villages as they are close to each other. Each participant signed an informed consent form before the data collection process began.

Data collection

The participants from the two villages gathered with the researcher at a community hall where the data collection and co-design session took place. To establish the current e-waste management practices in the villages, questions were verbally posed to the participants in a focus group discussion (FGD) format. The FGD questionnaire was written in English (see Appendix 1), but the questions were verbally posed in isiXhosa, which is the dominant language in the two villages. Audio-recording was used to capture the participants' verbal inputs, which were provided in isiXhosa. (The English-language FGD quotations that are provided later in this article are the researcher's translations of the participants' isiXhosa statements.)

After completion of the FGD, the co-design session took place, conducted in isiXhosa. For this session, participants were given post-it notes and pencils, and videos were played to explain what was required of them. Participants wrote in isiXhosa, on the post-it notes, the features that they wanted in the app, and posted the notes on a whiteboard (see Appendix 2). The researcher, who facilitated the co-design session, also contributed ideas during the co-design session. This co-design data collection process ended when saturation point was reached, i.e., when no new data was coming from participants. All the participants ultimately agreed on what they wanted from the mobile app. Thus, consensus among all 26 participants was achieved.

Data analysis

The data from the audio-recorded FGD on knowledge and awareness of e-waste was analysed thematically. In analysing the data, six stages of thematic analysis, guided by the work of Braun and Clarke (2012), were followed:

- familiarisation with the data by taking notes;
- generation of initial codes, by coding the most compelling parts of the data;
- grouping of codes into potential themes;
- reviewing of themes, checking them against the data to ensure that no potential themes had been missed;
- finalisation of the naming of the themes; and
- production of a research report, setting out the themes and the data linked to each theme.

With respect to the development of the app, participants' design options were combined to provide an overall picture of what was required.

4. Findings on current e-waste management practices in the villages

In the FGD with the 26 participants, it was initially found that none of them knew about the concept of e-waste. In the words of one participant: "[I]t is my first time hearing about of this kind of waste." All other participants said that they were in the same position. Thus, the researcher provided an explanation of what e-waste is, the toxins that it can release, the potential health and environmental implications from unsafe disposal in landfills, and the potential safe disposal methods.

Disposal practices

It was found that no special measures were being taken in either village with respect to the disposal of e-waste, with e-waste being dumped near homes or in landfills in the same manner as other waste. The following statements, by three different FGD participants, were typical of the responses to the question of disposal:

> I personally just throw my non-functioning electrical stuff away in the fields because I do not know what to do with [it].

> I agree with the previous speaker. I do the same, and I do not care what happens to them [the discarded items] as long as they [are] out of my yard, as they no longer do what I bought them for.

> Well for me, throwing in landfills is the only option I have as I do not know where to take them. As we speak here now, a lot of this e-waste is scattered in landfills and around households in the village.

Potential environmental and health impacts

After being made aware, by the researchers, of e-waste's potential harmful environmental impacts and, in turn, the harmful health impacts for both humans and animals, participants discussed some of the practices in their villages that they now realised were dangerous. In the words of one FGD participant:

> To be honest, all of us here did not know about the impact on the environment. What we do is, […] if it no longer works, we get rid of it. Nobody cared how and where one disposed [of] it.

Participants discussed the fact that they grow food, including maize and vegetables, in their gardens, while at the same time burying e-waste items—such as old batteries, old radios, and device motherboards—in the soil near the gardens. They acknowledged that such practices were dangerous, potentially poisoning the food that people ate. They also acknowledged the dangers of burning e-waste, because of the pollutants released into the air that can cause respiratory infections. Participants also pointed to the fact that people in the villages drink from the rivers and streams, and yet some e-waste could be found next to some of these bodies of water. Concern was also expressed about the potential e-waste contamination of lands where the villagers' livestock grazed. According to one FGD participant:

> Since we dispose of these [e-waste items] into landfills, dams and rivers, we are in danger. Also, for example, cows might eat these and die. Also, children are in danger because they go to these places to find something they can play with. They can get cuts, and at times they bring these [e-waste items] back to households to play with.

At the conclusion of the discussion, the participants expressed gratitude for having received the necessary information about e-waste, and they expressed a desire to spread awareness in their villages. Accordingly, the participants strongly supported the proposal to co-design a mobile app that their communities could use for e-waste management.

Summary of FGD findings

There was a clear lack of e-waste awareness in the two under-resourced communities. Disposal methods for e-waste were inappropriate, as e-waste was being disposed of in landfills and next to water sources such as rivers and streams. Another disposal

method was the burning of e-waste. Only when the researcher made the participants aware of the risks associated with the unsafe disposal of e-waste did the participants identify the need to change disposal practices in their villages.

5. Co-design of the e-waste management app

Identification of functions

Through the co-design process, the participants, in collaboration with the researchers, identified several functions that needed to be included in an e-waste mobile app for use in the villages. It was determined that the app needed to be able to do the following:

- send short message service (SMS) messages reminding people about the dangers of e-waste and how to manage e-waste;
- allow residents to enter a request, and receive confirmation of the successful entering of the request, for collection of an e-waste item; and
- send (based on an e-waste collection request) an SMS to municipal employees responsible for waste collection—with details of the item(s) to be collected and the place of collection.

Accordingly, there was consensus that the app would eventually need to be integrated with the operations of the municipality, so that local government would know when e-waste items were ready to be collected. (The municipality had been consulted to determine how it managed e-waste, and the municipality was found to lack e-waste awareness. There was also no policy on how e-waste should be managed, and the municipality disposed of e-waste together with general waste in a landfill.)

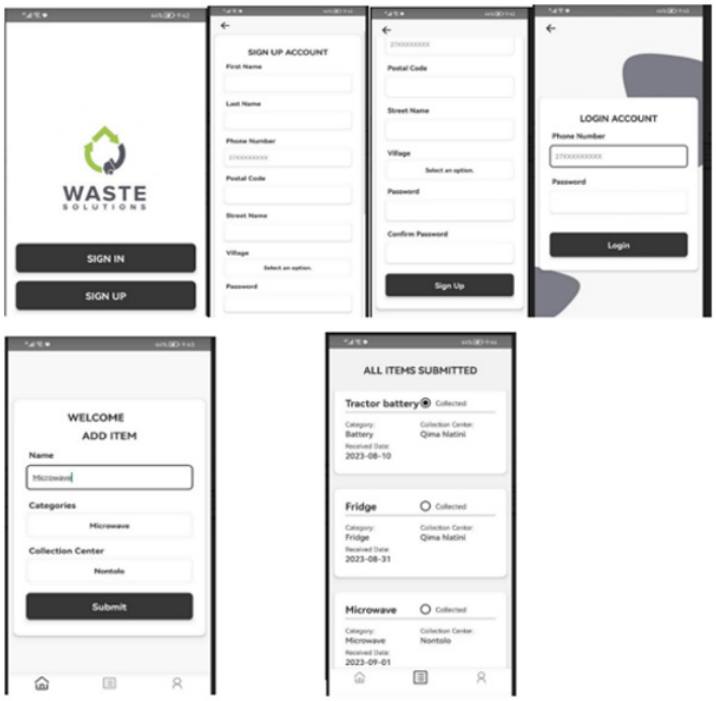
Development of the prototype

Based on the functions identified as necessary during the co-design session, a prototype app was developed. For the user interface (UI), reactive node was used. The back end was developed with Node JS. The data format used between the UI and back end was JavaScript object notation (JSON). For generating SMSs, the Vonage Application Programming Language (API) was integrated with the prototype, and the integrating was done via an http call to Vonage API. For the database, Mango DB, which is an open-source database, was used. The prototype app had three user categories:

- **Village user**: A user who can submit requests for e-waste collection. The user registers, and thereafter can log in at any time and submit requests for items to be collected.
- **Employee**: A user, employed by the local municipality, who receives, and ensures fulfilment of, collection requests from Village users.
- **Administrator:** A user (the most powerful of the three) who can create, read, update, and delete (CRUD) in the app. This user can, among other things, see what has been collected, by whom, and at what time, and can also see where the item has been taken.

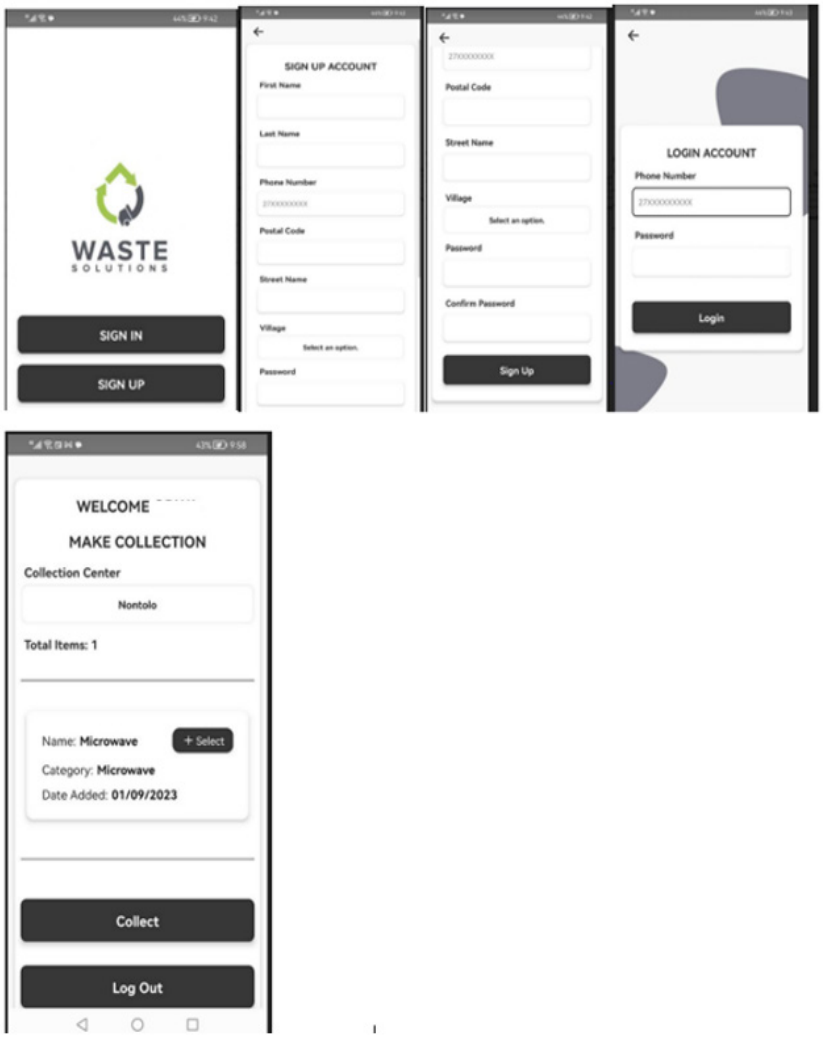
The app uses English as a communication medium. One reason for this was that participants stated that they were using this as a learning opportunity; they wanted to use this app to help them learn how to use other apps, and the majority of apps use English. Another reason that they gave was that, should the app be successful in terms of adoption and rollout to other places, this would put the two villages on the map as the ones to have successfully built an e-waste app now being used by other places. The participants stated that they wanted to make history, and having the app in English would help with that objective. Below are screenshots of the interfaces developed for the three user categories.

