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THE AFRICAN JOURNAL OF INFORMATION AND COMMUNICATION (AJIC)

ISSUE 22, 2018



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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)

AJIC 22 - 7-Dec-18 - 13h47 - final.indd 1 12/7/2018 1:52:02 PM

The African Journal of Information and Communication (AJIC)

Issue 22, 2018

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

Published since 2000, *The African Journal of Information and Communication (AJIC)* is a peer-reviewed, interdisciplinary, open access academic journal focused on information and communication ecosystems in Africa, elsewhere in the developing world, at at global level. Accredited by the South African Department of Higher Education and Training (DHET), *AJIC* pursues its open access objective by publishing online, free to the user, under a Creative Commons licence, and by not imposing article processing charges on its contributors.

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AJIC 22 - 7-Dec-18 - 13h47 - final.indd 2-1 12/7/2018 1:52:02 PM

Peer-Reviewing
AJIC acknowledges with gratitude the following peer reviewers of articles in this issue: Lucienne Abrahams, Chris Armstrong, Mark Burke, Vanessa Ferguson, Tshimanga Kongolo, Rasigan Maharajh, Caroline Ncube, Enyinna Nwauche, Hossana Twinomurinzi, and Wend Wendland.

Production
Sub-editing: LINK Centre
Desktop-publishing: LINK Centre

DOI: https://doi.org/10.23962/10539/26204

Recommended citation:
AJIC. (2018). *The African Journal of Information and Communication (AJIC)*, *22*.
https://doi.org/10.23962/10539/26204

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

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 headquartered at the Wits Tshimologong Digital Innovation Precinct, 41 Juta St., Braamfontein, Johannesburg, www.tshimologong.joburg

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Nigerian Copyright Reform and Implications for Access to Teaching and Learning Materials (TLMs) in the Digital Age

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Abstract
This article examines the extent to which the provisions of Nigeria's draft Copyright Bill promote access to teaching and learning materials (TLMs), with such access framed as an important public interest goal. The article highlights the weaknesses in the extant Nigerian copyright statute with regard to TLM access, and examines the extent to which the provisions of the draft Bill would provide improvement. The article concludes that while the draft Bill provides significant improvements in respect of TLM access, it also contains significant weaknesses and gaps which Nigerian lawmakers should seek to address.

Keywords
copyright, access, teaching and learning materials (TLMs), public interest, access to knowledge (A2K), Nigeria, Copyright Act, draft Copyright Bill

DOI: https://doi.org/10.23962/10539/26172

Recommended citation
Chuma-Okoro, H. (2018). Nigerian copyright reform and implications for access to teaching and learning materials (TLMs) in the digital age. *The African Journal of Information and Communication (AJIC)*, *22*, 1–28. https://doi.org/10.23962/10539/26172

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1. Introduction

The concern for access to teaching and learning materials (TLMs) is closely related to copyright law and how it impacts human wellbeing. It is also a critical part of the larger concern for access to knowledge (A2K), which is strongly affected by intellectual property rights, including copyright (see, for example, Armstrong et al., 2010; Krikorian & Kapczynski, 2010).[1] This has to do with the natural tendency of copyright to restrict access to protected subject matter in the absence of appropriate legal safeguards (Kapczynski, 2010, pp. 23-24)—i.e., in the absence of appropriate copyright limitations and exceptions. It has been argued that for most developing countries, "A2K has much to offer towards economic development in the form of improving access to learning materials, which constitute the basic resources of education" (Jonker, 2009, p. 1).

Education is not only integral to sustainable development (Brende, 2015; UN, 2011), but has long been recognised as a fundamental human right that should not be taken for granted (UN General Assembly, 1948; UN Convention on the Rights of the Child, 1989; UNESCO, 2005).More recently, the post-2015 Development Agenda has emphasised the need for governments to ensure "inclusive and equitable quality education" and to "promote lifelong learning opportunities for all" as an important strategy in attaining the Sustainable Development Goals (SDGs) (NPC, 2009; UNESCO, 2000; UNESCO, 2017, p. 6; UNESCO & UNICEF, 2013). TLMs are important resources for achieving quality education, including not only physical access to education but also, and more importantly, the content of what people learn (UNESCO & UNICEF, 2013, p. 22). Naturally, the content is directly affected by the quality of TLMs in use; poor-quality resources would result in poor knowledge and high quality materials would enhance knowledge.

Education is an important part of the Nigerian government's responsibility for its citizens both as a right and as an important policy matter. The Nigerian government has a legal responsibility to provide free, quality and compulsory basic education to every Nigerian child up to junior secondary level (Adesomoju, 2017).[2] This is in addition to a strong policy objective, as provided in section 18(1) of Nigeria's Constitution, to provide "equal and adequate educational opportunities at all levels". As a developing country, access to TLMs in Nigeria is strategic to the achievement of these objectives and the many education milestones in line with international standards and the ensuing obligations on countries to implement them. The timeframe for the achievement of the education agenda of the UN Millennium Development Goals (MDGs), which called on every country to ensure full primary

1 Out of this concern has emerged the A2K movement.

2 See section 2(1) of the Compulsory, Free Universal Basic Education (UBE) Act, 2004, and section 15 of the Child's Rights Act, 2003. See also Adesomoju (2017), and *The Registered Trustees of the Socio-Economic Rights & Accountability Project (SERAP) v The Federal Government of Nigeria & Another*, Suit No: ECW/CCJ/APP/12/07.

education for every child by the year 2015 may have expired, but the education project in the post-2015 development Agenda no doubt extends and reshapes the MDGs for sustainable development. The Nigerian education structure comprises both formal and informal education programmes for both youths and adults up to tertiary levels, in addition to the basic primary levels (Federal Republic of Nigeria, 2013). This has been fashioned with a clear objective of aligning education delivery with global trends and in response to the responsibility of government to ensure quality education at all levels for its citizens (Federal Ministry of Education, 2015). However, a rapidly growing population increases demand for education beyond capacity at all levels, leaving out large numbers of unserved prospective learners (IOM, 2014, pp. 18-22; Moja, 2000). Poverty creates further barriers for many who cannot afford the costs of quality education, including the cost of TLMs required by both teachers and learners for their respective needs (Onwurah & Chiaha, 2007).

Like in other African countries, many Nigerians face serious handicaps in accessing TLMs to meet their education needs (Federal Ministry of Education, 2015; Moja, 2000). While some research has been conducted on factors hindering access to quality education in Nigeria, not much has been said about the role of copyright in creating barriers to access to TLMs in Nigeria. Instead, inaccessibility of TLMs in Nigeria has been attributed mainly to unavailability in their required formats or content, coupled with the absence of a vibrant local industry for the production of the required materials and high cost of importing them (Federal Ministry of Education, 2015, p. 42; Moja, 2000). Lack of expert assistance and technical support, and inability to keep abreast with current innovative developments, are some of the factors that have been identified as hindrances to the ability of teachers to improvise instructional materials, with matters of copyright not highlighted (Olibie et al., 2013).

The Nigerian copyright system is largely ineffective in controlling infringement of protected works (Oguamanam, 2011; Solanke, 2014). Thus, it could be argued that the real impact of copyright on access, which could arise from challenges in obtaining copyright clearances for the use of work, has hardly been felt. Yet, as digital technology becomes increasingly pervasive, it is inevitable that concerns over copyright-induced barriers to access, which currently dominate the discourse on A2K at the global level, will become resonant in Nigeria. The increasing presence of digital content and digital platforms in all spheres of human endeavour in the country, including education, makes it almost inevitable that the copyright regime will eventually become a critical factor in ensuring access to TLMs. By its nature, digital technology transforms the manner of production, dissemination and storage of data. As such, the traditional safeguards and balance that have shaped copyright systems since inception, with a strong concern for access to copyright materials, have been threatened in ways that also affect access to TLMs (National Research Council, 2000). Copyrighted materials in digital form can be easily duplicated, but at the same time, access to these materials is now being protected with digital locks and licences,

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some of which impose protection standards in excess of minimum standards set out in copyright laws.

There is no doubt that copyright-induced barriers to knowledge access are relevant to Nigeria, given its status as a developing country, on the disadvantaged side of the digital divide, with much reliance on foreign-owned knowledge assets (Hongladarom, 2007; IOM, 2014). A prominent access to knowledge challenge, which also affects Nigeria, is the cost of obtaining licences for the use of copyrighted foreign works, especially materials in digital formats (CIPR, 2002, p. 96). Alternatively, producing TLMs locally requires incentives for the local industry (Oye et al., 2011). Copyright is traditionally intended to provide such incentives, albeit with the undesirable consequence of imposing a burden on access. As the UK's 2002 CIPR report noted,

> [t]he crucial issue for developing countries is getting the right balance between protecting copyright and ensuring adequate access to knowledge and knowledge-based products. This concern remains and particularly so for developing countries by the extension of copyright to software and to digital material. (CIPR, 2002, p. 96; see Adewopo, 2012, p. 16)

Presently, Nigeria is on the threshold of amending its Copyright Act of 1988 (hereafter the "Act"), which was enacted before the current issues arising from digital technology began to strongly manifest themselves. In late 2015, the Nigerian Copyright Commission (NCC) published the draft Copyright Bill (hereafter the "draft Bill"), but it is yet to be enacted into law. The NCC submitted the draft Bill to the Federal Executive Council (FEC) in 2017, and the NCC reported in June 2018 that the FEC has approved the Bill as "the 2017 Draft Bill".[3] The next stage will be presentation in the National Assembly to begin the process of passage into law.

This article provides an overview of the current Copyright Act provisions on access to TLMs, and outlines its inherent weaknesses in fostering access to TLMs in the digital age. The article also examines the extent to which the provisions of the draft Bill would, if passed into law, improve access to TLMs, and some elements of the draft Bill requiring reconsideration. I seek to identify what must be retained, what should be reviewed, and what should be removed, in the draft Bill in order to foster TLM access. In the process, the article explores the meaning of access in the context of TLMs; the role of copyright; and the implications of digital technology on both copyright and access to TLMs.

3 Information based on the author's email and telephonic communications in 2017 with Michael Akpan, Deputy Director, Regulatory Department, Nigerian Copyright Commission (NCC);and on the NCC's 29 June 2018 (NCC, 2018) announcement on its website.

2. Copyright and access to TLMs

The term TLMs may have context-specific meanings, depending on the subject in question.[4] But basically, the term refers to materials used for training and educational purposes in various settings. According to UNESCO, "teaching materials" are "aids used by trainers to help them in teaching their lessons effectively", and "learning materials" are those "used by learners/trainees to help them learn effectively" (Chanda et al., n.d., p. 2). TLMs cover a spectrum of materials in expressive formats, including articles, books, charts, pictures, diagrams and videos (Chanda et al., n.d., p. 4). This implies that TLMs could fall under any of the categories of protectable subject matter of copyright law, which generally protects expressive contents in the category of literary, artistic, dramatic, musical and scientific works (Berne Convention, Art. 2). In the digital era, these materials could be presented in print or digital formats, and include software.

TLMs can either be produced locally or sourced from outside the country. Either way, access is crucial as TLM producers generally rely on materials from other sources to develop new ones or to adapt existing ones to local needs (Chanda et al., n.d., pp. 3-5). However in the context of TLMs, access entails more than availability. It also goes beyond ownership of the materials and extends "to ways in which learners make use of texts" and other materials for their educational requirements (Rens et al., 2006, p. 6). Access therefore means that TLMs must be available, affordable, reliable and relevant to local needs (UNESCO, 2000, pp.13, 28–29). They must be available in an inclusive range of languages, and in formats suitable for use by anyone, including the print disabled (Chanda et al., n.d.). A material, e.g., a book, in the possession of a teacher or learner that is written in a language not understood by the teacher or learner does not constitute access.

The relationship between access to TLMs and copyright law is connected to the fact that TLMs constitute a range of materials normally protected under copyright law as works of expression.[5] As the CIPR report observed, "software, textbooks, and academic journals are key items where copyright is a determining factor in pricing and access, and which are also essential ingredients in education" (CIPR, 2002, p. 17). Concerns over the impact of copyright on access to TLMs derive from the very nature of copyright as a bundle of legal entitlements granting work owners the power to exclusively control most uses of their work. Therefore, use of the copyright-protected work by the public is subject to the consent of the copyright owner, usually at a cost to the intended user, and any use without the required consent amounts to

4 They are often grouped together and referred to as educational resources or "learning materials".
5 According to the Berne Convention, "literary and artistic works" include books, pamphlets, lectures, dramatic works, musical compositions, drawing, painting, architecture, and others. The WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) extends the scope of copyright subject matter to computer programs and databases. See Articles 1 and 2 of the Berne Convention, and Article 10 of the TRIPS Agreement.

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an infringement of the copyright (Lewinski, 2008). Although based on the well-intended objectives of incentivising creation, and facilitating dissemination, of works (Hughes, 1988), copyright can potentially restrict access to the subject matter under protection where the required consent cannot be easily obtained. In the case of TLMs, such barriers may affect activities like copying, reproducing the work in formats that are suitable for the potential users, and sharing or using the work to create new materials. These are acts generally reserved exclusively for owners of copyright and which require owners' consent for a third party to carry out any of these acts. They are, at the same time, activities that often occur indiscriminately within an education or learning environment.

Copyright law has always, since its onset, included recognition of the objective of ensuring public-interest access to works. Perambulatory provisions in copyright's mother statute, the Statute of Anne of 1710, underscores the fact that one of copyright's primary aims is to encourage the diffusion of knowledge "for the purpose of learning". Standard provisions in current copyright statutes that require the deposit of copies of copyrighted works in public libraries were inaugurated at that time, and clearly intended to encourage access to books for public use, particularly where university libraries were concerned. Sections 4 and 5 of the Statute of Anne required copies of books to be deposited with libraries of important academic institutions for their use—in recognition of the strategic role of libraries in promoting access to TLMs. Libraries, and other cultural institutions such as museums and archives—as "gateways to knowledge and culture"—facilitate access to knowledge resources by the public (White, 2012). They collate, preserve and lend out knowledge resources to users for their needs; and also provide on-site access to their resources. In the learning environment, libraries serve as the main sources of information for both learners and teachers for their work (Adeoye et al., 2011, pp. 65-77; White, 2012).

At-times-contending objectives—to protect owners' works on one hand, and to ensure adequate public access to works on the other—have also been with copyright law from inception (Tang, 2009). Copyright laws seek to mediate these contending interests through the mechanism of exceptions and limitations, which allow certain uses without requiring the consent of the copyright owner based on public interests and social policy goals (Samuelson, 2015). As Okediji (2006, p. ix) argues, exceptions and limitations "promote social goals such as education and basic scientific research" by enabling access to and use of protected works, as well as encouraging further creative activities. Thus exceptions and limitations typically allow use of protected work for purposes like "critical commentaries", news reporting, teaching and private study, preservation of materials by libraries and archives, and uses that lack economic significance (Samuelson, 2015, pp. 1-2). The existence of exceptions and limitations underscores the underlying concern that while protecting the economic rights of works' copyright owners, copyright laws should not engender barriers to public-interest access (Alexander, 2010; Oguamanam, 2011).

3. Implications of digital technology

The digital age has witnessed the permeation of digital technology into virtually every area of human endeavour, including education. Digital technology has various implications arising from its transformative effects, and dilemmatic consequences on data processing and use. Digital technology transforms the way knowledge-based products are produced, reproduced, disseminated and appropriated. Capacity and efficiency in the storage, manipulation and transmission of data makes it possible for the easy recording, storage and instantaneous transmission of data. Perfect copies of an existing work can be made and instantly distributed worldwide at minimal cost. A digital work can also be easily manipulated to create a new work. In general, in the absence of deliberate measures to prevent such activities, digital content can be easily accessed, shared, manipulated, and adapted to individual needs (Olojo et al., 2012, pp. 204–205).

These attributes should, thus, make TLMs in digital formats easily accessible within the meaning of "access to TLMs" as explained earlier. Teachers and students can easily obtain and examine new materials, adapt existing materials to their needs, and share materials in their possession. But this is where one of the diverse and conflicting consequences of digital technology manifests (CIPR, 2002; National Research Council, 2000). Digital technology enables works' copyright owners to have great control over access to and use of the content, through technology-assisted technological protection measures (TPMs) and encryption. As will be seen later, such control can easily affect access to, and use of, TLMs by teachers and learners, even for materials that they have legitimately acquired.

The transformations instituted by digital technology have had strong impacts on education in other ways, particularly in the inauguration of e-learning. E-learning represents a shift from traditional to ICT-based learning, and it makes quality education available at times of the learner's choice and at places suited to his or her requirements. This means that learners at different places can access information individually without geographical limitations (European Commission, 2013; Olojo et al., 2012, pp. 203–204; Naidu, 2006; Thakrar et al., 2009). This can be seen in the massive open online courses (MOOCs) emerging from many world-class universities, which are accessible to participants across the world who ordinarily would not be able to access or afford the real-time courses (Czerniewicz et al., 2015). Similarly, social media interactive forums have become active and effective platforms for instruction and learning on various subjects.[6] Although these platforms rely significantly on open content,[7] such as open educational resources (OERs), materials

6 e.g., WhatsApp, Google Hangout, Skype.

7 These are content available under an open licence such as the Creative Commons suite of licences. Within the Creative Commons group of licences, there are different possible gradations of openness to choose from, dependent on the rights-holder's choice of conditions in respect of reuse, sharing, revising, and adaption. Generally, wide access is a vital component of open-licence solutions.

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protected by copyright are also in use, and remain susceptible to access barriers fostered by copyright (EC, 2013; Thakrar et al.,, 2009). Similarly, improvements in internet connectivity and diffusion of affordable portable e-devices "to disseminate and display teaching and learning materials" in digital formats have increased the potential for greater "access to and quality of education by providing access to more educational content" to teachers and learners (Trucano, 2013).

E-learning is gaining ground in the Nigerian education ecosystem, as an answer to the country's education needs, by offering free, low-cost and flexible education programmes (Chanda et al., n.d.; Ige Akindele, 2014, p. 67; Umo, 2013, p. 10), and innovative educational technologies are also becoming diffused as complements to traditional learning resources. Open and distance learning (ODL) initiatives now exist both within and outside Nigerian tertiary institutions, taking quality education to many who would otherwise be left out.[8] Initiatives like the National Open University of Nigeria (NOUN), distance-learning institutes (DLIs) in Nigerian universities, MOOCs affiliated with prestigious tertiary institutions abroad such as Coursera and the Harvard-affiliated edX platform, are a few examples. Indeed, access to TLMs not only serves these e-learning platforms but also remains necessary for traditional institutions of learning at all levels to achieve their objectives. For all these initiatives, copyright remains a potential threat to accessing TLMs, particularly in the digital environment.

At the heart of the problem are the creation of new rights and distortions of key concepts that have traditionally underpinned the nature and contours of copyright laws. For example, the act of digitisation is a new form of copyright-protected use, creating additional burdens on users because they require fresh copyright clearances unless the act of digitisation is for purposes covered by an exceptions or limitation. This is because digitisation, which refers to the conversion of existing works in non-digital forms into computer-compatible digital forms, is ordinarily construed as "copying" (Christie, 2008, pp. 2-3). Therefore, for example, processes such as scanning hard copies of documents, or digital photographing of works, are equivalent to making a copy of the document of work. Related to this is the "right of making available to the public", which, in the digital era, includes the exclusive right of copyright owners to control the making available of their works by digital means, on an on-demand basis, for public consumption (WIPO Copyright Treaty (WCT), 1996, Art. 8; WIPO Performances and Phonograms Treaty (WPPT), 1996, Arts. 10, 14). This kind of "making available to the public" is, again, an offspring of digital technology outside the parameters of copyright law as originally contemplated (Ginsburg, 2004). The incorporation of digital rights into the copyright framework

8 ODL is defined as "[…] any scheme of education or training that seeks systematically to remove barriers to learning, whether they are concerned with age, time, place or space. With open learning, individuals take responsibility for what they learn, how they learn and where they learn" (Distance Education UK, 2003).

can, thus, significantly affect cultural institutions like libraries and archives in their efforts to digitise their collections and make them publicly accessible (Rosati, 2013; Hudson & Kenyon, 2007). Digital rights are also pertinent to e-learning, which relies on online communication as the default mode of engagement and can have access to its online TLMs undermined where the required consent from a copyright holder cannot be easily obtained.

Given the revolutionary effects of digital technology on data, it is not surprising that the traditional meaning of key concepts which limited the scope of copyright protection, and marked the boundaries between what is protected and what is exempted, have equally been distorted. Digitisation of data has blurred the lines between copying and reading or merely viewing a work. Each use of a work can now be deemed a new use entirely. Access, which was traditionally taken as a given for the user, has been transformed into an act of copying and performance (Cronqvist, 2010, p. 4; Litman, 2006). The natural dichotomy between "copying" and "access" allowed copyright law to only restrict the act of "copying" but not of "access" (or use) of a work, leaving a system of knowledge appropriation that was inherently quite open. Meanwhile, the notion of "public", with reference to certain rights like "publication", "distribution" and "communication to the public", has become distorted, with no clear distinction between public and private settings on the internet (National Research Council, 2000). Consequently, activities which hitherto constituted private acts by individuals, and on the basis of which they were exempted from copyright, now qualify as "publication" or "communication to the public" as via the borderless and openness-oriented public internet. These distortions have implications for individual learners and teachers, and inevitably compromise copyright's balancing mechanisms (National Research Council, 2000).

Digital technology has also enabled copyright owners to use TPMs and encryption technologies to further protect works. TPMs, implemented through technological and legal protocols, seek to address the weaknesses (from copyright owners' perspective) of copyright law by checkmating the ease of infringing use of digital content (Digital Millennium Copyright Act, 1998). They involve the use of technology to directly control access to, and use of, digital content, and the legal protection of these technologies against circumvention (WCT, Art. 11; WPPT, Art. 18). Such control is effected through licences and contracts that define the terms of use, with the terms sometimes exceeding internationally-agreed minimum protection standards and forcing users to have to deal with "triple locks" (EIFL, 2009a, p. 8; 2009b). This is made possible because contractual terms, often in the form of licences, take precedence over copyright law once a user has agreed to the terms. Such terms readjust the scope of the limitations and exceptions by controlling uses in ways not allowed under the law or by expanding the scope of protection in their definition of terms, e.g., giving a very narrow definition of the term "non-commercial" in setting out exceptions allowing for "non-commercial use".

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Digital technology has, thus, had significant impact on international and national copyright regimes, with grave implications for the original balance between owners' rights and access by the public. Accordingly, at the same time that steps have been taken to incorporate new uses and protections into the bouquet of rights reserved for owners of works, there is also growing concern for public access to published works, giving rise to new international instruments or proposed instruments with greater focus on exceptions and limitations. It is such concerns that led to adoption of the 2013 WIPO Marrakesh Treaty to Facilitate Access to Published Works for Persons who are Blind, Visually Impaired, or otherwise Print Disabled (MVT) (hereafter "Marrakesh Treaty"), and which have led to the ongoing efforts to conclude a treaty that caters for the needs of libraries and other cultural institutions in serving their users (Hackett, 2016).

4. Nigerian Copyright Act and access to TLMs

A close examination of the current Nigerian Copyright Act against the foregoing background reveals critical deficiencies. Works eligible for protection under the Act are: (a) literary works; (b) musical works; (c) artistic works; (d) films; (e) sound recordings; and (f) broadcasts.[9] While these are undoubtedly within the normal scope of protected subject matter, the Act does not incorporate sufficient safeguards in the form of exceptions and limitations to ensure the necessary balance between incentivising copyright owners and enabling access to copyrighted works, including TLMs, in any of these forms. This is not out of tune with the fact that the Act was enacted in 1988,[10] and so precedes developments in copyright reform globally as precipitated by digital technology. Treaties such the aforementioned WIPO Internet Treaties, WCT and WPPT, are therefore not reflected in the Act.[11] Even though driven more by a protectionist agenda than by a concern for access, these treaties nevertheless seek, among other things, to regularise the treatment of circumvention of TPMs, and do provide exceptions that to some extent seek to safeguard use of work for legitimate public-interest purposes.

At the outset, it can be called into question why the Act positions exceptions as a "schedule"—as the Second Schedule, linked to section 6(1) of the Act—outside the main provisions on owners' rights and thus potentially suggesting that the exceptions are secondary instead of core obligations for copyright owners. More substantively, the exceptions provided in the Second Schedule are inadequate for the digital era and for TLM access.

The Second Schedule stipulates actions which are exempted from the right of works' owners to control the use of the works, i.e., exceptions to copyright, and defences

9 Section 1(1).
10 It operates as amended in 1999 (and as codified in 2004) (Adewopo, 2012; Ola, 2015).
11 The 1999 amendment of the Act addressed mainly the issue of collective copyright management and administration.

against charges of copyright infringement. The Second Schedule provides in paragraph (a) that copyright shall not apply to "the doing of any of the acts mentioned in the said section 6 by way of fair dealing for purposes of research, private use, criticism or review or the reporting of current events", subject to due attribution of the authorship of the work if used in public, except in case of the use being an incidental inclusion in a broadcast. The determination of what is "fair" is not stated in the Act, but Nigerian courts have generally been guided by the decisions of British courts on the UK's fair dealing provision (upon which the Nigerian model is based) to determine what is "fair" within the context of the Act.[12] In the landmark 1972 case of *Hubbard v Vosper*[13] on this issue, the Court held per Lord Denning as follows:

> It is impossible to define what is fair dealing. It must be a question of degree. You must consider first the number and extent of the quotations and extracts. Are they altogether too many and too long to be fair? Then you must consider the use made of them. If they are used as a basis for comment, criticism or review, that may be a fair dealing. If they are used to convey the same information as the author, for a rival purpose, that may be unfair. Next, you must consider the proportions. To take long extracts and attach short comments may be unfair. But, short extracts and long comments may be fair. Other considerations may come to mind also. But, after all is said and done, it must be a matter of impression. As with fair comment in the law of libel, so with fair dealing in the law of copyright. The tribunal of fact must decide. (*Hubbard v Vosper [1972] 2 QB 84)*

This decision suggests that fair dealing is an issue that must be decided on a case-by-case basis at the discretion of a court of law.

In the context of access to TLMs, the potential impact of the Act's fair dealing exception is constrained by the fact that educational purposes are not included in the list of fair dealing "purposes", despite education's utilitarian, socioeconomic and socio-cultural value, its importance as a right for the Nigerian child, and its status as a cornerstone obligation of government to its citizens. Educational uses are only exempted from copyright in a number of narrowly-defined instances in the Second Schedule. These include the following:

- paragraph (f) provides an exception for inclusion of "not more than two excerpts" of a copyrighted work in a collection of literary or musical work designed for educational purposes and accompanied by an acknowledgement of the authorship;
- paragraph (g) provides an exception for the broadcast of a work "as an educational broadcast";
- paragraph (h) provides an exception for "any use of a work in an approved

12 See sections 29 and 30 of the UK Copyright, Designs and Patents Act 1988: https://www.legislation.gov.uk/ukpga/1988/48/introduction
13 *Hubbard v Vospar [1972] 2 QB 84.*

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educational institution for the educational purposes of that institution", but any reproduction made for such purposes must be destroyed as prescribed or within 12 months in the absence of any such prescription; and

- paragraph (k) provides an exception for use of a work by prescribed "public libraries, non-commercial documentation centres, and scientific or other institutions as may be prescribed, where use is in the public interest" and is non-revenue-generating.

A significant weakness in the Act's provisions on exceptions is the absence of provisions on TPMs, which have the potential to truncate even the most inclusive and open-ended forms of exceptions and limitations. This gap may be seen as providing an open field for unrestrained circumvention of TPMs, thus being ostensibly pro-access. But it also enables works' copyright owners to unduly restrict access to their works in the absence of the necessary exceptions which take cognizance of new uses. Other gaps in the law relate to new concerns, in the digital era, around: libraries and similar cultural institutions serving the needs of the public; access for print-disabled persons; and non-recognition of digital rights.

5. The draft Bill and provisions relevant to TLMs

There is no gainsaying the fact that the draft Copyright Bill inaugurates an important template for aligning Nigeria's copyright system with the digital age. It also represents an important milestone in copyright reform in Nigeria, given the inclusiveness of the process leading to the draft Bill—with inputs synthesised from a series of deliberations with stakeholders, focus groups, and public comments (Standeford, 2015). The draft Bill is therefore a conscious effort to remodel the Nigerian copyright law for the digital age and for the benefit of both the copyright industries and the user public. In a way that brings digital copies under the copyright paradigm, the draft Bill defines "copy" in section 85(1) as "a reproduction in any form including a digital copy". This differs from the definition of "copy" in section 51 of the Act which does not make reference to "digital copies".

The draft Bill delineates the scope of protectable works subject to exceptions that apply generally, and others that are specific to print-disabled persons and cultural institutions (sects. 21 and 22). Again this is a deviation from the Act, which recognises special exceptions for only sound recordings, in its Third Schedule. Like the Act, the draft Bill also provides both civil and criminal penalties for the infringement of copyright (Parts IV and V, respectively, of the draft Bill).[14] A proactive effort to ensure a balanced law is seen in sections 27-31 of the draft Bill, which allow resort to compulsory licences for public interest goals. With 88 sections in all, the draft Bill certainly seeks to move Nigerian copyright law into the digital era. I now turn to examination of the provisions of the draft Bill that are relevant to the focus of this article: access to TLMs.