Figure 3: Village user screens



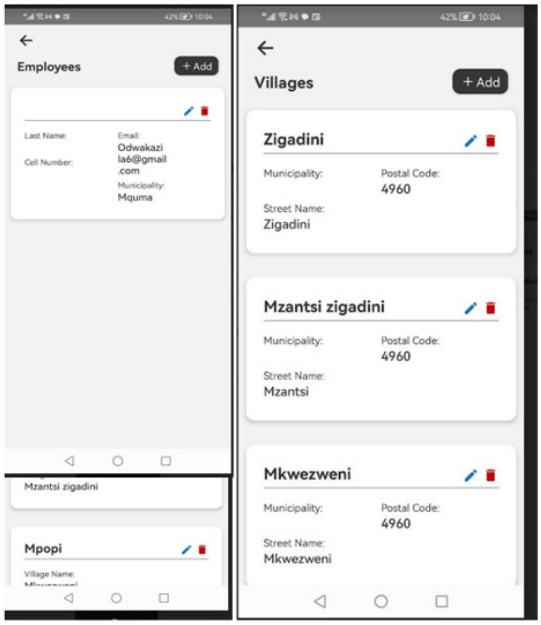
The Village users must first register before using the app. Once the village users register, they can log in to the system at any time and from anywhere. The users can then submit requests for items to be collected at their houses. The users can also see a history of the requests that they have submitted. Once a user captures what needs to be collected and presses "submit", an SMS is sent to the user confirming that their item has been registered for collection and will be collected as soon as the collecting entity is able to do so. The following categories of items can be selected on the app: batteries, computer screens and keyboards, televisions, fridges, stoves, and mobile phones.

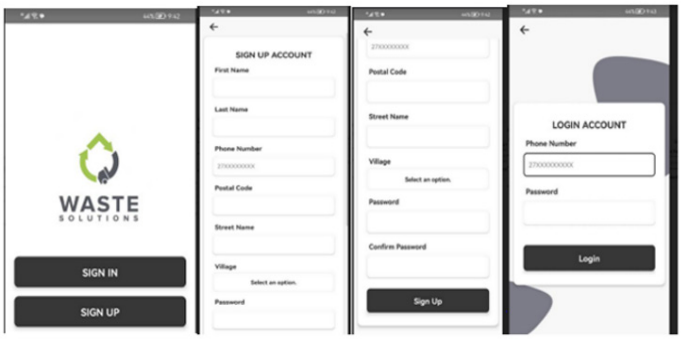
Figure 4: Employee user screens

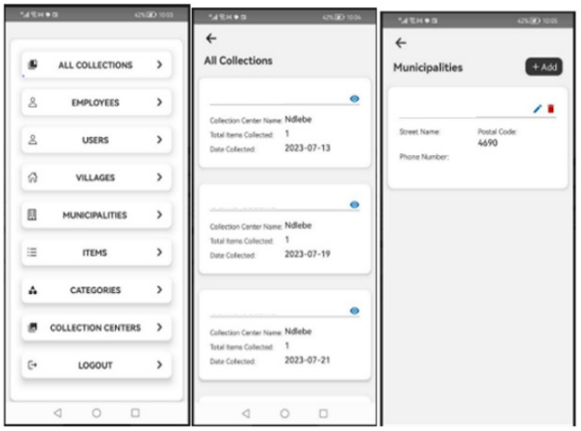


Via the screens shown above, the municipal Employee user registers, and can log in at any time to view Village user requests for items to be collected. When the Employee user selects an item and clicks on "collect", an SMS is sent to the Village user who submitted the request to indicate that collection will occur.

Figure 5: Administrator user screens







Administrator users can create, update, view, and delete villages, Village users, Employee users, and municipalities. An Administrator can see what items were collected and when they were collected. The Administrator can also see submitted items that still need to be collected and can alert the collecting entity.

Testing of app prototype

The researcher, who is a software developer by profession, asked colleagues to assist with the testing of the app, to ensure that it worked as required. The testing, as seen in the results in Table 3, was successful. The app was then shown to the Chief of Mantunzeleni village, as a way of reporting back on the progress made. The Chief stated that, during a community meeting, he would notify his subjects of the outcomes of the study. The Chief of Mpeta village was not available when the researcher went there to showcase the app.

Table 3: Test results

Test ID	Test case	Expected result	Result
1	Village user registers	Village user registered	successful
2	Village user logs in	Village user can log in	successful
3	Village user submits e-waste item(s)	E-waste item(s) submitted	successful
4	Village user receives SMS upon submitting items	Confirmation SMS received	successful
5	Employee user receives SMS to collect	Employee SMS for collection received	successful
6	Employee marks collection	Collection marked	successful
7	Village user receives SMS that e-waste item(s) have arrived in the collection centre	Confirmation SMS received by Village user	successful
8	Admin (Administrator user) creates Employees/collection centres/villages/ categories/municipalities	Employees/collection centres/ villages/categories/municipalities created	successful
9	Admin edits Employees/collection centres/villages/categories/ municipalities	Employees/collection centres/ villages/categories/municipalities edited	successful
10	Admin deletes an Employee/collection centre/village/category/municipality	Employee/collection centre/village/ category/municipality deleted	successful
11	Admin views Employees/collection centres/villages/categories/ municipalities in the system	Admin viewed Employees/ collection centres/villages/ categories/municipalities in the system	successful
12	Admin deletes user	User deleted	successful
13	Admin receives SMS if threshold of items is reached	SMS received	successful

Test ID	Test case	Expected result	Result
14	Admin views list of collected e-waste items	Admin viewed list of collected e-waste items	successful
15	Admin views list of uncollected e-waste items	Admin viewed list of uncollected e-waste items	successful
16	Village user receives SMS about e-waste awareness twice a month	SMS about e-waste awareness received by registered Village users	successful
17	Village user logs out of the system	Village user logged out	successful
18	Employee user logs out of the system	Employee user logged out	successful
19	Admin logs out of the system	Admin logged out	successful

6. Conclusions

The aims of this study were to engage a group of 26 residents from two South African rural communities to (1) determine current e-waste management practices in the two rural South African villages studied; and (2) facilitate a co-design process for a cloud-based mobile app that can improve e-waste management. The study participants, upon being made aware of the phenomenon of e-waste and its potential to generate harmful environmental and health impacts, pointed to widespread unsafe e-waste disposal practices in their communities. The participants also expressed an interest in ensuring e-waste awareness in their communities and welcomed the opportunity to work with the researchers to co-design a prototype mobile app to facilitate the safe disposal of such waste.

It is hoped that, if the app can be adopted by the local municipality, the study participants—the target communities—will find that the app directly suits their needs, and they will also feel a sense of ownership of the app because of the co-design process. Indeed, the study participants voiced happiness with the app that they had designed, assuring the researchers that they will be happy to use it once it goes through the necessary approvals. The study also found that the participants were grateful for the education and awareness that they had gained from the study. This study contributes to the body of knowledge on the use of mobile apps for the purposes of community-driven management of local environmental matters, and it also contributes to exploration of the role of co-design in the development of community-driven solutions to environmental problems.

Acknowledgements

This article draws on data collected as part of the first-listed author's PhD studies at the Cape Peninsula University of Technology, Cape Town. The authors acknowledge with gratitude the research participants from the Mantunzeleni and Mpeta villages, who contributed to the development of the prototype e-waste management mobile app.

Funding
Funding for this study was received from South Africa's Media, Information and Communication Technologies Sector Education and Training Authority (MICTSETA).

Data availability
The ethical clearance granted was on the basis that the data collected would be accessible only to the researchers. With provision subject to secondary ethical clearance, the data can requested, in writing, from the corresponding author, Odwa Gazana, at odwakazila6@gmail.com

AI declaration
AI tools were not used in the process of the study.

Authors' contributions
O.G.: Conceptualisation, methodology, data collection, sample analysis, data analysis, validation, data curation, writing – the initial draft; writing – revisions, project management and funding acquisition.
T.G.N.: Methodology, writing – revisions, student supervision, project leadership, project management and funding acquisition.
Both authors read and approved the final manuscript.

Competing interests
The authors have no competing interests to declare.

References

Abalansa, S., Mahrad, B. E., Icely, J., & Newton, A. (2021). Electronic waste, an environmental problem exported to developing countries: The good, the bad and the ugly. *Sustainability,13*, 5302, 1–24. https://doi.org/10.3390/su13095302

Abdulazeez, A. M., Zeebaree, S. R., & Sadeeq, M. A. M. (2018). Design and implementation of electronic student affairs system. *Academic Journal of Nawroz University*, *7*(3), 66–73. https://doi.org/10.25007/ajnu.v7n3a201

Avis, W. (2021). *Drivers, barriers and opportunities of e-waste management in Africa.* K4D Helpdesk Report No. 1074. Institute of Development Studies. https://doi.org/10.19088/K4D.2022.016

Bamako Convention. (1991). Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa. https://www.informea.org/en/treaties/bamako-convention/text

Basel Convention. (1989). Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf

Bazilian, S. (2020, November 27). E-waste in developing countries. *BORGEN Magazine*. https://www.borgenmagazine.com/e-waste-developing-countries

Berg, H., Sebestyén, J., Bendix, P., Le Blevennec, K., & Vrancken, K. (2020). *Digital waste management.* Eionet Report – ETC/WMGE 2020/4. European Environment Agency: European Topic Centre on Waste and Materials in a Green Economy.