14 The relevant sections in the Act are 15–30.

The draft Bill highlights, among its main objectives, the need to: align the copyright system with international treaties; position the creative industries for greater competiveness in the "digital and knowledge-based economy"; and "effectively protect the rights of authors to ensure just rewards and recognition for their intellectual efforts" while also "providing appropriate limitations and exceptions to guarantee access to creative works", encouraging "cultural exchange", and advancing "public welfare" (draft Bill, Policy Considerations, p. 3). These preambulatory policy guidelines underscore balance as a major concern, with emphasis on access. These policy guidelines therefore distinctly mark the balanced philosophy, not specified under the current law, which should underpin the future of copyright protection in Nigeria. Structurally, too, the draft Bill significantly deviates from the Act by incorporating exceptions as part of the main provisions and not as an appendage in a schedule.

In line with its stated objectives, the draft Bill assigns to owners of copyrightable works the exclusive right to control a number of uses of their works (sect. 8-12). These include the right to reproduce, publish, or adapt the work, or to communicate the work to the public. It also protects the rights to publish and produce translations of literary and musical works specifically. Part II provides exceptions for certain uses which would not require the authority of the work owner once the necessary conditions are established. The exceptions provided are of two categories: those, in section 20, applicable generally (except where otherwise provided in the draft Bill), and those applicable to specific users (sect. 21).

General exceptions

Under general exceptions, section 20(1)(a) imports (and expands) the fair dealing exception in the Act by exempting activities which qualify as fair dealing "for purposes of research, *teaching, education*, [emphasis added] private use, criticism, review or the reporting of current events", subject to attribution of authorship where the use is public. This differs from the more restricted scope of the fair dealing provision in the Act, which does not cover teaching and education. The question of whether a certain use constitutes fair dealing would, in terms of the draft Bill, depend on certain mandatory conditions contained in the proviso of sub-section 20(1)(a), which provides that:

> [...] in determining whether the use made of a work in any particular case is fair dealing, the factors to be considered shall include—
> (i) the purpose and character of the use, including whether such use is of a commercial nature or is for non-profit educational purposes;
> (ii) the nature of the work;
> (iii) the amount and substantiality of the portion used in relation to the work as a whole;
> (iv) the effect of the use upon the potential market for or value of the work; and

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> (v) if the use does not conflict with a normal exploitation of the work and does not unreasonably prejudice the legitimate interests of the owner of copyright. (draft Bill, sect. 20(1)(a))

As is discussed below, this draft section 20(1)(a) simultaneously, and problematically, both *widens* and *narrows* the scope of the fair dealing exemption.

More clearly encouraging for access to TLMs, the draft Bill's section 20(1) general exceptions also include, in addition to the fair dealing exception, exceptions for the benefit of libraries (sect. 20(1)(i), (n)), educational use (sect. 20(1)(f)), persons with disability (sect. 20(1)(q), and for purposes of (private) research and study sect. 20(1)(o), (t)). The general exceptions in the draft Bill's section 20(1) incorporate (and in some cases modify) some of the exceptions contained in the existing Act's aforementioned Second Schedule. For example, the draft Bill's section 20(1)(n), which allows the making of not more than three copies of a work by public libraries, and section 20(1)(o), which allows public libraries and other public institutions to reproduce unpublished literary or musical works in their possession for the purpose of research or private study, both have replicas in the existing Act.

Specific exceptions

The specific exceptions provided for in the draft Bill include "[s]pecial provisions for archives, libraries, museums and galleries" (sect. 21), and "[s]pecial exceptions for Blind, Visually Impaired, or Otherwise Print Disabled Persons" (sect. 22). There are also "[s]pecial exceptions in respect of a sound recording of a musical work" (sect. 23).

The special exceptions provided in the draft Bill's section 21 and 22 to (1) archives, libraries, museums and galleries, and to (2) visually impaired persons, address obligations arising from global concern for library-friendly copyright laws and recent international treaties. Both these sets of exceptions have far-reaching implications for access to TLMs by teachers and students alike in Nigeria.

Section 21's exceptions can assist Nigerian libraries and similar cultural institutions to alleviate the negative consequences of digital technology on their activities, and at the same time to harness the potential of digital technology to enhance their services. Section 21(1) permits libraries to distribute and share materials among themselves for non-commercial purposes, as part of their normal function of preserving and lending books to the public. Libraries are therefore accorded greater freedom to use digital materials and to integrate their services through consortiums, thus making educational materials more accessible.[15] Sections 21(2)(a) and (c) permit libraries to make copies of their existing works in other formats, including digital formats. Section 21(2)(a) permits archives, libraries, museums and galleries to "may make copies of

15 As is the case in South Africa, where such consortiums exist among universities.

works in their collection for the purpose of back-up and preservation". Section 21(2)(c) permits them to also "make copies of works that are or should be available in their collections in their chosen format, if they cannot reasonably be acquired in such format through general trade or from the publisher". Libraries can also make copies to complete an incomplete collection, where the work cannot reasonably be acquired through general trade or directly from the publisher (sect. 21(2)(b)); they can make whole copies of their collections where the required permission cannot be obtained and the work is not available by general trade or from the publisher (sect. 21(2)(d)); and the copies they make can be accessed and used on their premises or lent to their users (sect. 21(2)(e)).

The draft Bill's section 22 "special exceptions" for the print-disabled seek to bring Nigerian copyright law in alignment with the Marrakesh Treaty. Section 22(1) allows anyone having lawful access to a work, or copy of a work, to make it available in formats that print-disabled persons can conveniently access and/or utilise, without the need for the copyright owner's permission. This is, however, legal only if the production of the format for print-disabled is for non-commercial purposes and the copy is properly attributed. Section 22(3) permits importation of the desired format for non-profit uses, which constitutes an exception to provisions in the draft Bill prohibiting importation of copyrighted works.[16]

Provisions on circumvention of technological protection measures (TPMs) and rights management information

The draft Bill's sections 44 and 45 provide an entirely new set of provisions aimed at adopting international standards, as required by the aforementioned WIPO Internet Treaties, in respect of circumvention of TPMs used to protect works, and in respect of electronic rights management information.[17] (Nigeria deposited its ratification instruments for these treaties with WIPO on 4 October 2017, and is now in the process, through the draft Bill, of domesticating its obligations.) The TPM provisions outlaw circumvention of TPMs and production and dissemination of devices used for circumventing TPMs.[18]

In all instances, exceptions are provided to ensure that legitimate acts requiring circumvention of TPMs are not affected. For instance, circumvention of devices required by a person qualified under the draft Bill to execute a permitted act is not prohibited (sect. 44(9)). This accentuates the distinction between access and use in connection with the circumvention of TPMs to avoid the unintended consequence of criminalising legitimate access (National Research Council, 2000). Section 44(8) provides that the protection of TPMs "shall not affect the exceptions provided in [the] Act as it relates to the work in respect of which the technological protection

16 Sections 32(1)(b), 38(1)(b), 79(1) and 79(6).
17 Sections 44 and 45.
18 Sections 44(1) and 44(2).

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measure is applied". It can be assumed that circumvention by the visually impaired, in order to access content in accordance with section 22(1), would constitute use that satisfies legitimate access and so is therefore permissible. However, even with this section 44(8) recognition that TPMs should not affect uses permitted via exceptions, the TPM anti-circumvention provisions still raise fears in respect of limitation of users rights (with relevance to TLMs)—due to the additional capacity TPMs provide for copyright owners to control even normal uses of their work, such as format- and time-shifting (see EIFL, 2009a, p. 8)). Also of concern is the ability of copyright owners to impose contractual terms or licensing requirements that undermine lawful TPM circumvention that is provided for by exceptions. (See "Weaknesses and gaps in the draft Bill" section below for more on this matter.)

The right of communication to the public

The draft Bill, in section 85, redefines the right of communication to the public to include the right of making available to the public. This no doubt provides additional means for copyright owners to control the dissemination of their digital works. But again, consideration is given to access to TLMs by providing exceptions to aid education and learning. The draft Bill protects the right of communication to the public in respect of literary and musical works (sect. 8(1)(h)), films (sect. 10(d)), and sound recordings (sects. 11(d) and 14(7)). Section 85(1) makes it clear that communication to the public includes "live performance or delivery, any mode of visual or acoustic presentation, making available the work or copies thereof to the public, including by digital transmission over computer networks, but does not include a broadcast or re-broadcast; […]". However, section 20(1)(t) allows communication or making available copyrighted material "for the purpose of research or private study, to individual members of the public by dedicated terminals on the premises of publicly accessible libraries, educational establishments, museums and archives, of works and other subject matter not subject to purchase or licensing terms which are contained in their collections".

Redefinitions relevant to copying, publication

The draft Bill redefines certain concepts to specify their meaning in the digital environment. Section 85(1) defines "copy" to include making digital copies of a copyrighted work. But read in conjunction with section 20(1)(q), this does not include:

> temporary acts of reproduction which are transient or incidental and an […] essential part of a technological process and whose sole purpose is to enable a transmission in a network between third parties by an intermediary; or for other lawful use, where such use has no independent economic significance. (draft Bill, sect. 20(1)(q))

To accommodate the meaning of publication in the digital environment, where an individual with access to internet becomes a potential publisher, the draft Bill, in section 85(2)(a), deems a work as published "if copies of it have been made available in a manner sufficient to render the work accessible to the public". This means that a work is published once it is uploaded on the internet. (Such provisions can, on the whole, have negative implications for access to TLMs in the absence of adequate exceptions. We saw above the draft Bill's provision of exceptions for libraries desirous of making digital copies of existing collections for non-profit uses.)

Compulsory licensing

The draft Bill's prioritisation of access as an overriding public interest related objective is highlighted in its provisions for compulsory licences in sections 27, 28 and 31—which are much more far-reaching than the compulsory licence provisions in the current Act. The draft Bill's provisions on compulsory licences are no doubt designed to make learning materials more accessible in local languages, and to address the scarcity of publications in Nigeria—particularly textbooks and other science and technology-related publications. Section 27(1) provides as follows:

> Any qualified person may apply to the Commission [NCC] for a licence to produce and publish a translation of a literary work which has been published in printed or analogous forms of reproduction for the purposes of teaching, scholarship or research. (draft Bill, sect. 27(1))

In effect, section 27 allows the NCC to grant a non-exclusive licence to qualified persons to produce and publish translations of TLMs in all languages for use within Nigeria. For this purpose, it does not matter whether the translation is a commercial or non-profit project. Such works can also be officially used in one of two ways outside Nigeria if they are "in any language other than English". In terms of section 27(5), copies of translated works in any language other than English can be "sent to citizens of Nigeria residing outside Nigeria or to any association of such citizens outside Nigeria; or used for purposes of teaching, scholarship or research and not for any commercial purpose". In all cases, in terms of section 27(7)(a), an application for a licence will not be approved unless:

> the Commission is satisfied that no translation of the work into the language in question has been published in printed or analogous forms of reproduction, by or with the authorization of the owner of the right of translation, or that all previous editions in that language are out of print; […]. (draft Bill, sect. 27(7)(a))

Similarly, section 28 of the draft Bill allows licences to be granted by the NCC to qualified persons to reproduce and publish affordable copies of literary or artistic works in printed format which are not available in the market for up to six months,

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or where they are to be used in connection with systematic instructional activities. This provision is undoubtedly an important measure to stem scarcity and overpricing of TLMs, especially textbooks. In addition, section 31 of the draft Bill, entitled [c] ompulsory licenses for public interest" empowers the NCC to authorise the use of TLMs in the overall interest of the public as follows:

> (1) Notwithstanding any other section of this Act, the Commission may authorize the use of a work by any person for the following purposes—
> (a) to rectify abuse of dominant market position;
> (b) to remedy abuse of rights;
> (c) to promote public interest. (draft Bill, sect. 31(1))

An important qualification to this privilege is section 31's subsection 2, which provides:

> (2) In authorizing the use of a work under subsection 1 of this section, the Commission shall take into consideration the following—
> (a) that prior to such use, the proposed user has made efforts to obtain authorization from the owner of copyright on reasonable commercial terms and conditions and that such efforts have not been successful within a reasonable period of time:
> Provided that the Commission may waive this condition in the case of a national emergency or other circumstances of extreme urgency or in cases of public non-commercial use; and
> (b) the owner of copyright is accordingly notified; […]. (draft Bill, sect. 31(2))

The expression "on reasonable commercial terms and conditions" represents a marked difference with sections 27 and 28, where the reasonableness of the terms upon which the owner of the work is willing to permit use is not said to be a consideration in the question of whether grant of a compulsory licence is warranted/defensible. Moreover, in section 31(2) there is also provision for the "efforts to obtain authorisation" requirement to be waived in three cases: "national emergency", "other circumstances of extreme urgency" and "cases of public non-commercial uses". These cases could be interpreted to accommodate any number of scenarios, but in the context of TLMs, it implies that for the purpose of public education, compulsory licences could be granted for the printing of scarce materials relevant to education in critical areas like medicine, science and technology.

The draft Bill does not define "public interest", thereby leaving it open and subjective. It could be argued that the omnibus nature of the section is intended to cover as many circumstances as possible. A typical public interest rationale would be to remedy a situation where copyright producers do not see profit in certain kinds of works, e.g., "works in'neglected languages' spoken predominantly by poor people" (Shaver, 2014,

p. 124), or publications for diseases of the poor leading to scarcity of such materials for teaching and learning the subject.

The key broadening of the compulsory licence provisions in the draft Bill is via section 31 on "[c]ompulsory licenses for public interest", which does not have an equivalent in the provisions of the Act (in the Act's Fourth Schedule).

6. Weaknesses and gaps in the draft Bill

There is no gainsaying the fact that the draft Bill upgrades the protection of works in Nigeria in the digital age, with thoughts also given to facilitating access to TLMs. Overall, the exceptions enhance the prospects of accessing TLMs in Nigeria by allowing uses of copyrightable materials for private study and research; and provisions to help libraries and similar cultural institutions serve their users better. The special exceptions provided under sections 21 and 22 go a long way in addressing obligations arising from new treaties and the concern for A2K in the digital age for all. And the strong public interest orientation of the compulsory licensing provisions is potentially very positive for TLM access in the country. However there are also potential weaknesses and gaps, which I now discuss.

The fair dealing provision

As stated above, the draft Bill's section 20(1)(a) on fair dealing potentially both *widens* and *narrows* the scope of the fair dealing exemption. The addition of "education and teaching" to the fair dealing exemptions widens the scope of the exception by allowing for the use of copyrighted works for educational purposes without requiring the consent of works' owners, thereby potentially facilitating access to TLMs.[19] But at the same time, the section stipulates new conditions for application of fair dealing—conditions which potentially *narrow* the exception by mirroring, in section 20(1)(a)(v), elements of the "three-step test" found in key international instruments (Berne Convention, Art. 9(2); TRIPS Agreement, Art. 13; WCT, Art. 10; WPPT Art. 16(2)).[20] Given the background of the three-step test as the outcome of strong lobbying by copyright industries, its primary objective is to expand the protection granted to copyright owners by strengthening their rights, and it does so in a vague manner that leaves ample room for access-unfriendly interpretation.

The three-step test is composed of mandatory conditions that seek to ensure that work owners are not affected by exceptions in a way that deprives them of the "normal exploitation" of their rights (Christie & Wright, 2014, p. 26). The test, which has its origins in the 1967 revision of the Berne Convention, states that exceptions to copyright protection shall: (1) only affect "certain special cases", (2) that do "not conflict with a normal exploitation of the work", and (3) that do "not unreasonably prejudice the legitimate interests of the author" (Berne Convention, Art. 9(2)). All

19 Section 20(1) (a) (f).
20 See EFF (n.d.) on three-step test.

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three conditions in the test must be reasonably satisfied before a particular use can be considered as exempted. The draft Bill's section 20(1)(a)(v), in mirroring elements of the three-step-test, is thus potentially access-unfriendly (Geiger, 2007; Geiger et al., 2014). Jaszi, Carroll, and Flynn (2016) have recommended the removal of 20(1)(a)(v), and I too make this recommendation.

I am also in agreement with the recommendation by Jaszi et al. (2016) that, in order to give the draft Bill's sect. 20(1)(a) fair dealing provision more potential openness of interpretation by the Nigerian courts—with such openness of judicial interpretation being one of the strengths of the US "fair use" doctrine—that the draft Bill's sect. 20(1)(a) introductory language be changed.[21] Section 20(1)(a) currently states:

> the doing of any of the acts mentioned in the said sections by way of fair dealing for purposes *of* [emphasis added] research, teaching, education, private use, criticism, review or the reporting of current events, subject to the condition that, if the use is public, where practicable, it shall be accompanied by an acknowledgment of the title of the work and its authorship except where the work is incidentally included in a broadcast; [...]. (draft Bill, sect. 20(1)(a))

I concur with the Jaszi et al. (2016) recommendation that, in order to broaden the fair dealing exception, the word "of", as italicised above in the quote from 20(1)(a), be replaced with the words "such as" (Jaszi et al., 2016, p. 9).

TPM anti-circumvention provisions

The TPM anti-circumvention provisions, while generally favourable to TLMs access and use, are also a cause for some concern, as alluded to above. It is indisputable that the inclusion of protection of TPMs adds layers of protection not originally contemplated by the Act, thus strengthening copyright protection for copyright holders. Protecting TPMs can have unfavourable consequences in respect of access, not the least access to TLMs. While there is a need to reinforce protection for works in the light of rampant and random infringement of digital content in the country, it is equally important that the provisions do not unduly restrict access beyond the boundaries intended by the law. This is what the provisions on TPMs seek to ensure by distinguishing between lawful and unlawful uses in prohibiting circumvention, with section 44(8) making clear that protection of TPMs against circumvention does not affect the exceptions stipulated in the Act.

However, the objective of ensuring that protection of TPMs does not undermine exceptions would benefit from an additional measure in the draft Bill: a provision safeguarding lawful uses against overreaching contractual terms or licensing requirements. Such a safeguard could take the form of an omnibus "catch-all" clause

21 See De Zwart (2006) for comparison between US fair use model and Australian fair dealing provisions.

covering exceptions and limitations generally, as suggested by Jaszi et al. (2016). Jaszi et al. (2016) recommend the insertion of an omnibus clause that "[c]ontractual terms which purport to restrict or prevent the doing of the acts permitted by limitations and exceptions under this Act are unenforceable". Such a clause, which finds precedents in UK copyright law[22] and the South African Copyright Amendment Bill 2015,[23] would invalidate contractual terms seeking to restrict or prevent the doing of acts permitted by the embedded limitations and exceptions (Jaszi et al., 2016, p. 13). The absence of such a provision in the draft Bill can be seen as a clear gap that needs filling if TLM access is to be maximised.

Communication to the public

The draft Bill's section 20(1)(t), which exempts from copyright protection communication to the public for the purposes of research and private study, ensures that TLMs can be disseminated among teachers and learners in public institutions through secured terminals. But the fact that the exception does not apply to content which is subject to purchase or licensing terms means that copyright authorisations are still necessary for such cases. This makes the exemption somewhat superficial, as the only items not requiring copyright authorisations are likely to be open materials for which access is already not restricted, such as open educational resources (OERs), open access publications, and publications carrying Creative Common licences. Again, contractual terms will potentially override the exception, making this provision a potential weakness in the draft Bill in respect of bolstering TLM access.

5. Conclusion

Several provisions in Nigeria's draft Copyright Bill have the potential to improve access to TLMs, in turn serving the education needs of Nigerians and the education polices of the government. Provisions in the draft Bill would improve on the extant Act by broadening the scope of exceptions for education and research purposes, aligning them with the realities of the digital age, for both individuals and institutions. The draft Bill also seeks to introduce provisions to address the needs of the print-disabled, in line with new international standards. To address the problems of scarcity and high prices of learning materials, the draft Bill provides for more robust provisions in support of use of compulsory licences. In sum, the draft Bill's recognition of new rights, its realignment of existing rights, and its expansion of exceptions to cover more education-related needs, would, if passed into law, significantly strengthen the user-access side of copyright's balancing objective. This would enhance the potential of access to, and use of, TLMs under the law.

At the same time, the Bill has weaknesses and gaps in respect of its efforts to ensure adequate access to TLMs in the digital era in Nigeria. Its fair dealing exception

22 See UK Government (2014); and UK Copyright, Designs and Patents Act 1988: https://www.legislation.gov.uk/ukpga/1988/48/introduction

23 See https://www.gov.za/sites/default/files/39028_gon646c.pdf

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requires refinement so as to not lead to overly narrow judicial interpretations of the exception; its TPM anti-circumvention provisions would benefit from additional measures safeguarding lawful uses against overreaching contractual terms or licensing requirements; and the draft Bill's section 20(1)(t) on "[c]ommunication to the public" requires reconsideration to see if it can be broadened.

As the process of amending the Nigerian copyright law unfolds, it is important that the salient terms of the current draft Bill be maintained, accompanied by a conscious effort to address the weaknesses and gaps identified above, in order to create a legitimate framework that enables and fosters access to TLMs for all in Nigeria in the digital age.

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Mobile Phone Use by Zimbabwean Smallholder Farmers: A Baseline Study

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Abstract
This article provides findings from a baseline study on mobile phone use by smallholder farmers in Zimbabwe. The study investigated use of mobile phones by 58 farming households in a village in Zimbabwe's Midlands Province. Via a survey questionnaire and a focus group discussion, the study found that 100% of the surveyed households identified "asymmetry of information" as a challenge they face in their agricultural activities, and 90% cited "absence of market information" as a challenge. Yet at the same time, the study found low levels of household mobile phone usage, with only 50% of households were found to be using mobile telephony in support of a farming activity. The article concludes with a recommendation for how to close this apparent gap between the smallholder farmers' felt need for increased agricultural information and, at the same time, their lack of use of mobile telephony to access such information.

Keywords
mobile technologies, information and communication technology (ICT), smallholder agriculture, smallholder farmers, spatial arbitrage, time arbitrage

DOI: https://doi.org/10.23962/10539/26171

Recommended citation
Musungwini, S. (2018). Mobile phone use by Zimbabwean smallholder farmers: A baseline study. *The African Journal of Information and Communication (AJIC)*, *22*, 29-52. https://doi.org/10.23962/10539/26171

Acknowledgements
The author thanks all those who participated in this research; for without them, this work would not have been a success. Special thanks go to two farmers, who will remain anonymous, for their immense contribution in this work through assisting the researchers in administering the questionnaires.

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1. Introduction

Smallholder agriculture has a direct influence on the rural livelihoods of rural Zimbabweans. Viability, productivity and sustainability of smallholder farming are critical for attainment of UN Sustainable Development Goals in Zimbabwe, particularly Goals 1, 2 and 8 (UN, n.d.). Studies have found that smallholder farmers able to secure increased access to information, appropriate technology, suitable markets, suitable credit, and better prices, and insurance are likely to be more productive and more sustainably develop (Bagazonzya, Safdar, & Sen, 2012; Jayne, Mather, & Mghenyi, 2006; Mago, 2012; Musungwini, 2016; Palmer, 2012; Pienaar & Traub, 2015; Tadesse & Bahiigwa, 2015; World Bank, 2011). And smallholder farmers with limited access to the above-listed elements, and often also faced with unsupportive government policies, droughts, and demographic pressures, are underproductive (Mittal, 2012; Mutami, 2015; Von Loeper, Musango, Brent, & Drimie, 2016).

Meanwhile, in Sub-Saharan Africa, as elsewhere in the developing world and in the developed world, the mobile phone and mobile information and communication technologies (ICTs) are transforming the manner in which people interrelate, unlocking exhilarating and unexplored opportunities in support of trade (Musungwini et al., 2014), and transforming all facets of life (Duncombe & Boateng, 2009; Ogunleye, 2010; Walsh & Power, 2011). Among the myriad sectors where mobile ICTs are having a profound impact is in developing-world smallholder agricultural settings.

Most smallholder farming systems are much less productive and profitable than they could be (Brugger, 2011; FAO, 2011; Nguthi, 2007). ICTs, and in particular mobile ICTs, are often seen as game-changers in smallholder agriculture. In one study in Tanzania, mobile phones were found to be responsible for increasing farmers' profits by 15% (Furuholt & Matotay, 2011). De Silva and Ratnadiwakara (2008), researching the impact of ICTs on rural agriculture in Sri Lanka, found that a key challenge smallholder farmers faced, and which ICTs could potentially address, was information asymmetry, or information lop-sidedness, whereby rural smallholders typically possess less of the important market and other information than the buyers and other more powerful actors they interact with in pursuit of their livelihoods. And Qiang, Kuek and Dymond (2011) have found that among the key barriers that developing-world smallholder farmers face are the information and skills gaps that constrain adoption of available technologies and technology-enabled management practices—or reduce the technical efficiency of these practices when adopted (Qiang et al., 2011).

The empirical data on mobile phone use by smallholder farmers in Sub-Saharan African settings is still very limited. The research on which this article is based sought to begin to address that gap in the Zimbabwean context, specifically in respect of the

smallholder farmers of Havana Extension village in the Tokwe resettlement area, Shurugwi District, Midlands Province. The specific objectives of the research were to establish: the main agricultural practices of the smallholder farmers; the challenges faced by the farmers in their agricultural activities; the farmers' sources of agricultural information; the farmers' level of mobile phone ownership; the farmers' main uses of mobile phones; and the extent of farmers' use of mobile phones for farming activities.

2. Background

Sub-Saharan Africa is home to many countries that have the bulk of their population living below the poverty line and residing in rural areas. The livelihoods of these people are often wholly dependent on farming. According to a 2012 estimate by ZIMSTAT (2012), more than 67% of the population of Zimbabwe, then estimated at 14.7 million people, was residing in rural areas, where they depended on farming as a source of livelihood. Today, Zimbabwe's population is estimated at over 16 million (Trading Economics, n.d.), and it can be presumed that the majority still lives in rural areas given, among other things, the closure of many urban-based companies in the period 2012 and 2017 (as reported by Mugova (2017), Nkomo (2016), Samukange & Mutomba (2014), and Vusani (2015)).

After the country's independence in 1980, the Zimbabwean Government established agriculture marketing boards to administer and manage harvested crops. For example, grain farmers could acquire inputs from the Grain Marketing Board (GMB), and sell their produce to GMB. For cotton, there was the Cotton Marketing Board (CMB) doing the same. However, the CMB was later privatised and became Cotton Company of Zimbabwe (Cottco). The crumbling of the Zimbabwean economy in the 2000s culminated in the collapse of the agro-processing industry and in the agricultural value chain. The GMB no longer functions well, and there have been cases where it has failed to pay farmers for more than two years for grain collected. Recent years have witnessed an increasing presence by middlemen in the agriculture value chain, providing alternative markets for farmers' produce. However, the use of middlemen brings problems of its own. For example, there have been cases where middlemen bought farmers' produce and paid with fake USD notes.

Midlands Province is Zimbabwe's central province, and Shurugwi District is one of the Midlands Province's most vibrant districts in terms of agriculture, second only to Gokwe District. Statistics from the GMB depot at Tongogara growth point, in Shurugwi District, indicate that the bulk of Shurugwi District's maize deliveries since 1985 come from the Tokwe resettlement area. And within Tokwe, according to agricultural extension (Agritex) officers from the area, Havana Extension is the dominant village in terms of both the number of farmers holding Master Farmer certificates (as awarded through the Agritex system), and farmers' performance in agricultural competitions in the area (Havana farmers usually sweep the prizes). It was for these reasons that I undertook the research in Havana Extension.

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3. Literature review

This literature review focuses on contextualising smallholder agriculture in Sub-Saharan Africa; mobile phone adoption in Sub-Saharan Africa; and mobile phone use in support of smallholder agriculture in Sub-Saharan Africa.

Smallholder agriculture in Sub-Saharan Africa

A number of articles have looked at the challenges faced by smallholder farmers in Sub-Saharan Africa (Gabagambi et al., 2013; Kavoi et al., 2014; Murray et al., 2016; Musungwini, 2016; Pienaar & Traub, 2015; Von Loeper et al., 2016). For example, in the Malawian smallholder-farmer context, Murray, Gebremedhin, Brychkova and Spillane (2016) identify the following challenges:

- small size of land and asset holdings;
- low food crop productivity;
- limited choice in respect of inputs and crop types;
- limited market information;
- limited land-use education;
- shifts in urban food consumption in favour of crops not produced by smallholder farmers;
- national government shortcomings, e.g., limited national public expenditure on the agriculture sector; and
- global governance dynamics, including shifts in global agricultural trade policies and declining donor assistance for smallholder farmers.

Similar findings are provided by Masaba (2013), based on research on palm oil smallholder farmers in Uganda, with the following identified as the major challenges:

- limited markets, market access and related marketing infrastructure;
- high cost of, and limited access to, high-quality farm inputs and production technology;
- lack of access to agricultural credit facilities;
- inadequate agricultural extension services;
- decline in the agriculture sector growth;
- lack of ownership and control of land by women; and
- lack of gender analysis to inform policy formulation, planning and budgeting.

Other literature looks more specifically at issues of dryland farming (the type of farming practised in Zimbabwe), and the need for rainwater-harvesting and development of water resources. Cooper, Dimes, Rao, Shapiro, Shiferaw and Twomlow (2008) focus on the need for climate change adaptation mechanisms for smallholder farmers in Sub-Saharan Africa. Adjognon, Liverpool-Tasie and Reardon (2017) argue that the availability of technology, inputs, and market information, while important, are of limited value if smallholder farmers do not also get access to tailored credit facilities.

Mobile phone adoption in Sub-Saharan Africa

Across the developing world, mobile phones have pervasively penetrated every facet of life, making tremendous impact on the lives of people (Ilahiane & Sherry, 2009; Waverman et al., 2005; World Bank, 2012), including reducing the costs of communicating (Baumuller, 2015; Wulystan & Andrew, 2013; Zanello, 2011).