Bhat, V. P., & Savale, O. (2019). A comparative study of e-waste management in urban and rural areas of India and the role of media in spreading e-waste awareness. In *Proceedings of International Conference on Media Ethics* (pp. 1–10), 9–10 June, Pune. https://doi.org/10.2139/ssrn.3402035

Braun, V., & Clarke, V. (2012). Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, & A. T. Panter (Eds.), *APA handbook of research methods in psychology*, *Vol. 2* (pp. 51–71). American Psychological Association. https://doi.org/10.1037/13620-004

Burkett, I. (2021). *An introduction to co-design.* http://ingridburkett.com/wp-content/uploads/2017/09/Introduction-to-Codesign-2.pdf

DeVroom, D. (2019, January 28). W*hy it's important to dispose of e-waste properly.* IDR Environmental Services. https://blog.idrenvironmental.com/why-it-s-important-to-dispose-of-e-waste-properly

EPR Waste Association of South Africa (eWASA). (n.d.). *8 types of e-waste and how to recycle them.* https://ewasa.org/8-types-of-ewaste-and-how-to-recycle-them

Forti, V., Baldé, C. P., Kuehr, R., & Garam, B. (2020). *The global e-waste monitor 2020: Quantities, flows and the circular economy potential*. UNU-VIE, UNITAR, ITU, and International Solid Waste Association (ISWA). https://ewastemonitor.info/wp-content/uploads/2020/11/GEM_2020_def_july1_low.pdf

Gauteng Department of e-Government. (2022, July 3). *Gauteng tackles the mounting e-waste in the province*. https://www.gauteng.gov.za/News/NewsDetails/%7BA1BC7B64-17B0-43BB-9685-0C2483106FF6%7D

Gazana, O. (2016). *The role of telehealth in enhancing access to healthcare services in an under-resourced setting: A case of Mantunzeleni in Eastern Cape Province*. [Master's thesis, Cape Peninsula University of Technology, Cape Town].

Godfrey, L., Ahmed, M. T., Gebremedhin, K. G., Katima, J. H. Y., Oelofse, S., Osibanjo, O., Richter, U. H., & Yonli, A. H. (2019). Solid waste management in Africa: Governance failure or development opportunity? In N. Edomah (Ed.), *Regional development in Africa* (pp. 1–14). IntechOpen https://doi.org/10.5772/intechopen.86974

Godfrey, L., & Oelofse, S. (2017). Historical review of waste management and recycling in South Africa. *Resources*, *6*(4), 1–11. https://doi.org/10.3390/resources6040057

Golightly, L., Chang, V., Xu, Q. A., Gao, X., & Liu, B. (2022). Adoption of cloud computing as innovation in the organization. *International Journal of Engineering Business Management*, *14*, 1–7. https://doi.org/10.1177/18479790221093992

Grant, K., Goldizen, F. C., Sly, P. D., Brune, M.-N., Neira, M., van den Berg, M., & Norman, R. E. (2013). Health consequences of exposure to e-waste: A systematic review. *Lancet Global Health*, *1*(6), 350–361. https://doi.org/10.1016/S2214-109X(13)70101-3

IBM. (n.d.). *What is artificial intelligence (AI)?* https://www.ibm.com/za-en/cloud/learn/what-is-artificial-intelligence

Ichikowitz, R., & Hattingh, T. (2020). Consumer e-waste recycling in South Africa. *South African Journal of Industrial Engineering*, *31*(3), 44–57. https://doi.org/10.7166/31-3-2416

Jefthas, T. L. (2023). *E-waste management, practices, knowledge, and behaviour: A case study of Stellenbosch University.* [Master's thesis, Stellenbosch University, South Africa].

Kaminsky, H. S. (1992). Assessment of the Bamako Convention on the Ban of Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa. *Georgetown International Environmental Law Review*, *5*(1), 77–90.

Lebbie, T. S., Moyebi, O. D., Asante, K. A., Fobil, J., Brune-Drisse, M. N., Suk, W. A., . . . Carpenter, D. O. (2021). E-waste in Africa: A serious threat to the health of children. *International Journal of Environmental Research and Public Health*, *18*, 8488, 1–25. https://doi.org/10.3390/ijerph18168488

Ludek, A. (2024, February 16). *Circular opportunities for e-waste repair and reuse of electrical and electronic equipment in South Africa.* WasteAid. https://wasteaid.org/circular-opportunities-for-e-waste-repair-and-reuse-of-electrical-and-electronic-equipment-in-south-africa

Lydall, M., Nyanjowa, W., & James, Y. (2017). *Mapping South Africa's waste electrical and electronic equipment (WEEE) dismantling, pre-processing and processing technology landscape.* Report prepared by Mintek for the Department of Science and Technology (DST) and the Council for Scientific and Industrial Research (CSIR).

Machete, F. (2017). Environmental health risks associated with e-waste exposure in Badplaas, Carolina and Elukwatini landfills, Republic of South Africa. *African Journal of Science, Technology, Innovation and Development*, *9*(6), 679–684. https://doi.org/10.1080/20421338.2017.1355602

Namasudra, S. (2021). Data access control in the cloud computing environment for bioinformatics. *International Journal of Applied Research in Bioinformatics (IJARB)*, *11*(1), 1–11. https://doi.org/10.4018/IJARB.2021010105

Odumuyiwa, V., Adelopo, A., & Nubi, A. (2021). *Circular economy in Africa: Examples and opportunities: Electronics and e-waste*. Ellen MacArthur Foundation. https://ellenmacarthurfoundation.org/circular-economy-in-africa-e-waste

Perunding Good Earth. (2021). *The e-waste inventory project in Malaysia*. Prepared for the Department of Environment, Malaysia.

Red Hat. (2019, November 6). *What is private cloud?* https://www.redhat.com/en/topics/cloud-computing/what-is-private-cloud

Sahle-Demessie, E., Glaser, J., & Richardson, T. (2018). Electronics waste management challenges and opportunities. Presentation to American Chemical Society 2018 National Meeting, 19–23 August, Boston.

Shaptunova, Y. (2024, April 8). *4 best cloud deployment models overview*. SaM Solutions. https://www.sam-solutions.com/blog/four-best-cloud-deployment-models-you-need-to-know

Slattery, P., Saeri, A. K., & Bragge, P. (2020). Research co-design in health: A rapid overview of reviews. *Health Research Policy and Systems*, *18*(17), 1–13. https://doi.org/10.1186/s12961-020-0528-9

Statistics South Africa (Stats SA). (2018, September 5). *Only 10% of waste recycled in South Africa*. http://www.statssa.gov.za/?p=11527

Stats SA. (2019). *Annual report 2019/2020.*

Umenze, N. (2019). Twenty years of the Bamako Convention: Recounting Africa's waste trade experience and its journey to toxic waste freedom. *South African Journal of Environmental Law and Policy*, *25*(1), 146184. https://hdl.handle.net/10520/ejc-jlc_sajelp-v25-n1-a6

United Nations Environment Programme (UNEP). (2018, September 24). *Turning e-waste into gold: The untapped potential of African landfills*. https://www.unep.org/news-and-stories/story/turning-e-waste-gold-untapped-potential-african-landfills

UNEP (n.d.-a). *Basel Convention: Overview*. http://www.basel.int/TheConvention/Overview/tabid/1271/Default.aspx

UNEP. (n.d.-b). *The Bamako Convention.* https://www.unep.org/explore-topics/environmental-rights-and-governance/what-we-do/meeting-international-environmental

Williams, N., & Adetuyi, A. (2022). *E-waste management in Africa – Overview and policy developments.* Brooks and Knights Legal Consultants.

World Economic Forum (WEF). (2021). *A new circular vision for electronics: Time for a global reboot.* https://www3.weforum.org/docs/WEF_A_New_Circular_Vision_for_Electronics.pdf

World Health Organisation (WHO). (2021, June 15). *Children and digital dumpsites: E-waste exposure and child health*. https://www.who.int/publications/i/item/9789240023901

Ylä-Mella, J., Keiski, R. L., & Pongrácz, E. (2022). End-of-use vs. end-of-life: When do consumer electronics become waste? *Resources*, *11*(18), 1–14. https://doi.org/10.3390/resources11020018

Appendix 1: FGD questionnaire

Introduction

Thank you very much for attending. Let us start by getting to know each other, with just a brief introduction, like your name, surname and your village.

Questions

Do you know what e-waste is?

Can you define e-waste in your own words?

Are there any dedicated places for the village people to throw e-waste?

If yes, where are they?

If no, where do you throw it?

Anything else to add?

List the different categories of e-waste you have at home.

How can e-waste affect your health?

How can it affect children's health?

How can it affect the environment (river flows, vegetation, grazing land)?

What do you think should be done to help with e-waste handling?

If the municipality provided means for you to safely dispose of e-waste, would you make use of such a service?

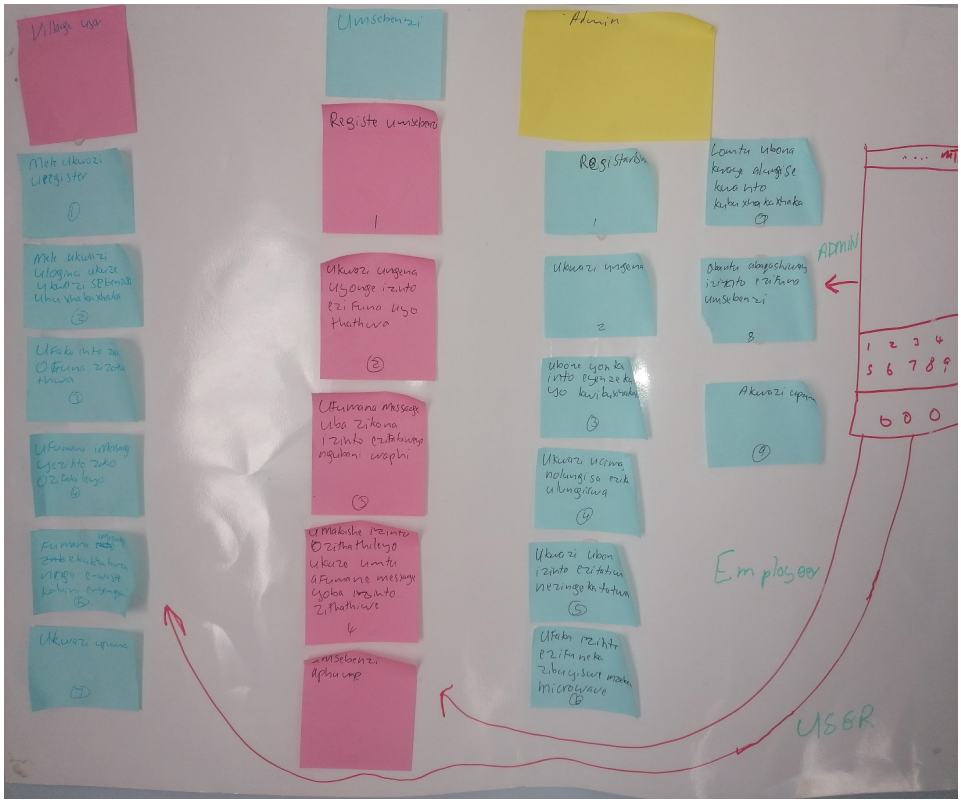
Are you aware of any legislation that deals with e-waste disposal?