Developing-world public-sector, private-sector, and civil society actors alike are now able to send and receive information quickly and cheaply on important economic, political, social, and cultural matters (Annan, 2013; OECD & ITU, 2011; Kushchu, 2004; Page et al., 2013; Potnis, 2014). Accordingly, African policymakers and researchers are now focused on the dynamism and potential provided by the wide variety of mobile digital applications and services. A number of articles have looked at the adoption, use, prevalence, and impact, of mobile telephony in Sub-Saharan Africa. Aker and Mbiti (2010) look at how exponential growth of mobile telephony in Sub-Saharan Africa has opened new possibilities to the continent. In most of Sub-Saharan Africa, the mobile phone is the only technology accessible to many inhabitants and therefore, across social strata, urban and rural divides, and rich and poor divides, it is facilitating connections between people; access to information; access to markets; and access to services (Aker & Mbiti, 2010; Jagun et al., 2008; Mekuria, 2007; Rashid & Elder, 2009; Wamuyu, 2014).

Mobile phone use in support of smallholder agriculture in Sub-Saharan Africa

The UN *2030 Agenda for Sustainable Development,* in which 17 Sustainable Development Goals (SDGs) are identified to be pursued in the quest for a better world for all, gives much prominence to agriculture (UN, n.d.). The development of agriculture is crucial because it has a direct impact on the SDGs 1, 2, 3 and 8, while indirectly impacting 10 of the other SDGs. The mobile phone has been identified as a key driver for achievement of SDGs (Heeks, 2014a; 2014b). Qureshi and Najjar (2017) found that in developing-world small island states, an extra 10 phones per 100 people can boost GDP growth by 0.8%.

A number of articles have been published which show that the reduction in communication costs and instant delivery of messages associated with mobile telephony have brought with them tangible economic benefits which have greatly improved smallholder agricultural activities in developing countries, including Sub-Saharan African countries (Bonthu, 2014; Duncombe, 2012; Ndiwalana et al., 2008; Ogunleye, 2010; Olsen, 2008; Zanello, 2011). ICTs in general, and mobile technologies in particular, are often touted as the key catalyst to levelling the playing field in smallholder agriculture in developing countries. Developing-world, including African, farmers can obtain real-time market pricing information via mobile telephony, saving time and travel and making them better-informed about where and what price to sell their products, thereby raising their incomes and improving the sustainability of their livelihoods (Beuermann et al., 2012; Furuholt & Matotay,

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2011; Islam & Grönlund, 2011; Katengeza et al., 2011; Shaffril et al., 2015; Marshall, 2018; Walsh & Power, 2011) .

Integral to the aforementioned challenge of information asymmetry, as a vulnerability for rural African farmers, is their scarcity of access to key information on a range of key matters, during farming, transportation, and marketing of their crops (Furuholt & Matotay, 2011). A study conducted in Niger from 2001 to 2006 found that the introduction of mobile phones reduced grain price dispersion by 6.4%, and reduced price variation by 12%, over the course of one year (Aker & Mbiti, 2010). In a baseline survey conducted in Tanzania in July 2013, it was established that rural farmers were making wide use of Tigo Kilimo, an agricultural information service developed and deployed by mobile network operator (MNO) Tigo (Pshenichnaya & Palmer, 2013).

Generally, smallholder farmers value mobile telephony as a fast and a convenient way to communicate with various stakeholders in the agriculture value chain and to get prompt answers in respect of problems they face (Freeman, 2017; Ogbeide & Ele, 2015). The mobile phone engenders opportunities for the farmers especially in respect of getting marketing and weather information (Churi et al., 2012; Masuka et al., 2016; Ogbeide & Ele, 2015; Tadesse & Bahiigwa, 2015). Through mobile telephony, smallholder farmers can directly keep in touch with many clients in various marketplaces, and offer their produce at competitive prices (Zyl, Alexander, Graaf, & Mukherjee, 2014; Chhachhar, Chen, & Jin, 2016; Furuholt & Matotay, 2011; Mansingh & Erena, 2016). Use of a mobile phone also enables smallholder farmers to be aware of real-time weather forecasts and current information on agricultural inputs such as fertilizers and pesticides (Baumüller, 2015; Mansingh & Erena, 2016; Wulystan & Andrew, 2013).

This mobile handset is carving an indelible mark on the socio-economic processes of rural communities in Sub-Saharan Africa, offering new directions and approaches for rural farmers (Bonthu, 2014; Chhachhar et al., 2016; Etwire et al., 2017; Mittal, 2016). Studies indicate that mobile phone technologies are producing energy and time savings for farmers, and ultimately improving their incomes (Baumüller, 2015; Mansingh & Erena, 2016; Masuka et al., 2016).

In the available literature, the factors found to have a bearing on adoption and effective utilisation of mobile phones in smallholder agriculture can be classified into three categories, as outlined in Table 1.

Table 1: Factors affecting adoption and use of mobile phones in smallholder agriculture

	Factors	Sources in the literature
Factors produced by mobile phone capabilities	Mobile phone: • can be a tool for education • can reduce communication and information costs • can reduce information asymmetry • capable of providing information for weather, input prices, market price for products, diseases and other disasters in real-time • capable of facilitating knowledge-sharing among farmers • capable of facilitating money transfer, banking, and transaction services between buyers and sellers	• Duncombe (2012) • Foster and Heeks (2013 • Furuholt and Matotay (2011) • Masuka, Matenda, Chipomho, Mapope, Mupeti, Tatsvarei, and Ngezimana (2016) • Mittal and Mehar (2012 • Musungwini (2016 • Musungwini and Van Zyl (2017) • Musungwini, Zhou Tinashe, Zhou, and Ruvinga (2014 • Wyche and Steinfield (2016)
Factors influencing mobile phone use	• mobile phone ownership • education level • gender • age • availability of infrastructure • accessibility of mobile phone services • level of digital knowledge	• Asif, Uddin, Dev, and Miah (2017) • Hamad, Eltahir, Ali, Hamdan, and Elsafi (2018 • Mansingh and Erena (2016) • Shaffril, Omar, D'Silva, and Bolong (2015) • Morawczynski (2010 • Mutisya (2016)
Factors inhibiting optimal mobile phone use	• lack of necessary knowledge and information to use mobile phones • illiteracy • old age • lack of infrastructure • gender dynamics • socioeconomic status • high cost of mobile phones and mobile services	• Arreymbi, Agbor, and Adnan (2008) • Baumüller (2015) • Etwire, Buah, Ouédraogo, Zougmoré, Partey, Martey, Dayamba, and Bayala (2017) • Islam and Grönlund (2011 • Khayyat and Heshmati (2013) • Kiilu (2013) • Leon, Schneider, and Daviaud (2012) • Martin and Abbott (2011 • World Bank (2012) • Wyche and Steinfield (2016)

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With its 103% mobile penetration rate and 91% literacy rate (Musungwini et al., 2014), Zimbabwe would appear to be well-placed to see its rural smallholder farmers harness mobile technologies to address some of their challenges.

4. Research design

The research data collection instruments used were a survey questionnaire and a focus group discussion. The questions in the survey questionnaire (see Appendix) were multiple-choice with closed-ended responses. I was assisted in the process of administering the questionnaires by two smallholder farmers in the study area. For the focus group discussion, I was the facilitator, and the discussion was recorded on a mobile phone.

Both the survey questionnaire and the focus group sought to probe the following:

- the main agricultural practices of the smallholder farmers;
- the challenges they faced in their agricultural activities;
- their sources of agricultural information;
- their level of mobile phone ownership;
- their main uses of mobile phones;
- and their extent of use of mobile phones for farming activities.

The questionnaire was completed by 58 smallholder farmer households in Havana Extension village. Purposive sampling was used to select Havana out of the other 13 villages in Tokwe resettlement area. As mentioned above, Havana has a history of being generally the most productive village, in terms of agriculture, in the Tokwe resettlement area. There are 60 households in Havana Extension village, and initially it was planned that the questionnaire would be administered to all the households. However, at the time of conducting the research, occupants of two households were not available, and thus 58 households were surveyed. The questionnaires were self-administered, but with participants answering in the presence of a member of the research team and thus able to seek clarification where necessary.

The focus group participants were: an agricultural extension (Agritex) officer; a veterinary officer who serves farmers in the Tokwe resettlement area; and five smallholder farmers in Tokwe. The farmers were chosen based on their being holders of Master Farmer certificates and via a snowball sampling technique, i.e., after the Agritex officer, veterinary officer, and one farmer had been identified, these three people were asked to help identify the other four farmers. The focus group discussion was conducted primarily in the Shona language, as all participants were found to be more comfortable expressing themselves in Shona than in English. Some of the participation was in a mixture of Shona and English. While there were guiding questions to the focus group discussion (linked to the survey questionnaire questions as provided in the Appendix), some degree of unfocused discussion was included.

Methodological limitations

Zimbabwe has smallholder farmers in many different areas, including resettlement areas, small-scale farms, and tribal trust lands commonly called "reserves". Havana Extension village in the Tokwe resettlement area is but one village, and therefore, the experiences of Havana Extension farmers cannot be said to be representative of all Zimbabwean smallholder farmers.

Additionally, while focus group discussions are a vital tool for qualitative research data collection, they also have inherent weaknesses that can affect the outcome of research. Among focus group participants, some may dominate the discussion, and this affects the outcome of the research. Moreover, according to Calder (1977) and Eliot & Associates (2005), focus groups cannot necessarily be expected to produce reliable data on sensitive topics that appeal to feelings and emotions, with poverty being one such issue. Finally, it must be acknowledged that, in some cases, focus group participants have been found to say things that are contrary to actual observable reality.

5. Findings

Respondents' farming activities

The focus group participants provided valuable contextual information about the farming activities being carried out by smallholder farmers in the area under study:

> Farming is a practice which is usually practised by people from all walks of life. When everything else has failed, you find yourself going to the rural areas, and to survive you have to practice farming. Farmers in this area come from diverse backgrounds, but most have a general farming background. (focus group participant)

> Farming involves land preparation, which is done […] usually during harvesting around April-August. We usually plant crops around October and November and […] late December due to change in weather patterns. It is critical to prepare and plant your crops on time in order to get a good yield. (focus group participant)

The focus group participants indicated that the farmers in the area mainly produced cereals, with maize the main product—as it is the staple food for the majority of the Zimbabwean populace. This finding was echoed in the survey results, with all 58 surveyed households indicating that they produce maize more than any other crop (often in combination with other crops such as groundnuts (peanuts), rapoko (millet), sunflowers, and castor beans).

Twenty-seven of the households indicated that they produced cotton up until 2012 but then stopped. (Cash crops such as cotton can be problematic for smallholder

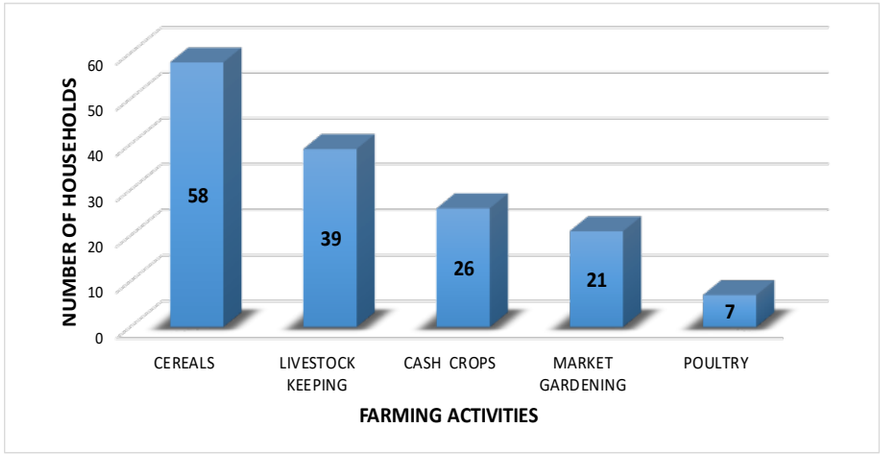
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farmers because they are not for household consumption. As a consequence, marketing options for cash crops can become unreliable.) The farmers in the study said they ceased producing cotton because they had, as one research participant put it, been "robbed" by Cottco, the aforementioned company set up by government to oversee production and buying of all cotton in Zimbabwe. The farmers expressed deep displeasure at the way Cottco had treated them.

The farmers said they had entered into contract-farming relationships with Cottco, in which each farmer was given inputs for cotton production. Cottco had promised the farmers that upon harvesting, they would be able sell their cotton produce to Cottco at USD1/kg. But after harvesting, the farmers were notified that the price was now USD0.24/kg. The farmers refused to sell for some time, hoping for an improvement in the price. But the price did not change, and they eventually had to sell the cotton to Cottco at the USD0.24/kg price. The farmers then ended up owing Cottco money, after the company subtracted the value of inputs (seeds, fertiliser and chemicals) it had advanced to each farmer at the beginning of the farming season. As a result of this experience, all the farmers who participated in this research vowed that they will never produce cotton again. Some of the farmers have started to produce other cash crops, e.g., sunflowers and castor beans.

Thirty-nine of the surveyed households were found to also practise livestock-keeping, for draught power and for selling of animals to augment their incomes, and seven households were practising poultry farming. Twenty-one of the households were practising market gardening, i.e., producing vegetables and tomatoes to sell within the community. Figure 1 shows the survey findings on farming activities.

Figure 1: Respondents' farming activities (n=58)

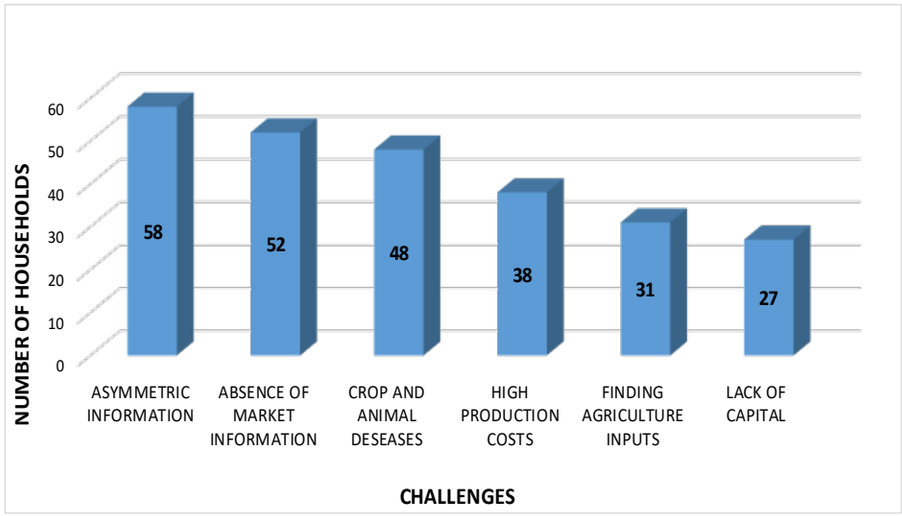


Respondents' challenges faced in agricultural activities

The survey participants generally agreed that there are inherent problems with smallholder farming in their area. In general, it was found that they see themselves as suffering from an inherent vicious cycle of poverty, i.e., poverty causing poverty.

As seen in Figure 2, the two most-cited challenges in respect of agricultural activities were *asymmetry of information* and *absence of market information*, cited by 58 (100%) and 52 (90%) of surveyed households respectively. This tallies with findings by Aker et al. (2016), Jagun et al. (2008), Kadigi et al. (2013), and Mittal (2016), who have found that such information asymmetry and information absence are major impediments to the development of smallholder agriculture.

Figure 2: Respondents' challenges faced in agricultural activities (n=58)



Asymmetry of information, absence of market information

The respondents stated that, in some cases, perishable products go bad due to unavailability of markets, and that when the farmers produce good yields, they seldom benefit as fully as they could. Key causes cited for these difficulties were *spatial arbitrage* (different market prices for the same commodity in different market places at the same time) and *time arbitrage* (different prices for the same product at different time intervals).

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According to one focus group participant,

> […] the major challenge is [that] the market price after harvesting is usually very bad, [so] that a farmer may not be able to recover money for input costs. Sometimes when preparing for the crop season, we get very remarkable prices being announced, but soon after harvesting we are told of very low prices. Sometimes as farmers we are compelled to sell our produce to private buyers [middlemen], who come with their cars and buy. And they go on to sell to such perennially dry places as Chirumanzu and Chivi Districts. (focus group participant)

What this focus group participant describes is an illustration of *spatial arbitrage*: The middlemen, after buying the grain from the farmers, then go and sell the grain at premium prices in drought-stricken areas such as Chivi and Chirumanzu.

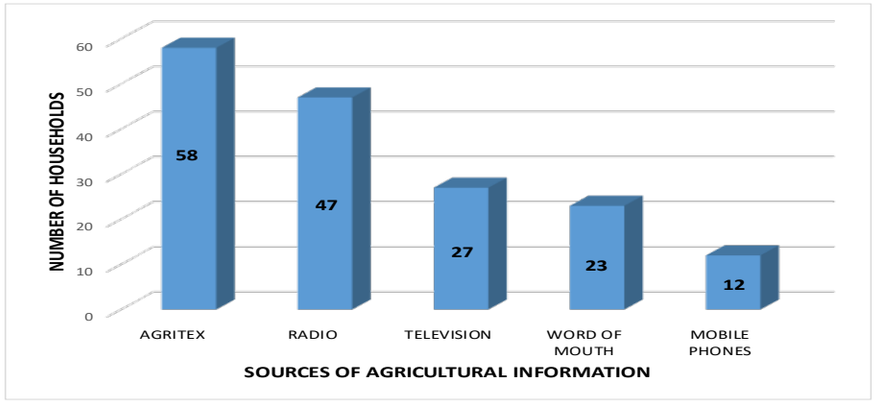
In respect of use of *time arbitrage*, it was said that middlemen and some of the more-established smallholder farmers in Shurugwi District are the chief culprits. The more-established smallholder farmers were said to practise hoarding, i.e., they will not sell when they feel the price is not right, and keep their grain until the price goes up. They also buy grain from less-established smallholder farmers at very low prices—and sometimes even sell it back to these very same farmers at high prices when the farmers are desperate for money (to, for instance, buy food to feed their households, or pay school fees).

Respondents spoke of the myriad forms of persuasion middlemen use to entice farmers to part with their yields. For instance, when winter is commencing, the middlemen come with items such as jackets, vaseline, blankets, and sugar. Farmers' circumstances induce them to buy these products from the middlemen, with payment in the form of grain. According to the focus group discussion, in most cases the middlemen have much more pricing information and other important market information than the farmers, allowing the middlemen to be highly exploitative. The farmers said that by the time they get the information they need, it is typically stale and no longer useful.

Respondents' sources of agricultural information

As shown in Figure 3, all 58 surveyed households said they get agricultural information from an Agritex officer. The next most-used source of agricultural information was found to be radio (47 households), followed by television (27). Twenty-three households said they get farming information through word-of-mouth. Significantly for the purposes of this research, only 12 (21%) of the households indicated that they receive agricultural information via their mobile phones.

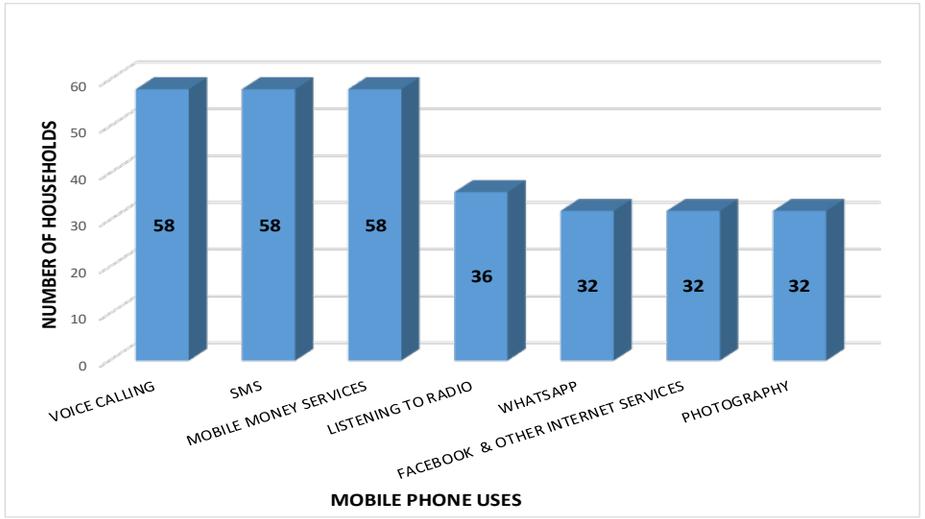
Figure 3: Respondents' sources of agricultural information (n=58)



Respondents' uses of mobile phones

It was found that all 58 households had a mobile phone of some sort, and 37 had more than one (with some households owning up to five mobile phones). Thirty-two of the households had at least one smart phone. Figure 4 shows the uses of mobile phones by the 58 households. All 58 households said, as Figure 5 shows, they use the phones for voice-calling, SMS-messaging and mobile money transfer. The farmers indicated that, through these three uses, the mobile phone has transformed their day-to-day lives.

Figure 4: Respondents' uses of mobile phones (n=58)



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One focus group participant had this to say, in Shona, concerning mobile phones:

> Kune munhu asina cellphone mazuva ano? Ndikasiya cellphone yangu ndinoita sendisina kupfeka. Cellphone yangu yakakosha kudarika doro zvokuti ndikawana mari chekutanga kutenga "juice card" ndozofunga zvedoro.

In English, this translates as:

> Is there anyone without a mobile phone these days? When I mistakenly leave my mobile phone I feel like I am naked. My mobile phone is more important than beer and if I get any money the first thing that comes to my mind is to buy a "juice card" [airtime] and then think of beer later. (focus group participant)

Another focus group participant, who had children living in South Africa, stated that:

> With my phone, I will never be stranded. Once I SMS my children that I need some money, I receive it within minutes, and I go to the nearest shop and cash out my money. (focus group participant)

The 32 households that had smart phones were found, unsurprisingly, to be the ones who take photos, and use WhatsApp, Facebook and other internet services, with their phones (activities that are not possible on non-smart feature phones).

Respondents' uses of mobile phones in support of farming activities

Earlier we saw, in Figure 3, that only 12 (21%) of the households stated that they use mobile phones as a source of agricultural information. However, later in the survey and as shown in Table 2 below, when respondents were given a list of nine farming activities (several of which were agriculture information-gathering activities, such as "enquire for inputs") and asked which ones they use their mobile phones for, it was found that somewhere between 14 and 29 households—i.e., between 24% and 50%—were engaging in each of the nine farming activities via their mobile phones. Thus, the number of households using mobile phones for agricultural information (as defined with more nuance in this latter part of the survey) would seem to be higher than the figure of 12 households (21%) from earlier in the survey suggests.

Nevertheless, even the higher percentages of mobile-phone engagement with agricultural information detected do not top 50%, meaning that—since 100% of the households were found to have at least one mobile phone—there are still at least 50% of households not yet using their mobile phones in support of obtaining agricultural information and conducting their farming activities.

Table 2: Respondents' use of mobile phones in support of farming activities (n=58)

	Farming activity via mobile phone	No. of households using mobile phones for the activity	Percentage of households using mobile phones for the activity
1	general farming housekeeping	29	50%
2	enquire for inputs	27	47%
3	[obtain] weather information	25	43%
4	[obtain] market price for inputs	23	40%
5	pre-planting management	21	36%
6	[obtain] pest and disease control information	19	33%
7	animal husbandry	18	31%
8	post harvesting management	15	26%
9	[obtain] market price for produce	14	24%

As seen in Table 2, the highest-percentage response for use of mobile phones in support of farming activities, at 50%, was for use for "general farming housekeeping". The lowest percentage, at 24%, was for use of a mobile phone for enquiring to "[obtain] market price for produce"—an interesting finding given the fact that, as we saw above, "absence of market information" was the second-most cited challenge faced in agricultural activities. (This apparent contrast between the farming households' strong felt need to get more market information and, at the same time, there weak adoption of mobile telephony as a means to acquire this information, is, at first glance, puzzling given that there are existing mobile agricultural information platforms in Zimbabwe, e.g., EcoFarmer, Mobi Agri, eMKambo and eHurudza. However, during the survey and the focus group discussion, it was found that not one of the respondents had heard of any of these platforms.)

Researcher observations

From the general observations I was able to make at the time of carrying out the research, those households that were using mobile phones in support of many of their farming activities were those that were comparatively well-resourced among the 58 surveyed households. These households tended to have homestead assets such as scotch carts (two-wheeled carts), granaries, and cattle. Meanwhile, the households not using mobile phones for agricultural purposes tended to be less-well-resourced. However, it was not within the ambit of this baseline research to probe potential correlations between livelihood success and mobile phone use for agricultural purposes.

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6. Analysis, conclusions and recommendations

This baseline study found that mobile phone use is prevalent among the smallholder farming households in Zimbabwe's Havana Extension village, with every household that participated in the research having at least one mobile phone of some sort. But at the same time, the study found that when respondents were prompted to consider how they might be using their mobile phones for farming activities, a full 50% (29) of the households did not select any of the nine options. Meanwhile, the two key agricultural challenges selected by more than 50% of respondent households were asymmetry of information (selected by 100% of households) and absence of market information (selected by 90% of households)—two challenges that could be addressed, at least to some extent, through acquisition of information via mobile telephony.

Thus, while much of the available literature (see Ilahiane & Sherry, 2009; Masuka et al., 2016; Wyche & Steinfield, 2016; Zanello, 2011) posits a relationship between farmers' mobile phone use and positive effects on the farmers' agricultural activities, the findings of this baseline study show that the relationship is by no means automatic, at least in respect of the farmer households in the particular Zimbabwean village studied.

It seems clear that many, if not all, of the smallholder farmers of Havana Extension could benefit, at least to some extent, from using their mobile phones to engage with one or more of the existing mobile agricultural platforms serving Zimbabwe, e.g., the aforementioned EcoFarmer, Mobi Agri, eMKambo and eHurudza. But, as mentioned above, none of the surveyed farmers said they knew of these platforms. Accordingly, there could be merit in the Zimbabwean Government taking a leading role in facilitating the development of an all-encompassing mobile application that could be used to disseminate agricultural information in respect of prices and availability of inputs (e.g., seeds, fertilisers, chemicals); and market information, as provided by different buyers, for sale of agricultural products.

Such a mobile application could facilitate negotiation between smallholder farmers and both input providers and agricultural product buyers. For instance, based on the information available through such an application, smallholder farmers could collectively negotiate with suppliers and send representatives to collect inputs on behalf of a group of farmers, thus cutting travel costs and allowing selection of well-priced inputs. Similar collective actions could be undertaken for sale of the farmers' products.

Such an application could be supported by the Government of Zimbabwe through the Ministry of Agriculture. At the time of carrying out this research, the

government, through the Ministry of Health and Child Welfare, was facilitating health information, through mobile phones, to all citizens. Therefore, it would seem that, with political will, an all-encompassing application in support of Zimbabwean smallholder agriculture could also come to fruition.

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Appendix: Survey questionnaire

This study is important because smallholder farmers have become critical in the economic welfare of Zimbabwe. Over the past two decades the Zimbabwe economy experienced a continued downfall which resulted in the collapse of the commercial farming and the agribusiness formal industry. As a result farmers are faced with challenges when it comes to selling their products. Therefore understanding the smallholder farmers' operations and how they are using mobile technologies in their business has become critical to the ICT4D [ICT for development] discourse. This study will provide greater nuances to the people into the understanding of the implications of mobile communication technologies to assist in the achievement of development initiatives.

Your responses will only be used for the purposes of this research. To ensure your anonymity, you will not be asked about your name [...].

1) What are the agricultural practices you are involved in? Please tick all that apply to you.

I. Cereals
II. Cash crops
III. Market gardening
IV. Livestock keeping
V. Poultry

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2) What are the challenges you face in the agricultural activities? Please tick all that apply to you.

I. Asymmetry of information
II. High production costs
III. Absence of market information
IV. Lack of capital
V. Challenge of finding agriculture inputs
VI. Crop and animal diseases

3) What are the sources of agricultural information for you? Please tick all that apply to you.

I. Radio
II. Television
III. Agritex
IV. Word of mouth
V. Mobile phones

4) a) Does anyone in the household own a mobile phone? Tick where appropriate.

I. Yes
II. No

b) Does anyone in the household own a smartphone? Tick where appropriate.

I. Yes
II. No

c) What do you use the mobile phone for? Please tick all that apply to you.

I. Listening to radio
II. Voice calling
III. SMS
IV. Photography
V. Mobile money services
VI. Facebook and other internet services
VII. WhatsApp

d) Which farming activities do you use your mobile phone for? Please tick all that apply to you.

I. Pre-planting management
II. Enquire for inputs
III. Market price for inputs
IV. Market price for produce
V. Pest and disease control information
VI. General farming housekeeping
VII. Weather information
VIII. Post harvesting management
IX. Animal husbandry

Evolution of Africa's Intellectual Property Treaty Ratification Landscape

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Abstract
Intellectual property (IP) policy is an important contributor to economic growth and human development. However, international commitments harmonised in IP treaties often exist in tension with local needs for flexibility. This article tracks the adoption of IP treaties in Africa over a 131-year span, from 1884 to 2015, through breaking it down into four periods demarcated by points in time coinciding with key events in African and international IP law: the periods 1884–1935, 1936–1965, 1966–1995, and 1996–2015. The article explores relevant historical and legal aspects of each of these four periods, in order to assess and contextualise the evolutions of the IP treaty landscape on the continent. The findings show that treaties now saturate the IP policy space throughout the continent, limiting the ability to locally tailor approaches to knowledge governance.