Do you own a smartphone or computer/laptop?

Do you know what is meant by the term internet?
Do you connect to the internet using your smartphone/computer/laptop?

Closing
This is the end. Let me thank you again for your input.

Appendix 2: Co-design post-it notes, in isiXhosa, on the whiteboard



Information systems (IS) and smallholder farming in developing countries: A systematic literature review

Peter Mkhize
Professor, School of Computing, University of South Africa (UNISA) Science Campus, Johannesburg
https://orcid.org/0000-0003-0554-4245

Abstract
In the context of the fourth industrial revolution, the potential of information systems (IS) to revolutionise smallholder farming practices and enhance sustainability is a topic of growing interest, particularly in developing countries. This systematic literature review examines the intersection of agriculture and IS to explore how technology adoption can help to transform small-scale, subsistence farming enterprises into profit-generating, sustainable small businesses, while at the same time addressing the unique challenges present in developing-world contexts. The review critically examines the potential barriers and challenges faced by smallholder farmers in adopting and effectively using IS solutions in their operations. Among other things, the review investigates the assumption of basic literacy in many IS theories, and the extent to which this assumption aligns with the reality of developing-world smallholder farming communities, where literacy levels and digital proficiency may be limited.

Keywords
information systems (IS), smallholder farming, developing world, technology adoption, sustainable agriculture, literacy, food security

DOI: https://doi.org/10.23962/ajic.i33.17050

Recommended citation
Mkhize, P. (2024). Information systems (IS) and smallholder farming in developing countries: A systematic literature review. *The African Journal of Information and Communication (AJIC), 33,* 1-21. https://doi.org/10.23962/ajic.i33.17050

1. Introduction

The fourth industrial revolution has sparked significant interest and eager anticipation in the academic and agricultural communities, particularly in developing countries across Africa, the Asia-Pacific, and Latin America (Schwab, 2017). This curiosity is rooted in the urgent need to discover innovative solutions to address the impending challenges faced by the agricultural sector, with global food security being one of the most critical issues. As the world faces these challenges, there is a growing recognition of the potential of information systems (IS) to transform smallholder, subsistence farming practices into profitable and sustainable enterprises, especially in the context of developing nations (Okediran & Ganiyu, 2019).

However, a fundamental quandary exists in IS theories and IS-infused business models focused on smallholder farming communities in developing countries. Many of these IS theories and models assume that individuals possess a foundational level of literacy and digital proficiency. Yet, the landscape of smallholder farming in the developing world presents a distinctive dynamic. Farmers and farmworkers in these settings may lack the basic literacy and digital literacy skills required to effectively engage with IS (Debrah & Asare, 2012). This incongruence calls for a critical examination of the integration of IS into smallholder farming businesses in developing-world contexts, with the aim of identifying barriers that could hinder successful IS adoption.

This study seeks to provide the necessary critical examination through a systematic literature review focused on the intersection of agriculture and IS in the context of smallholder farming communities in developing countries. The review explores the application of technology in farming practices in these contexts and identifies the challenges faced by smallholder farmers as they navigate the adoption and use of IS solutions. Additionally, it aims to explore how these technologies can contribute to transforming small-scale, subsistence farming into profit-generating and sustainable small businesses while addressing the unique challenges present in developing-world contexts.

To conduct this systematic literature review, a comprehensive search strategy was employed across a range of academic databases, including Scopus, Science Direct, Web of Science, and IEEE Xplore. These databases were selected for their extensive coverage of both IS and agricultural research. The literature search focused on peer-reviewed journals and conference proceedings that were widely recognised as credible in the fields of IS and agriculture. Key journals included the *Journal of Agricultural & Food Information*, *Computers and Electronics in Agriculture*, and *Information Systems Research*. The search was conducted using a combination of keywords including "information systems", "smallholder farming", "technology adoption", "sustainable agriculture", and "food security", to ensure a thorough exploration of the intersection between these fields. While the reviewed literature was primarily drawn from the

fields of agriculture and IS, the review also included relevant literature from adjacent disciplines to provide a broader perspective.

The review seeks to identify an inclusive and sustainable path for smallholder farmers in developing countries. If these farmers can harness the power of appropriate IS solutions sustainably, they can potentially not only enhance their productivity and profitability but also make substantial contributions to addressing the global challenge of food security.

The findings of this study can potentially be valuable to a diverse range of stakeholders, including researchers, agricultural practitioners, policymakers, and technology developers, as they seek to identify ways in which IS can be leveraged to support smallholder farmers in overcoming the unique challenges that they face.

2. Background and research problem

In developing countries, the narrative of industrial revolutions unfolds within a historical pattern of transitioning away from agriculture as the dominant economic force. However, throughout these revolutions, agriculture has continued to retain enduring significance, extending into subsequent industrial eras. Within this trajectory, a pressing concern is ensuring global food security, a mandate prominently featured in the UN Sustainable Development Goals (SDGs), and recognised as essential to averting future food insecurity crises (Okediran & Ganiyu, 2019; Schroeder et al., 2021) environmentally sustainable, and equitable, one that can help deliver the Sustainable Development Goals. Implicitly interconnected with food security, agriculture holds a central position, encompassing both livestock and crop production (Sekaran et al., 2021)

The rapid rise of IS has created new industry giants. Technology has been a cornerstone of growth across diverse industries, seamlessly integrating into their operational frameworks (Chandra & Malaya, 2012; Rahaman et al., 2021). Conversely, smallholder, subsistence agriculture in the developing world, addressing the fundamental sustenance needs of households and communities, provides a livelihood for those lacking the modern technical skills required in other sectors. Given this context, there is a quest to determine the potential of IS to drive the evolution and progress of smallholder agriculture, akin to the influence of IS across numerous other domains.

Envisaging a synergy between agriculture and technological advancements, including automation and increased access to vital farm intelligence, aligns with the impressive advancements witnessed in IS and computer science. These advancements have led to innovations, applications, and tools spanning different sectors. Even in the traditionally self-sustaining realm of smallholder farming, a shift towards commercialisation has occurred in many settings. In developing nations, government entities have implemented support frameworks that seek to transform smallholder

farms into income- and employment-generating businesses (Chandra & Malaya, 2012). The infusion of technology into smallholder farming is regarded as a logical progression.

The fourth industrial revolution has sparked discussions about the potentially symbiotic role between IS and smallholder farming (Rahaman et al., 2021). These discussions align with the overarching objective of revitalising agricultural growth and addressing the imminent global food security challenge. However, it is essential to acknowledge the unique context of smallholder farmers, often self-employed land inheritors who may lack literacy skills (Range, 2017). This reality challenges prevailing IS theories and IS-driven business models that assume a certain level of collective literacy and digital literacy within the social fabric of a business.

Common IS theories, which assume a foundational literacy and digital literacy baseline among employees, encounter a discrepancy in developing nations. In such settings, farmers and farm labourers often lack basic literacy and digital literacy skills. In this study, the systematic literature review was grounded in the following research questions:

- Which specific barriers and challenges do smallholder farmers encounter when attempting to adopt and effectively use IS solutions in their farming operations, particularly in developing countries?
- To what extent does the foundational assumption of basic literacy in IS solutions align with the literacy levels and digital proficiency of smallholder farming communities in developing countries, and how does this impact the adoption of IS solutions?
- To what extent can the adoption of technology contribute to narrowing the literacy and digital literacy gap in smallholder farming communities in developing countries, and what tailored IS application strategies can be developed to address the unique characteristics and requirements of these farmers?
- What insights can be extracted regarding the successful integration of IS into smallholder farming enterprises in the developing world, and how can these insights guide the development of strategies to maximise the advantages of IS adoption by such enterprises?

3. Methodology for systematic literature review

Systematic literature review, the method deployed in this research, is a distinct and rigorous methodology (Okoli, 2015), which encompasses the following steps:

- formulate research questions;
- prepare a comprehensive research protocol;
- conduct an exhaustive literature search;
- develop a coding framework;

- code the articles, ensuring reliability; and
- analyse and discuss the results.

Research questions

After defining the research problem, I thoroughly analysed it in order to identify key aspects, which aided in formulating the above-listed four research questions. These questions were instrumental in guiding me towards comprehensive conclusions regarding the issues at hand (Rowley & Slack, 2004). The research questions were designed to explore theories that elucidated the role and application of IS in smallholder agriculture, with a specific focus on ensuring food security in developing-world settings.

Research protocol

The research questions played a vital role in shaping the research protocol. Using the questions, I crafted a protocol to guide the review, ensuring that the review was conducted within defined parameters and addressed core concerns (Kitchenham & Brereton, 2013). The protocol development began with gaining familiarity with the literature through extensive reading and initial coding to identify potential themes. Subsequently, I identified specific themes and keywords, which were then used in the comprehensive literature search.

Literature search

The relevant literature was identified based on the parameters specified in the research protocol. The literature search adhered to the defined keywords, timeline, and the type of literature to be reviewed. The keywords included information systems (IS), smallholder farming, technology adoption, sustainable agriculture, literacy gaps, and food security. These keywords were applied across various databases. The article search was confined to articles published between 2005 and 2021.

Initially, the use of the logical operator "AND" to combine all keywords yielded zero results across all databases. To broaden the search, I introduced the logical operator "OR" between IS-related keywords and agriculture-related keywords. However, I retained the "AND" logical operator between agriculture and IS keywords in order to find articles at the intersection of both disciplines. This approach led to the identification of 124 articles after experimenting with different keyword combinations.

The selected articles encompassed topics from the agriculture and IS disciplines. However, it is essential to note that their inclusion did not guarantee relevance or the ability to address the research questions. To ensure the selection of pertinent articles, I established specific inclusion and exclusion criteria based on relevance. Significantly, the contextual setting emerged as a significant exclusion criterion, resulting in the specific exclusion of articles focused solely on developed-country contexts, yielding a total of 57 articles.

Coding framework

For an in-depth analysis, I imported the selected articles into the ATLAS.ti qualitative data analysis software. Each article's abstract, introduction, and conclusion were scrutinised to gauge its relevance and potential contribution to addressing the research questions. During the initial review, a codebook containing essential phrases was formulated and served as the coding framework in ATLAS.ti.

Coding

Using the ATLAS.ti software, codes were assigned to information and quotations extracted from each article. Following this process, related codes were aggregated to form five themes. ATLAS.ti facilitated the organisation of quotations associated with code groups under each theme. These collections of quotations were then employed to construct a coherent narrative, guided by the research questions. The narrative aligned with the code network for each theme, as presented in the next section via a set of thematic relationship networks. Each thematic relationship network visually represents relationships between codes within a theme. The findings presented in the next section are narratives that reflect my interpretation of the compiled codes and quotations.

4. Findings: Intersections between IS and smallholder farming in the developing world

As stated above, five key themes emerged from the coding of the literature:

- improving knowledge-sharing;
- strengthening the supply chain;
- increasing food security;
- leveraging existing agricultural technology; and
- enhancing technology use.

The themes, and the relationship networks generated by the coding of the themes, are set out in the five sub-sections that follow.

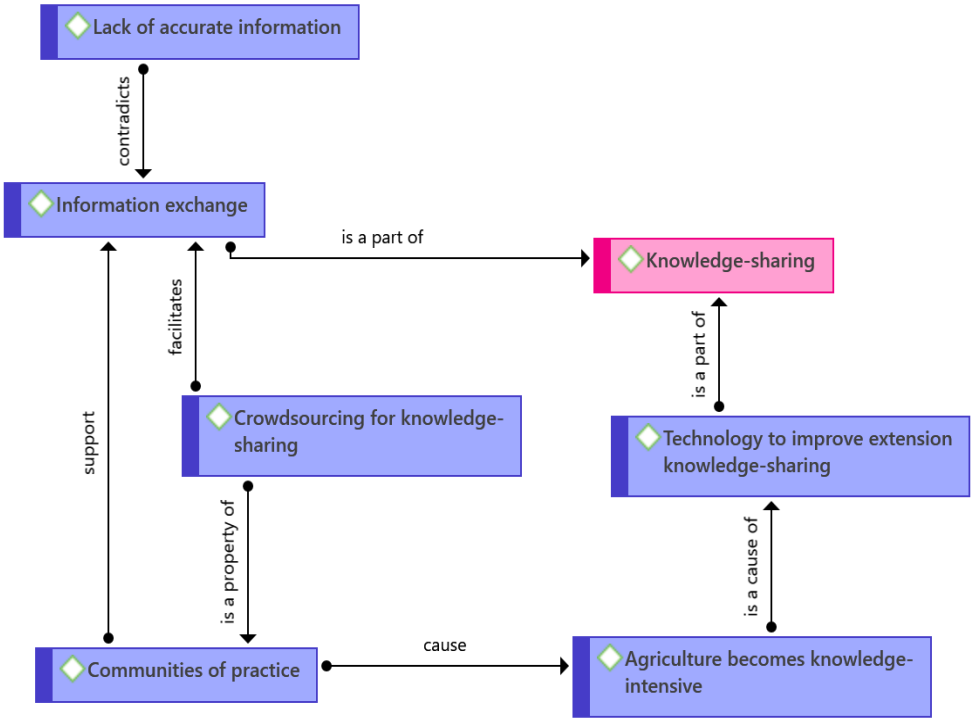
Improving knowledge-sharing

The discourse about industrial revolutions often begins by acknowledging the significance of the agricultural revolution, recognised as the first recorded revolution. Subsequently, three successive industrial revolutions gradually streamlined production processes and business methodologies, culminating in the fourth industrial revolution. Even amidst these transformations, agriculture's importance remains undiminished, captivating scholars across both developed and developing nations, particularly in the context of the fourth industrial revolution (Nehra et al., 2018; Schroeder et al., 2021). This enduring significance of agriculture is underscored by the inclusion of food security as a pivotal objective in the UN SDGs document (UN, 2015), emphasising the vital role of the agricultural and food sector (Lee et al., 2021). Consequently, the agricultural domain must thrive in order to address global food insecurity in the fourth industrial revolution era (Schroeder et al., 2021). However, industrial

revolution trajectories are marked by the fusion of technological advancement and human behaviour to achieve the revolution's objectives. The rapid technological progress of the fourth industrial revolution necessitates concurrent skills acquisition to keep pace with emerging technologies. There is no reason for the agricultural sector to lag behind; rather, its technological progress should be paralleled by the swift accumulation of knowledge in the farming community (Okediran & Ganiyu, 2019).

Historically, farming relied on manual labour by workers with limited education (Camargo et al., 2012). This labour-intensive approach undermined the appeal of agriculture as a livelihood, leading to underused or repurposed land (Birt et al., 2012). However, a shift towards knowledge-based farming is revitalising the sector, and foregrounding its importance in addressing the global challenges of food security and environmental sustainability (Ortmann, 2000). This transition underscores agriculture's evolving role in the modern industrial landscape, as shown in the thematic relationship network illustrated in Figure 1.

Figure 1: Thematic relationship network: Improving knowledge-sharing



The knowledge era, characterised by rapid knowledge acquisition to meet the demand for skills fuelled by technological development, requires swift decision-making by farmers to enhance seasonal yields (Schroeder et al., 2021). Farming communities

traditionally rely on each other for relevant information on soil management, fertilisation, cost reduction strategies, and other tips to boost farm productivity (Schroeder et al., 2021). This practice has endured among smallholder farmers, who have shared knowledge through traditional methods.

Evidence highlights the global impact of digital transformation across various economic sectors, influencing business operations and the urgency of decision-making (Okediran & Ganiyu, 2019). Emerging technologies, integral to this transformation, find extensive use for information dissemination on platforms such as social network sites. The widespread penetration of mobile technology in developing countries indicates that smallholder farmers are likely to participate in this digital transformation, especially if knowledge acquisition experiences are designed for mobile technology.

Even during the agricultural revolution, farmers engaged in some form of crowdsourcing and crowdfunding when coming together for the common goal of agricultural prosperity (Schroeder et al., 2021). In the era of digital transformation, information technology has facilitated even easier crowdsourcing for specific communities of practice. Social network sites could enable the aggregation of produce and production by smallholder farmers, potentially fostering business growth if user experiences are thoughtfully designed.

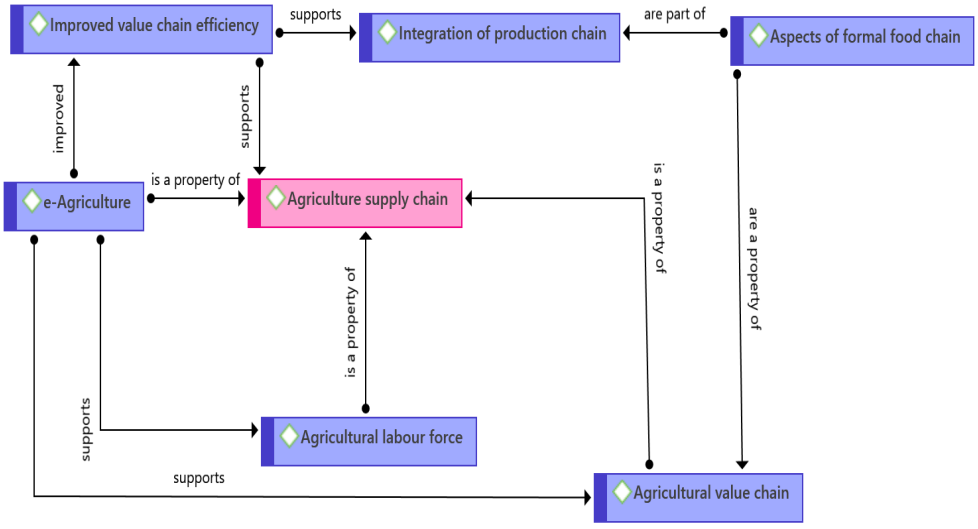
As Okediran and Ganiyu (2019) assert, the agricultural sector is increasingly becoming knowledge intensive. Access to accurate information in the right format, at the right time, and through the appropriate platform and device is critical for rapid decision-making. Informed decisions are vital due to the unpredictable nature of factors such as sudden weather changes that could decimate crops, like hail for butternut or frost for other crops (Walisadeera et al., 2015). Communities of interest are valuable for alerting farmers about impending disasters and exchanging information about available preventative measures.

Social platforms' inherent nature—requiring no specialised training and aligning with social inclinations—renders them universally accessible (Helmi et al., 2019; Pi et al., 2013). Engaging with these networks becomes second nature, transcending social strata and literacy levels. This accessibility fosters a supportive environment where community members readily seek technical insights about shared interests, like market reports. Despite their primary focus on social interaction, these platforms have proven useful for business purposes. This unexpected yet valuable application indirectly addresses literacy challenges in the farming community, empowering individuals to glean sector-specific insights, make informed decisions, and seize opportunities (Liao & Chou, 2012). Initiating this transformation could begin with extension officers forming groups to disseminate information about market trends, prevalent crops, and locally successful agricultural practices.

Strengthening the supply chain

It is crucial to acknowledge that farming enterprises do not exist in isolation; they are integral components of broader ecosystems that involve various businesses contributing value to the farm's processes and outputs. The importance of an efficient supply chain cannot be overstated, and warrants attention from farmers and their supporting organisations. As noted by Schroeder et al. (2021), the remarkable agricultural growth experienced in recent decades in developing countries is not solely attributable to the expansion of land, water, and agricultural inputs, but is equally attributed to the optimised use of agricultural resources through advanced technology and innovative production techniques. As illustrated in the thematic relationship network provided in Figure 2, the rapid integration of enhanced technological solutions into agriculture has the potential to function as a catalyst for improved agricultural production practices and efficient supply-chain management in smallholder farming communities (Okediran & Ganiyu, 2019).

Figure 2: Thematic relationship network: Strengthening the supply chain



Debrah and Asare (2012) emphasise the potential of technology to enhance the agricultural value chain by reducing transaction costs, expanding market access, increasing productivity, and facilitating effective communication with stakeholders in the farming business. Technology plays a pivotal role in providing access to crucial market information and facilitating the flow of information throughout the agricultural supply chain. This seamless information flow benefits both farmworkers and management, ensuring that each participant in the supply chain understands their role and expectations. Typically, when the objectives of all chain members are aligned, this leads to improved efficiency, ultimately enhancing the distribution of farm products (Okediran & Ganiyu, 2019). An efficient supply chain in smallholder

farming businesses is argued to enhance overall success, encompassing aspects of office automation and field operations.