Keywords
international law, Africa, intellectual property (IP), treaty ratification, development, data visualisation, WIPO, WTO, trade, harmonisation

DOI: https://doi.org/10.23962/10539/26173

Recommended citation
De Beer, J., Baarbé, J., & Ncube, C. (2018). Evolution of Africa's intellectual property treaty ratification landscape. *The African Journal of Information and Communication (AJIC)*, *22*, 53-82. https://doi.org/10.23962/10539/26173

Acknowledgements
This work was carried out under the auspices of the Open African Innovation Research (Open AIR) network, with financial support from Open AIR, the Social Sciences and Humanities Research Council (SSHRC) of Canada, the International Development Research Centre (IDRC), and the UK Department for International Development (DFID). This work is also based on research supported in part by the National Research Foundation (NRF) of South Africa. Any opinion, finding and conclusion or recommendation expressed in this material

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is that of the authors and the funders do not accept any liability in this regard. This article draws on the contents of a 2017 Open AIR Working Paper (De Beer, Baarbé & Ncube, 2017) by the same authors.

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1. Introduction

Innovation policy is important for economic growth and human development (Muchie, 2016, p. 26). Countries across Africa are, therefore, developing policy to encourage innovation (Adesida, Karuri-Sebina & Resende-Santos, 2016). Measures that address intellectual property (IP) in a locally relevant way are integral to the broader innovation landscape.

IP policy is complex and controversial because it seeks to balance protection of, and access to, knowledge. Policy that leads to either an absence, or overabundance, of proprietary IP rights may discourage innovation (Heller & Eisenberg, 1998, p. 698). Domestic policymakers may look to research showing that strict IP protection economically advantages developed countries while disadvantaging developing countries (Forero-Pineda, 2006; Schneider, 2005). Similarly, they may be presented with research supporting a contrary view (Gathii, 2016). Evidence-based IP policymaking is, therefore, often a fraught exercise (De Beer, 2016).

The international dimensions of IP are as complex, and often in fact more complex, than domestic aspects. Because IP protects valuable intangibles, these resources move easily across borders. Accordingly, international treaties set out minimum standards for IP protections. There is tension between international harmonisation (on the belief that it promotes predictability and, thus, foreign direct investment and international trade) versus national flexibility (to eliminate trade barriers, and to ensure national governments are able to develop policies that respond to local needs).

National governments on the African continent are increasingly constrained by international IP law when seeking to tailor their approaches to localised knowledge governance priorities. At the same time, there have in recent years been significant continental and regional developments in Africa with respect to IP norm-setting (Ncube, 2016). Meanwhile, the confluence of IP policy with trade policy has generated an additional layer of complexity to the already-wide array of international negotiations (De Beer, 2013).

There is research evidence showing that the pressures exerted by the international harmonisation agenda has resulted in "IP socialisation", resulting in ostensibly context-inappropriate IP norms frequently being adopted in developing countries (Morin, Daley, & Gold, 2011). Research is also emerging that generates recommendations of appropriate strategic directions for African policymakers to take in pursuit of African-context-appropriate IP norms and deeper continent-wide economic integration (Ncube, Schonwetter, De Beer & Oguamanam, 2017). The ability to implement such recommendations is, however, constrained to some extent by the powerful global IP governance schemata.

In this article, we describe the results of a study in which we mapped a 130-year history of influence by the international IP treaty landscape on governance of, protection of, and access to, knowledge in Africa. We begin by describing our data collection and visualisation methods, used to interrogate the history and extent of African countries' binding to the global IP regime.

Our findings and analysis are organised into four distinct periods of treaty-making history. The demarcations from one period to another are not bright lines reflecting sudden transformations. Rather, we identified these broad and general phases in the proliferation of IP treaties in Africa by combining quantitative insights from our dataset together with multi-disciplinary literature on the political and economic development of Africa during the modern era of multilateral IP norm-making.

With respect to the period 1885 and 1935, we describe how IP treaties were instruments of colonialism. Between 1936 and 1965, we observe how treaties were maintained in a neo-colonial response to independence. Then, we find the period from 1966 to 1995 characterised by attempts to limit the influence of African countries on global IP policy. Finally, in the "African rising" phase from 1996 to 2015, we see increasing focus on innovation policy as the frame within which African national, regional and continental IP policies must sit.

2. Methods

We engaged in four overlapping activities for our data collection, analysis and presentation:

- identification of international IP treaties;
- gathering, processing and validating of treaty data and treaty ratification data;
- development of an interactive map showing ratifications; and
- quantitative and qualitative data analysis. [1]

1 Dataset available at https://doi.org/10.23962/10539/2619

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Identification of international IP treaties

We began by identifying relevant international treaties and agreements. A review of WIPO's website and other resources (Frankel & Gervais, 2016; UNECA, 2016; WIPO, n.d.) provided a list of 34 instruments that met the following criteria for inclusion:

- the instrument is multilateral;
- the list of parties to the instrument includes at least one African country; and
- the instrument binds signatories to take measures in respect of:
    - copyrights;
    - patents;
    - trademarks;
    - trade secrets;
    - traditional knowledge;
    - bio-diversity; and/or
    - genetic resources.

We did not include multilateral trade agreements or economic partnerships, apart from the WTO Agreement on Trade-Related Aspects of Intellectual Property (TRIPS), which is Annex 1C of the Marrakesh Agreement Establishing the World Trade Organisation (WTO). While other trade and economic partnership agreements and partnerships are highly relevant to the international IP landscape governing knowledge in Africa, mapping their proliferation and analysing their implications would require different methods and data sources. That work remains to be done.

The World Intellectual Property Organisation (WIPO) administers 26 treaties, all of which met the criteria for inclusion in the study, listed among the items in Table 1 below (WIPO, n.d.). WIPO curates records of four additional treaties by making them available on its WIPO Lex database: TRIPS (pursuant to a cooperation agreement between WIPO and the WTO), the International Treaty on Plant Genetic Resources, and the Universal Copyright Convention (UCC), which are also included in Table 1. The Beijing Treaty on Audiovisual Performances, and the Washington Treaty on Intellectual Property in Respect of Integrated Circuits, are not yet in force, and therefore excluded from our analysis.

We accessed information pertaining to the other three agreements in Table 1—the Convention on Biological Diversity (CBD)'s Nagoya Protocol on Access and Benefit Sharing, the International Treaty on Plant Genetic Resources for Food and Agriculture (IT PGRFA), and the International Union for the Protection of New Varieties of Plants (UPOV)—on their respective websites (CBD, n.d., IT PGRFA, n.d., UPOV, n.d.). Only publicly available records, published online, were used in this study. These agreements are not all dedicated "IP" instruments in the sense that the

WIPO-administered treaties and the TRIPS Agreement are. Rather, they contain provisions that are pertinent to IP protection and have been included in this study due to their significance.

Table 1: International IP treaties identified (n=34), in alphabetical order

Treaty (year)	IP regime	Source
Beijing Treaty on Audiovisual Performances (2012)	Copyrights	WIPO
Berne Convention for the Protection for Literary and Artistic Works (1886)	Copyrights	WIPO
Brussels Convention Relating to the Distribution of Programme-Carrying Signals Transmitted by Satellite (1974)	Neighbouring Rights	WIPO
Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure (1977)	Patents	WIPO
Convention for the Protection of Producers of Phonograms against Unauthorised Duplication of Their Phonograms (1971)	Neighbouring Rights	WIPO
Hague Agreement Concerning the International Registration of Industrial Designs (1925)	Industrial Designs	WIPO
International Treaty on Plant Genetic Resources for Food and Agriculture (2001)	Plant Genetic Resources	FAO
Lisbon Agreement for the Protection of Appellations of Origin and their International Registration (1958)	Geographic Indications	WIPO
Locarno Agreement Establishing an International Classification for Industrial Designs (1968)	Industrial Designs	WIPO
Madrid Agreement for the Repression of False or Deceptive Indications of Sources of Goods (1891)	Trademarks	WIPO
Madrid Agreement Concerning International Registration of Marks (1891)	Trademarks	WIPO
Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks (1989)	Trademarks	WIPO
Marrakesh Visually Impaired Persons Treaty (2013)	Copyrights	WIPO
Nagoya Protocol on Access and Benefit Sharing (2010)	Access and Benefit Sharing	CBD Secretariat
Nairobi Treaty on the Protection of the Olympic Symbol (1981)	Trademarks	WIPO
Nice Agreement Concerning the International Classification of Goods and Services for the Purposes of the Registration of Marks (1957)	Trademarks	WIPO

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Paris Convention for the Protection of Industrial Property (1883)	Patents and Trademarks	WIPO
Patent Cooperation Treaty (PCT) (1970)	Patents	WIPO
Patent Law Treaty (2000)	Patents	WIPO
Rome Convention for the Protection of Performers, Producers of Phonographs, and Broadcasting Organisations (1961)	Copyrights	WIPO
Singapore Treaty on the Law of Trademarks (2000)	Trademarks	WIPO
Strasbourg Agreement Concerning the International Patent Classification (1971)	Patents	WIPO
Trademark Law Treaty (1994)	Trademarks	WIPO
Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) (1995)	Comprehensive	WIPO
Universal Copyright Convention (UCC) (1952)	Copyrights	UNESCO
Universal Copyright Convention (UCC) (1971)	Copyrights	UNESCO
UN Convention on WIPO (1967)	Copyrights	WIPO
International Convention for the Protection of New Varieties of Plants (UPOV Convention) (1961)	Plant Varieties	UPOV
International Convention for the Protection of New Varieties of Plants (UPOV Convention) (1978)	Plant Varieties	UPOV
International Convention for the Protection of New Varieties of Plants (UPOV Convention) (1991)	Plant Varieties	UPOV
Vienna Agreement Establishing an International Classification of the Figurative Elements of Marks (1973)	Trademarks	WIPO
Washington Treaty on Intellectual Property in Respect of Integrated Circuits (1989)	Computer Chips	WIPO
WIPO Copyright Treaty (WCT) (1996)	Copyrights	WIPO
WIPO Performances and Phonograms Treaty (WPPT) (1996)	Neighbouring Rights	WIPO

Gathering, processing and validating treaty and treaty ratification data

Treaties administered by WIPO include a "Contracting Parties" section containing a table listing parties to the treaty, as well as the date of signature, filling of legal instrument used to ratify the treaty, and entry into force, amongst other details. Similar tables were available for the Nagoya Protocol, which is administered by the Secretariat of the Convention on Biological Diversity (CBD), and the International Treaty on Plant Genetic Resources, administered through the UN Food and Agriculture Organisation (FAO). From these online tables we scraped the raw data

for each treaty and their accompanying acts into an Excel database. Data from each treaty and act were deposited in a separate sheet in the database. Because tables were not available online for the three UPOV treaties (1961, 1978, 1991), we constructed the data manually from the list of convention notifications.

In summary, we were able to gather data on:

- ratifications of 34 IP treaties
- IP ratification behaviour in respect of the 34 treaties by 54 African countries over a 131-year period, from 1884 to 2015
- a total of 485 ratifications by the 54 countries

We then cleaned and processed the data. After ensuring all entries were represented in machine-readable formats, we began by identifying and isolating the entries for African countries and then compiled the data into a series of aggregated tables for use in the study. Because WIPO reports which of its Member States have acceded to, or ratified, the treaties that it administers, only those states listed by WIPO or other administering organisations were included in the study. We loaded a polished, user-friendly version of the database, entitled "Status of IP Treaties in Africa", to Airtable.com, a cloud database provider, so that the database can be used as an open source resource by other researchers and the general public (Baarbé & De Beer, 2016).

Development of interactive map showing ratifications

In order to visualise African countries' ratification of international IP treaties in temporal and spatial terms, we developed an interactive web map application (Baarbé, 2016; baarbeh, n.d.). The application superimposes a vector circle over each African country, representing the number of treaties ratified by that country. The larger the circle, the greater number of treaties the country has ratified. A slider changes the display in five-year increments ranging from 1885 to 2015, allowing users to view the history of IP treaty ratification across a 130-year period. We used JavaScript, the Leaflet.js data-mapping library, and Mapbox to develop the web application (Leaflet, n.d.; Mapbox.com, n.d.). We sourced latitudinal and longitudinal data from Google's Open Dataset Canonical Concepts repository (Google Developers, n.d.). The application is based on Donohue, Sack and Roth's time-series mapping tutorial (Donohue, Sack & Roth, 2013).

Quantitative and qualitative analysis

Quantitatively, the extracted descriptive statistics showed the status of treaty ratifications across the continent, identifying which national IP contexts were offering more or fewer opportunities for localised IP policy innovation. (MS Excel was used to calculate common statistical descriptors.) Qualitatively, the interactive map revealed the 130-year history of IP treaty adoption in Africa, providing contrasts between colonial/neo-colonial legacies of the international IP system and more recent, post-colonial attempts to engender developmental approaches to knowledge governance.

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This research also potentially lays the groundwork for future analyses using inferential statistics to investigate longitudinal relationships between IP treaty adoption and metrics such as the Human Development Index, the Global Innovation Index, and national gross domestic product (GDP).

3. Findings and discussion

Ratifications between 1884 and 2015

As explained above our database tracks the years—beginning in 1884, when Tunisia ratified the Paris Agreement—on which 54 African countries ratified 34 international IP treaties across a 131-year time span, up to the end of 2015. During this time, the total number of ratifications grew to 485. Table 2 shows the evolution of the ratifications in tabular form, with cumulative African ratification totals at four moments in time:

- 1935
- 1965
- 1995
- 2015

Ratification dates were used because they represent the date on which legal obligations take effect. For TRIPS, because countries did not have to ratify it, its in-force date of 1995 was used as a measure of legal obligation on a country. Although TRIPS came into force in 1995, a series of transition periods in the Agreement exempted some countries from complying with its provisions. For instance, Article 66.1 gave least developed countries (LDCs) a 10-year compliance transition period, starting 1 January 1996, which exempted them from compliance with TRIPS provisions except for Article 3 (national treatment), Article 4 (most-favoured-nation (MFN) treatment), and Article 5 (precedence of WIPO procedures). This transition period was later extended for a further seven and a half years (until 1 July 2013), and thereafter for a further eight years (until 1 July 2021, or earlier should the LDC become a developing country).