Even though smallholder farmers often receive training and financial support from governmental and agricultural organisations, they require real-time information that covers all aspects of supply-chain activities. This information is essential for making informed business decisions related to market dynamics and production processes (Chandra & Malaya, 2012; Rahaman et al., 2021). Such information assists in decisions about the management of crop diseases, the identification of high-value crops, the prediction of weather patterns, and the logistics and transportation arrangements for aggregation purposes (Rahaman et al., 2021). Equipped with pertinent and timely information, a farmer can make informed choices about participation in produce aggregation or pursuing independent operations for the season. The effective integration of farming resources and produce is advantageous for both individual farmers and aggregators, although individual farmers may choose to opt out of aggregation based on yield projections and market prices. Access to accurate and timely information, made achievable through relevant IS systems, is indispensable for making such decisions (Chandra & Malaya, 2012), especially in the context of smallholder farming in developing countries.

Okediran and Ganiyu (2019) assert that the integration of IS into agriculture has the potential to elevate the socioeconomic status of farmers, particularly in developing countries. This transformation is achieved by exchanging valuable information, a shift that brings tangible benefits to economically disadvantaged farming communities. This process of information exchange significantly enhances knowledge acquisition in the labour force in smallholder farming communities, fostering improved decision-making and workflow efficiency. The end result is increased productivity, as noted by Phiri et al. (2020).

Highly productive smallholder farms not only serve to improve their own economic well-being but also extend their advantages to communities that may otherwise struggle to generate income. This ripple effect reaches beyond the farm, benefiting other businesses as well (Chandra & Malaya, 2012). Retailers, for example, gain a steady source of agricultural products for sale, while transport businesses play a crucial role in transporting the farmers' produce to wider markets (Phiri et al. 2020). The integration of IS thus becomes a key driver in improving the socioeconomic status of farmers and their surrounding communities, effectively contributing to economic growth and stability, particularly in developing regions.

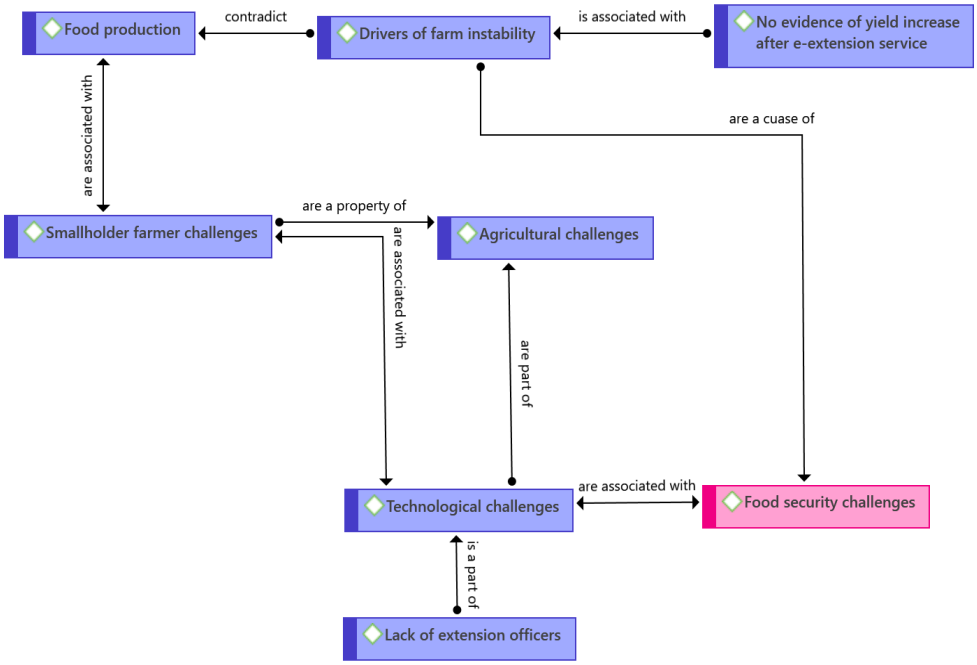
Increasing food security

Food insecurity is a global concern that arises when nations struggle to afford or produce an adequate amount of food to sustain their populations, thus posing a critical threat to the achievement of the UN SDGs (Sekaran et al., 2021). While food insecurity is especially prevalent in developing countries, it remains a threat that

transcends national borders. Even developed nations, constrained by limited arable land, grapple with their own food production challenges (Matlou, 2018).

The primary responsibility for food production falls on the agricultural sector, which faces an array of challenges. Factors like the urbanisation of agricultural land, insufficient farming knowledge, inadequate investment in information technology and innovation, and inconsistent governmental sectoral support contribute to the sector's difficulties (Sekaran et al., 2021). The reallocation of arable land for urban development, driven by the profitability challenges faced by smallholder farms, exacerbates this problem (Lee et al., 2021). In this context, selling arable land can appear to be a more viable option than contending with a multitude of threats, including natural and climatic factors, as well as technological advancements (Hatab et al., 2019). Urgent action is required to address the food security threat if the goal of achieving food security by 2030, under the UN SDGs, is to be met, acknowledging that agricultural investment initiatives typically entail a considerable lag time to realise returns (Stats SA, 2019). Figure 3 illustrates the thematic relationship network, as generated by the systematic literature review, for the imperative of increasing food security.

Figure 3: Thematic relationship network: Increasing food security



In the face of these formidable challenges, smallholder farming businesses in developing countries confront significant difficulties in making a profit and sustaining their operations. These businesses serve as both sources of employment and primary

income for local communities, which are simultaneously their customers (Topal, 2007). As the value and supply chains falter, a vicious cycle ensues, perpetuating poverty and malnutrition in communities. In contrast, larger farming enterprises are reaping the benefits of agricultural technology, such as precision agriculture and e-Agriculture, due to their capacity to invest in advanced technologies. However, it is worth noting that some farmers in developing countries possess mobile phones and use them to a limited extent for certain farming functions, although the potential impact of this technological solution remains restricted for smallholder farmers (Lee et al., 2021).

In regions where extension services are available, smallholder farmers often rely on extension officers for product advice, including guidance on technology adoption in farming (Mohamad & Gombe, 2017). Nevertheless, the inability of extension officers to provide appropriate counsel on technology infusion might deprive farmers of the benefits that effective technological application could offer.

In smallholder farming communities, the most used and preferred technological tool is the mobile phone, albeit with limited business application capabilities unless equipped with suitable applications (Okediran & Ganiyu, 2019). Despite the extensive market penetration of mobile phones in developing countries, it is important to differentiate between mobile phone availability and the prevalence of effective technology use. While many mobile devices owned by farmers in these regions are technically capable of running useful software, the challenge lies in developing cost-effective software that genuinely contributes to the agricultural endeavours of smallholder farmers (FAO, 2014).

Although information technology alone may not provide a comprehensive solution to food security challenges, it has the potential to empower smallholder farmers with enhanced business capabilities. This, in turn, could lead to more efficient farm operations, allowing these farmers to compete on an equal footing with larger producers in specific sectors. By strengthening the resilience of smallholder farmers, the burden of addressing food insecurity would be lightened for larger agricultural players. Ultimately, this could assist governments in their mission to ensure adequate sustenance for their populations, particularly in the context of developing countries.

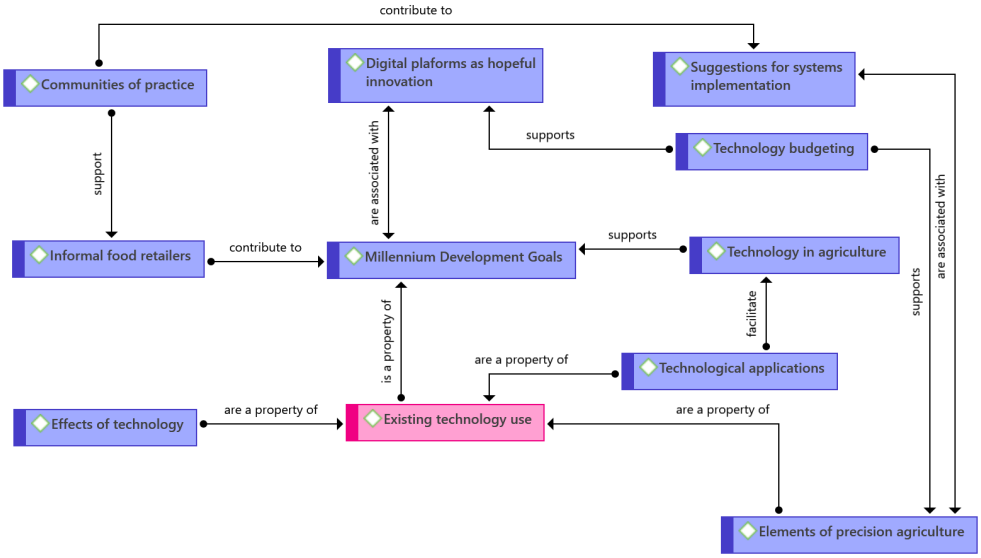
Leveraging existing agricultural technology

The role of technology in agriculture is witnessing an upward trajectory, accompanied by innovative production methods and emerging technologies that have become integral to the daily lives of individuals across various educational backgrounds and geographic regions. These transformative technologies are evident in their influence on various aspects of life, including electronic social media interactions (Rahaman et al., 2021), and in the fortunes amassed by numerous tech entrepreneurs, some of whom are among the world's wealthiest individuals. Given this global context, there is a logical expectation that the integration of IS should extend to industries central

to a nation's well-being, such as agriculture, particularly in developing countries (Sekaran et al., 2021).

The integration of technology into smallholder farming communities is as crucial as it is for any other business sector that has experienced enhanced efficiency and efficacy in achieving its goals. However, the ability of individual smallholder farmers to invest in advanced technologies, including precision agriculture, is often constrained unless government support is provided (Lee et al., 2021). Nevertheless, envisioning a future where all smallholder farmers in developing countries can access and benefit from farming information technology investments is feasible and promises to contribute to eradicating food insecurity. Figure 4 illustrates the thematic relationship network, as generated by the systematic literature review, for the imperative of leveraging agricultural technology.

Figure 4: Thematic relationship network: Leveraging existing agricultural technology



It is important to note that certain well-researched and developed farming technologies, such as precision agriculture, are already available (Camargo et al., 2012). These technologies have been proven to enhance production efficiency and effectiveness, particularly on large commercial farms (Schroeder et al., 2021). However, these larger farms, while significant, cannot single-handedly supply the quantities of crops or meat required to meet a nation's food demands, let alone address food shortages in other developing countries (Okediran & Ganiyu, 2019). The review reveals instances where certain developing countries, with government support, have invested in technology infusion primarily in enhancing information-sharing among farmers, although not necessarily in precision agricultural technology.

Despite the efforts of governmental bodies to introduce information technology into farming operations, many countries seem to prioritise other government matters over technology infusion, even in the face of persistent hunger crises (FAO, 2014). Eradicating hunger, a prominent objective in the UN SDGs, should be a top priority, not only for the governments of developing countries, but also for developed nations. It is imperative to recognise that food is a fundamental requirement for individuals and communities worldwide (Schroeder et al., 2021). As a result, it is perplexing why those responsible for fostering and nurturing the agricultural sector in their regions often place less emphasis on technology infusion when technology has clearly demonstrated its significance as a critical component of the business value chain (Rahaman et al., 2021).

Most large commercial farming businesses have successfully integrated information technology into their operations, reaping the benefits of improved economies of scale. In contrast, smallholder farmers often struggle to sustain their businesses, with some unable to break even (Sekaran et al., 2021). Technology infusion has the potential to enhance business efficiency and effectiveness, provided that the technology is customised to address the specific operational needs of each farm (Camargo et al., 2012; Chandra & Malaya, 2012).

The emergence of technologies in the context of the fourth industrial revolution offers numerous opportunities for farming communities to thrive and achieve prosperity in the agricultural sector (Camargo et al., 2012). E-Agriculture capabilities in both plant and animal farming have demonstrated their ability to revolutionise business operations for those who are able to invest in such technology. Particularly, advancements in animal production have significantly benefited from current technological applications, with a focus on monitoring vital health information for livestock and animal tracking solutions. This data feeds into management systems for scheduling and overseeing vaccination and other animal health activities (Okediran & Ganiyu, 2019).

In contrast, smallholder farmers often rely on extension services for business support and farming information, making decisions based on a combination of technology and knowledge-sharing. Smallholder farmers find hope in the community of practice that they form, where they informally exchange information pertinent to their shared objectives (Maumbe, 2012). Mobile phone-based applications serve as a common platform for farmers to exchange accurate and timely market-related information (Lee et al., 2021).

These mobile phone-based applications play a pivotal role in the spectrum of technology infusion for business growth. Their efficacy ranges from menu-driven interactions to graphic and video interfaces, depending on whether they operate on smartphones or conventional phones (Walisadeera et al., 2015). The substantial increase in mobile phone penetration in developing markets over the past decade,

coupled with the dual functionality of most app development for both mobile and computer platforms, eases access to technology for smallholder farmers (ARC, 2020; Walisadeera et al., 2015). This dynamic landscape enables software developers to create mobile apps tailored to smallholder farm business rules without requiring significant investment in sophisticated computing equipment.

Until smallholder farmers can afford state-of-the-art computing equipment, software developers can serve as allies by crafting mobile apps aligned with smallholder farm needs (Uduji et al., 2020). These apps can be tailored to mobile platforms, facilitating integration with precision agriculture equipment. This approach offers a solution for maximising the potential of advanced equipment that may otherwise remain underused on farms.

Furthermore, the infusion of IS into smallholder farm businesses can be achieved by leveraging affordable and accessible technology already prevalent in these communities, mainly mobile phones. Such devices can be harnessed for knowledge acquisition and collaboration between farmers and extension officers (Sekaran et al., 2021). By sharing information on specific crops and market dynamics, farmers can collaborate in production processes, thereby contributing to market price determination and efficient crop scheduling.

In essence, the information revolution has ushered in modern technologies that can enhance farm management, field production, and information dissemination in farm operations (Adeyeye & Idowu-Adebayo, 2019). However, the successful adoption of innovative technologies depends on their alignment with local contexts and the customisation of content to address the unique needs of the farmers who will use the technology (FAO, 2014). This approach ensures that technology plays a transformative role in the socioeconomic upliftment of smallholder farming communities in developing countries.

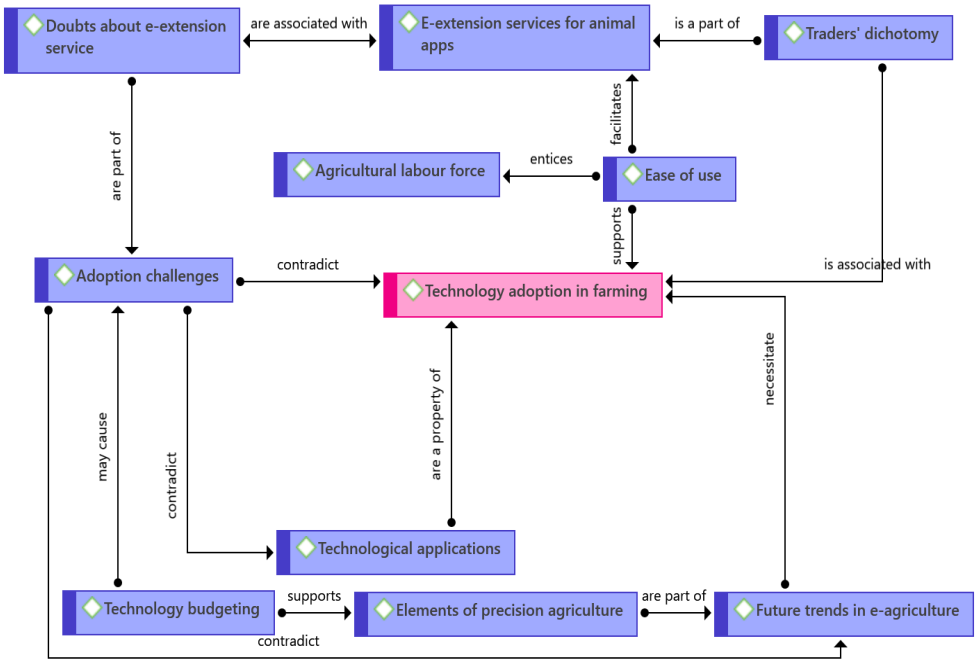
Enhancing technology use

While fostering technology adoption is crucial, the use of these technologies by smallholder farmers remains a significant challenge. Similar to other businesses, farming employs information technology to enhance decision-making, efficient transactions, and effective communication (Lee et al., 2021; Nutter et al., 2011; Schroeder et al., 2021). However, the adoption and use of IS will not yield the intended results unless embraced by those who stand to benefit from it. The reported use of IS by smallholder farmers is primarily for office automation and record-keeping, even though numerous IS technologies could enhance production and environmental management for these farmers (Nam et al., 2017).

Superficially, one might assume that smallholder farmers, due to their nature, lack the means or inclination to adopt advanced technologies. Nonetheless, it is crucial to examine the factors influencing technology adoption by smallholder farmers in

developing countries to enhance the return on technology investments. Ortmann (2000) contends that complex information systems are predominantly used by expert advisors in the agricultural sector, rather than directly benefiting each smallholder farmer's production. Moreover, smallholder farmers' decisions to invest in technology primarily depend on perceived ease of use, usefulness compared to the associated costs, and the capital required to implement such technology. Given that smallholder farming typically involves limited capital investment and restricted access to funding, these factors play a substantial role. Figure 5 shows the thematic relationship network, as generated by the systematic literature review, for enhancing technology use.

Figure 5: Thematic relationship network: Enhancing technology use



While a few commercial farmers report innovative technology use and state-of-the-art technologies, the growth in agricultural technology development has not yet reached smallholder farmers, especially in developing countries (Nehra et al., 2018). Agricultural technologies can extend beyond office automation to improve decision-making and the coordination of farming activities. A slightly increased investment could enable farmers to sponsor systems development that enhances various aspects of their farming business, from transportation and market information updates to farm management and field production management (Debrah & Asare, 2012).

Extension services play a pivotal role in smallholder farming's survival and growth by providing advisory services, training, and management guidance. Consequently, extension officers have the potential to promote technology infusion among farmers

due to their influence on decision-making processes (Schroeder et al., 2021). In countries such as Niger, Kenya, and India, e-extension services have improved skills acquisition and yield by 4%, underscoring the potential of information technology to uplift the lives of smallholder farmers and eradicate food insecurity in developing countries (Schroeder et al., 2021). The impact of extension officers on technology adoption can be linked to their familiarity with and inclination towards technology. According to Phiri et al. (2020), the farming sector is likely to absorb economically active youth in Sub-Saharan Africa, given the persisting issues of unemployment and youth population growth. Youth participation in smallholder farming presents another avenue for promoting technology integration in farming activities (Phiri et al., 2020). As Matlou (2018) asserts, youth involvement in farming is already prevalent in smallholder agriculture, often due to inherited family businesses. Generally, youth are inclined towards technology use, whether for leisure or other purposes.

Several factors must be considered when influencing technology adoption in the smallholder farming community, including ease of use, perceived usefulness, the farmer's age, and extension officers' inclination towards technology (Ortmann, 2000). This calls for a comprehensive and empirical investigation into how these factors impact the application of IS in smallholder farming businesses.

In conclusion, the significance of IS in driving agricultural development in developing nations is undeniable. The key to this success lies in providing smallholder farmers with timely, relevant information to empower them to effectively manage their agricultural endeavours, including information on optimal crops, market dynamics, weather trends, and optimal farming techniques.

5. Analysis

Enhancing food security

The review findings underscore the pivotal role of IS in smallholder farming practices, particularly in the context of developing countries. By addressing the barriers and challenges faced by smallholder farmers in adopting IS solutions, these nations can significantly enhance their food security. IS can provide farmers with essential information for improved crop management, market access, and decision-making, contributing to a more stable and sustainable food supply.

Bridging the literacy gap

In many developing countries, literacy levels, including digital proficiency, are limited. Understanding how the assumption about basic literacy aligns with smallholder farming communities is crucial. IS application strategies that are tailored to the unique characteristics and needs of these farmers can help to bridge the literacy gap. By simplifying technology interfaces and providing training, governments and organisations can facilitate technology adoption and knowledge-sharing by farmers.

Empowering rural economies

Smallholder farming is a primary source of livelihood in developing countries. The adoption of IS in agriculture can uplift the socioeconomic status of rural communities. It not only benefits farmers but also extends advantages to economically disadvantaged regions. As smallholder farmers enhance productivity and gain access to wider markets through technology, this has a ripple effect on local economies, creating opportunities for related businesses and entrepreneurs. By understanding the challenges, tailoring strategies, and actively engaging with relevant stakeholders, these nations can unlock the potential of IS to transform their agricultural sector and enhance the overall well-being of their people.

6. Conclusion

In conclusion, the significance of IS in driving agricultural development in developing nations is undeniable. The key to this success lies in providing smallholder farmers with timely, relevant information to empower them in effectively managing their agricultural endeavours, including crop decisions, market dynamics, weather trends, and optimal farming techniques.

Furthermore, the democratisation of technology among smallholder farmers holds great promise for advancing agriculture. By using mobile phones, farmers can access a wealth of resources, including agricultural applications, online market platforms, and real-time weather updates. These technological tools facilitate efficient farm management, connect farmers with potential buyers, and provide essential insights crucial for success. By integrating IS throughout the agricultural value chain, not only does productivity increase, but the efficiency of distribution also rises, significantly contributing to the reduction of food insecurity.

In summary, IS empowers smallholder farmers by providing them with vital information and resources to enhance agricultural practices, establish market connections, and make significant strides in alleviating food insecurity in developing countries. It is the responsibility of governments, non-governmental organisations, and relevant stakeholders to continue their investment in, and advocacy for, the adoption of IS, ensuring sustained agricultural progress and universal food security.

Funding

No funding was received for this study.

Data availability

The data supporting the results of this study is available upon written request from the author at mkhizpl@unisa.ac.za

AI declaration

AI was used to manage language issues in the writing of this article.

Competing interests

The author has no competing interests to declare.

References

Adeyeye, S. A. O., & Idowu-Adebayo, F. (2019). Genetically modified and biofortified crops and food security in developing countries: A review. *Nutrition and Food Science*, *49*(5), 978–986. https://doi.org/10.1108/NFS-12-2018-0335

Agricultural Research Council (ARC). (2020). *ICT4Agriculture: Exploring information and communication technologies for agricultural development*. https://www.dst.gov.za/images/2017/2017_pdfs/16-946-ICT4Agriculture-Extension-project.pdf

Birt, A. G., Calixto, A., Tchakerian, M., Dean, A., Coulson, R. N., & Harris, M. K. (2012). Harnessing information technology (IT) for use in production agriculture. *Journal of Integrated Pest Management*, *3*(1), D1–D8. https://doi.org/10.1603/ipm11008

Camargo, A., Molina, J. P., Cadena-Torres, J., Jimenez, N., & Kim, J. T. (2012). Intelligent systems for the assessment of crop disorders. *Computers and Electronics in Agriculture*, *85*, 1–7. https://doi.org/10.1016/j.compag.2012.02.017

Chandra, D. G., & Malaya, D. B. (2012). Role of e-agriculture in rural development in Indian context. In *2011 International Conference on Emerging Trends in Networks and Computer Communications (ETNCC)* (pp. 320–323). https://doi.org/10.1109/etncc.2011.6255913

Debrah, S. K., & Asare, I. K. (2012). Using ICT to overcome constraints in the agriculture value chain: Emerging trends in Ghana. In B. Maumbe & C. Z. Patrikakis (Eds.), *E-agriculture and rural development: Global innovations and future prospects* (pp. 31–41). https://doi.org/10.4018/978-1-4666-2655-3.ch003

Food and Agriculture Organisation of the United Nations (FAO). (2014). *10-year WSIS action line facilitator's reports on the implementation of WSIS outcomes: WSIS action line – C7: E-agriculture*.

Hatab, A. A., Cavinato, M. E. R., & Lagerkvist, C. J. (2019). Urbanization, livestock systems and food security in developing countries: A systematic review of the literature. *Food Security*, *11*(2), 279–299. https://doi.org/10.1007/s12571-019-00906-1

Helmi, A. F., Widhiarso, W., Putri, A. K., Marvianto, R. D., Priwati, A. R., & Shaleha, R. R. A. (2019). A model of online trust among adolescents. *International Journal of Cyber Behavior, Psychology and Learning*, *9*(2), 34–50. https://doi.org/10.4018/IJCBPL.2019040103

Kitchenham, B., & Brereton, P. (2013). A systematic review of systematic review process research in software engineering. *Information and Software Technology*, *55*(12), 2049–2075. https://doi.org/10.1016/j.infsof.2013.07.010

Lee, J., Oh, Y.-G., Yoo, S.-H., & Suh, K. (2021). Vulnerability assessment of rural aging community for abandoned farmaland in South Korea. *Land Use Policy*, *11*(1), 1–10. https://doi.org/10.1108/BFJ-05-2021-0552

Liao, S., & Chou, E. (2012). Intention to adopt knowledge through virtual communities: Posters vs lurkers. *Online Information Review*, *36*(3), 442–461. https://doi.org/10.1108/14684521211241440

Massaro, M., Dumay, J., & Garlatti, A. (2015). Public sector knowledge management: A structured literature review. *Journal of Knowledge Management*, *19*(3), 530–558. https://doi.org/10.1108/JKM-11-2014-0466

Matlou, M. (2018). Facing the facts: Challenges and constraints for small-scale farmers' agricultural productivity in South Africa. *Harvest SA*.

Maumbe, B. M. (2012). Global e-agriculture and rural development: E-value creation, implementation challenges, and future directions. In In B. Maumbe & C. Z. Patrikakis (Eds.),*E-agriculture and rural development: Global innovations and future prospects* (pp.1–15). https://doi.org/10.4018/978-1-4666-2655-3.ch001

Mohamad, M. R., & Gombe, I. (2017). e-Agriculture revisited: A systematic literature review of theories, concept, practices, methods, and future trends. In *British Academy of Management Annual Conference* (pp. 1–13). 5–7 September 2017, Warwick Business School. https://nrl.northumbria.ac.uk/43317

Nehra, K., Jangra, M. R., Jangra, S., & Kumar, R. (2018). Role of information technology in agriculture. In P. K. Yadav, S. Kumar, S. Kumar, & R. C. Yadav (Eds.), *Crop improvement for sustainability* (pp. 537-555). Daya Publishing.

Nam, W. H., Kim, T., Hong, E. M., Choi, J. Y., & Kim, J. T. (2017). A Wireless Sensor Network (WSN) application for irrigation facilities management based on Information and Communication Technologies (ICTs). *Computers and Electronics in Agriculture*, *143*(October), 185–192. https://doi.org/10.1016/j.compag.2017.10.007

Nutter, F. W., Byamukama, E. Z., Coelho-Netto, R. A., Eggenberger, S. K., Gleason, M. L., Gougherty, A., Robertson, A. E., & Van Rij, N. (2011). Integrating GPS, GIS, and remote sensing technologies with disease management principles to improve plant health. In S. A. Clay (Ed.), *GIS applications in agriculture, volume three: Invasive species* (pp. 59–90). Routledge. https://doi.org/10.1201/b10597-5

Okediran, O. O., & Ganiyu, R. A. (2019). E-agriculture reviewed: Theories, concepts and trends. *FUOYE Journal of Engineering and Technology*, *4*(1), 125–130. https://doi.org/10.46792/fuoyejet.v4i1.366

Okoli, C. (2015). A guide to conducting a standalone systematic literature review. *Communications of the Association for Information Systems*, *37*, 879–910. https://doi.org/10.17705/1CAIS.03743

Ortmann, G. F. (2000). Use of information technology in South African agriculture. *Agrekon*, *39*(1), 26–35. https://doi.org/10.1080/03031853.2000.9523564

Phiri, H., Phiri, J., & Kunda, D. (2020). A review of e-agriculture application in developing countries for the youth: Challenges, opportunities and open issues. In *Issues on Zambia's ICT sector, volume 1* (pp. 6–13). Zambia Information and Communications Technology Authority.

Pi, S. M., Chou, C. H., & Liao, H. L. (2013). A study of Facebook Groups members' knowledge sharing. *Computers in Human Behavior*, *29*(5), 1971–1979. https://doi.org/10.1016/j.chb.2013.04.019

Rahaman, A., Kumari, A., Zeng, X. A., Khalifa, I., Farooq, M. A., Singh, N., Ali, S., Alee, M., & Aadil, R. M. (2021). The increasing hunger concern and current need in the development of sustainable food security in the developing countries. *Trends in Food Science and Technology*, *113*(April), 423–429. https://doi.org/10.1016/j.tifs.2021.04.048

Range, J. (2017, November 6). Farming in the age of technology. *Farmer's Weekly*. https://www.farmersweekly.co.za/agri-technology/farming-for-tomorrow/farming-age-information-technology

Rowley, J., & Slack, F. (2004). Conducting the literature review. *Management Research News*, *27*(6), 31–39. https://doi.org/10.1108/01409170410784185

Schroeder, K., Lampietti, J., & Elabed, G. (2021). *What's cooking: Digital transformation of the agrifood system*. World Bank. https://doi.org/10.1596/978-1-4648-1657-4

Schwab, K. (2017). *The fourth industrial revolution*. Crown Publishing Group.

Sekaran, U., Lai, L., Ussiri, D. A. N., Kumar, S., & Clay, S. (2021). Role of integrated crop-livestock systems in improving agriculture production and addressing food security – A review. *Journal of Agriculture and Food Research*, *5*, 100190. https://doi.org/10.1016/j.jafr.2021.100190

Statistics South Africa (Stats SA). (2019). *Towards measuring the extent of food security in South Africa: An examination of hunger and food adequacy*. Report No. 03-00–14.

Topal, R. S. (2007). Food safety problem in the world and in Turkey. *Social Responsibility Journal*, *1*(1), 70–80. https://www.emerald.com/insight/content/doi/10.1108/SRJ-01-2017-0012/full/html

Torraco, R. J. (2005). Writing integrative literature reviews: Guidelines and examples. *Human Resource Development Review*, *4*(3), 356–367. https://doi.org/10.1177/1534484305278283

Uduji, J. I., Okolo-Obasi, E. N., & Asongu, S. A. (2020). Does growth enhancement support scheme (GESS) contribute to youth development in informal farm entrepreneurship? Evidence from rural communities in Nigeria. *Journal of Enterprising Communities*, *15*(3), 451–476. https://doi.org/10.1108/JEC-06-2020-0116

United Nations (UN). (2015). *Transforming our world: The 2030 agenda for sustainable development*. https://sdgs.un.org/2030agenda

Walisadeera, A. I., Ginige, A., & Wikramanayake, G. N. (2015). User centered ontology for Sri Lankan farmers. *Ecological Informatics*, *26*(2), 140–150. https://doi.org/10.1016/j.ecoinf.2014.07.008

The African Journal of Information and Communication (AJIC)

Published by the LINK Centre
University of the Witwatersrand (Wits)
Johannesburg, South Africa
https://www.wits.ac.za/linkcentre

ISSN 2077-7213 (online version)
ISSN 2077-7205 (print version)