Table 2: IP treaty ratifications by African countries up to 2015

Treaty	Regime (source)	Cumulative totals: No. of African countries who have ratified the treaty			
		Up to end of 1935	Up to end of 1965	Up to end of 1995	Up to end of 2015
Beijing Treaty on Audiovisual Performances (2012)	Copyrights (WIPO)				1
Berne Convention for the Protection for Literary and Artistic Works (1886)	Copyrights (WIPO)	3	13	35	44
Brussels Convention Relating to the Distribution of Programme-Carrying Signals Transmitted by Satellite (1974)	Neighbouring Rights (WIPO)			2	4
Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the Purposes of Patent Procedure (1977)	Patents (WIPO)				3
Convention for the Protection of Producers of Phonograms against Unauthorised Duplication of Their Phonograms (1971)	Neighbouring Rights (WIPO)			4	6
Hague Agreement Concerning the International Registration of Industrial Designs (1925)	Industrial Designs (WIPO)	2	3	6	15
International Treaty on Plant Genetic Resources for Food and Agriculture (2001)	Plant Genetic Resources (FAO)				42
Lisbon Agreement for the Protection of Appellations of Origin and their International Registration (1958)	Geographic Indications (WIPO)			6	6
Locarno Agreement Establishing an International Classification for Industrial Designs (1968)	Industrial Designs (WIPO)			1	2
Madrid Agreement for the Repression of False or Deceptive Indications of Sources of Goods (1891)	Trademarks (WIPO)	2	3	4	4
Madrid Agreement Concerning International Registration of Marks (1891)	Trademarks (WIPO)	1	2	5	11

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Protocol Relating to the Madrid Agreement Concerning the International Registration of Marks (1989)	Trademarks (WIPO)				21
Marrakesh Visually Impaired Persons Treaty (2013)	Copyrights (WIPO)				1
Nagoya Protocol on Access and Benefit Sharing (2010)	Access and Benefit Sharing (CBD Secretariat)				30
Nairobi Treaty on the Protection of the Olympic Symbol (1981)	Trademarks (WIPO)			11	11
Nice Agreement Concerning the International Classification of Goods and Services for the Purposes of the Registration of Marks (1957)	Trademarks (WIPO)			5	9
Paris Convention for the Protection of Industrial Property (1883)	Patents and Trademarks (WIPO)	2	22	39	49
Patent Cooperation Treaty (PCT) (1970)	Patents (WIPO)			22	45
Patent Law Treaty (2000)	Patents (WIPO)				1
Rome Convention for the Protection of Performers, Producers of Phonographs, and Broadcasting Organisations (1961)	Copyrights (WIPO)		2	5	9
Singapore Treaty on the Law of Trademarks (2000)	Trademarks (WIPO)				3
Strasbourg Agreement Concerning the International Patent Classification (1971)	Patents (WIPO)			2	3
Trademark Law Treaty (1994)	Trademarks (WIPO)				4
Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) (1995)	Comprehensive (WIPO)			33	43
Universal Copyright Convention (UCC) (1952)	Copyrights (UNESCO)		4	14	15
Universal Copyright Convention (UCC) (1971)	Copyrights (UNESCO)			9	10
UN Convention on WIPO (1967)	Copyrights (WIPO)			43	53
International Convention for the Protection of New Varieties of Plants (UPOV Convention) (1961)	Plant Varieties (UPOV)			1	1
International Convention for the Protection of New Varieties of Plants (UPOV Convention) (1978)	Plant Varieties (UPOV)			1	2
International Convention for the Protection of New Varieties of Plants (UPOV Convention) (1991)	Plant Varieties (UPOV)				3
Vienna Agreement Establishing an International Classification of the Figurative Elements of Marks (1973)	Trademarks (WIPO)			1	2
Washington Treaty on Intellectual Property in Respect of Integrated Circuits (1989)	Computer Chips (WIPO)			1	1
WIPO Copyright Treaty (WCT) (1996)	Copyrights (WIPO)				12
WIPO Performances and Phonograms Treaty (WPPT) (1996)	Neighbouring Rights (WIPO)				12

Table 3 (on pp. 64-65) presents the cumulative number of treaties ratified by each of 54 African countries, on or before 1935 and 1965. Table 4 (on pp. 66-67) presents the same information for 1995, and 2015. Both tables also display the relative adoption of treaties as a percentage of all IP treaties in force and available to be ratified at that time. And together the tables also provide—for each of the four years of study: 1935, 1965, 1995 and 2015—the minimum and maximum possible number of treaties signed by any one country, and the median, mean (average) and standard deviation for the number of treaties signed by the signatory countries.

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Table 3: Ratification status of African countries, 1935 and 1965

Country	Up to end of 1935		Up to end of 1965	
	Treaties ratified	% of treaties in force (5)	Treaties ratified	% of treaties in force (11)
Algeria			1	9.1%
Angola				
Benin			1	9.1%
Botswana				
Burkina Faso			2	18.2%
Burundi				
Cameroon			2	18.2%
Cabo Verde				
Comoros				
Central African Republic			1	9.1%
Chad			1	9.1%
Congo			3	27.3%
Democratic Republic of the Congo			1	9.1%
Djibouti				
Egypt			4	36.4%
Equatorial Guinea				
Eritrea				
Ethiopia				
Gabon			2	18.2%
The Gambia				
Ghana			1	9.1%
Guinea-Bissau				
Guinea				
Côte d'Ivoire			2	18.2%
Kenya			1	9.1%
Lesotho				
Liberia			1	9.1%
Libya				
Madagascar			1	9.1%
Malawi			2	18.2%
Mali			1	9.1%
Mauritania			1	9.1%
Mauritius				
Morocco	5	100%	5	45.5%
Mozambique				
Namibia				
Niger			3	27.3%
Nigeria			2	18.2%
Rwanda				
Sao Tome and Principe				
Senegal			2	18.2%
Seychelles				
Sierra Leone				
Somalia				
South Africa	1	20%	2	18.2%
South Sudan				
Sudan				
Swaziland				
United Republic of Tanzania			1	9.1%
Togo				
Tunisia	4	80%	4	36.4%
Uganda			1	9.1%
Zambia			1	9.1%
Zimbabwe				
Min.	**1**		**1**	
Max.	**5**		**5**	
Median	**4**		**1**	
Mean (standard deviation)	**3.3 (1.7)**		**1.8 (1.1)**	
Total signatory countries	**3 countries**		**27 countries**	

Notes:
Min. = minimum possible number of treaties signed by any one country
Max. = maximum possible number of treaties signed by any one country
Median = median (middle-value) number of treaties signed by any one country
Mean = average number of treaties signed by any one country
Standard deviation = average deviation from the mean (average) value

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Table 4: Ratification status of African countries, 1995 and 2015

Country	Up to end of 1995		Up to end of 2015	
	Treaties ratified	% of treaties in force (26)	Treaties ratified	% of treaties in force (34)
Algeria	9	34.6%	16	47.1%
Angola	1	3.8%	5	14.7%
Benin	6	23.1%	12	35.3%
Botswana	1	3.8%	11	32.4%
Burkina Faso	8	30.8%	13	38.2%
Burundi	3	11.5%	5	14.7%
Cameroon	7	26.9%	8	23.5%
Cabo Verde			4	11.8%
Comoros			5	14.7%
Central African Republic	5	19.2%	5	14.7%
Chad	4	15.4%	6	17.6%
Congo	7	26.9%	10	29.4%
Democratic Republic of the Congo	4	15.4%	7	20.6%
Djibouti	1	3.8%	6	17.6%
Egypt	11	42.3%	17	50%
Equatorial Guinea	1	3.8%	5	14.7%
Eritrea			2	5.9%
Ethiopia	1	3.8%	4	11.8%
Gabon	6	23.1%	11	32.4%
The Gambia	3	11.5%	7	20.6%
Ghana	5	19.2%	11	32.4%
Guinea-Bissau	4	15.4%	7	20.6%
Guinea	7	26.9%	16	47.1%
Côte d'Ivoire	6	23.1%	8	23.5%
Kenya	10	38.5%	15	44.1%
Lesotho	6	23.1%	10	29.4%
Liberia	6	23.1%	11	32.4%
Libya	3	11.5%	5	14.7%
Madagascar	5	19.2%	10	29.4%
Malawi	9	34.6%	11	32.4%
Mali	5	19.2%	11	32.4%
Mauritania	5	19.2%	7	20.6%
Mauritius	5	19.2%	7	20.6%
Morocco	12	46.2%	20	58.8%
Mozambique	1	3.8%	9	26.5%
Namibia	3	11.5%	10	29.4%
Niger	7	26.9%	11	32.4%
Nigeria	6	23.1%	8	23.5%
Rwanda	5	19.2%	12	35.3%
Sao Tome and Principe			5	14.7%
Senegal	9	34.6%	12	35.3%
Seychelles			6	17.6%
Sierra Leone	2	7.7%	7	20.6%
Somalia	1	3.8%	1	2.9%
South Africa	6	23.1%	9	26.5%
South Sudan				
Sudan	4	15.4%	8	23.5%
Swaziland	4	15.4%	8	23.5%
United Republic of Tanzania	4	15.4%	8	23.5%
Togo	7	26.9%	15	44.1%
Tunisia	12	46.2%	17	50%
Uganda	5	19.2%	7	20.6%
Zambia	4	15.4%	7	20.6%
Zimbabwe	4	15.4%	7	20.6%
Min.	**1**		**1**	
Max.	**12**		**20**	
Median	**5**		**8**	
Mean (standard deviation)	**5.2 (2.8)**		**9.0 (4.0)**	
Total signatory countries	**48 countries**		**53 countries**	

Notes:
Min. = minimum possible number of treaties signed by any one country
Max. = maximum possible number of treaties signed by any one country
Median = median (middle-value) number of treaties signed by any one country
Mean = average number of treaties signed by any one country
Standard deviation = average deviation from the mean (average) value

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Africa's colonial IP regime up to 1935

In October 1935, Italy, under Mussolini, invaded Abyssinia (now Ethiopia), marking the end of the "Scramble for Africa" and the "golden age of colonialism" (Mazrui & Wondji, 1993 p. 58; Shillington, 1989, p. 301). Economies across Africa were struggling to emerge from global recession. Italy's invasion of Ethiopia challenged international diplomacy, as the League of Nations was powerless to prevent aggression between two of its Member States.

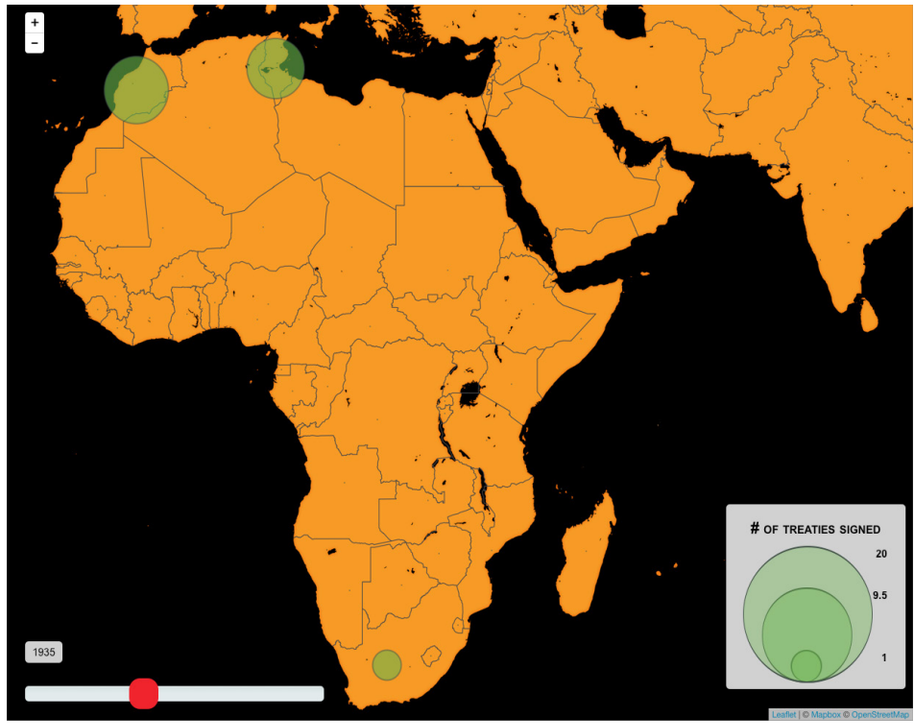
Fifty years earlier, at the beginning of the "Scramble", the colonial powers of Britain, Belgium, France, Germany, Italy and Spain formed an international (yet decidedly Eurocentric) IP union. The Paris Convention (1883) protected industrial property, including patents; the Berne Convention (1886) protected the copyright of authors and publishers; and the Madrid Agreements (1891) protected trademarks and the counterfeiting of goods. Later, the Hague Agreement (1925) protected industrial designs. These treaties were designed to extend the national IP policies of the colonial powers to as many markets as possible, with no substantive input from the colonised countries into the content of these treaties.

European powers agreed to carve up the continent of Africa at the Berlin West Africa Conference (1884-85), with the goal of controlling African markets (Shillington, 1989, pp. 301–05). IP treaties were, accordingly, used as instruments of colonial control of creative and industrial markets, in service to European rights-holders (Peukert, 2016, p. 40). For example, prior to 1886, authors in the colonies of the British Empire had to first publish their works in the United Kingdom in order to acquire copyright that would be valid in their home countries (Peukert, 2016, p. 41). Other colonial powers were more explicit in their discrimination. German legislation expressly prevented *"eingeborne"* ("natives") from holding rights to IP (Peukert, 2016, p. 41).

By 1935, according to WIPO, only three African countries (Morocco, South Africa, and Tunisia) had ratified international IP treaties. Morocco had ratified all of the five treaties in force at the time. South Africa had ratified one treaty. Tunisia, had ratified four treaties, three of which it was a negotiating party to: the Berne Convention, the Hague Agreement and the Madrid Agreement (Indications of Sources of Goods).

The Moroccan and Tunisian ratifications were effected through the colonial power, France, under which they fell. For example, a French law professor represented Tunisia in Berne, while French diplomats represented Tunisia in Madrid and The Hague (Peukert, 2016, p. 440). Figure 1 provides a graphical representation, as extracted from the aforementioned interactive web map application.

Figure 1: African IP treaty signatory landscape in 1935



Not represented in Figure 1 (or earlier in Table 3) are the African colonies which were made subject to international IP treaties through the decisions of their colonial masters. Article 19 of the Berne Convention (1886) expressly gives "[c]ountries acceding to the present Convention […] the right to accede thereto at any time for their Colonies." A similar provision was added to the Paris Convention, the Hague Agreement and the Madrid Agreements during the London Revision Conference in 1934 (Bodenhusen, 1969, p. 18). All colonial powers used these provisions during this period to unilaterally declare that treaty obligations extended to their colonies. However, we have not been able to include these data points in our dataset because these declarations are not readily available on any website we located. For example, WIPO notes under "Details" that France's ratification of Berne included colonies but does not specify which colonies, or when the treaty obligations took effect.

The period 1936 to 1965: IP's shift from colonial to post-colonial tool

In September 1940 Italian forces invaded Egypt, escalating confrontation on the African front of the Second World War. Throughout the war, French and British colonies provided troops and resources that were essential to the Allied war effort. After the war, rising African nationalism and Europe's reduced capacity to maintain control over the colonies led to a movement for independence across the continent

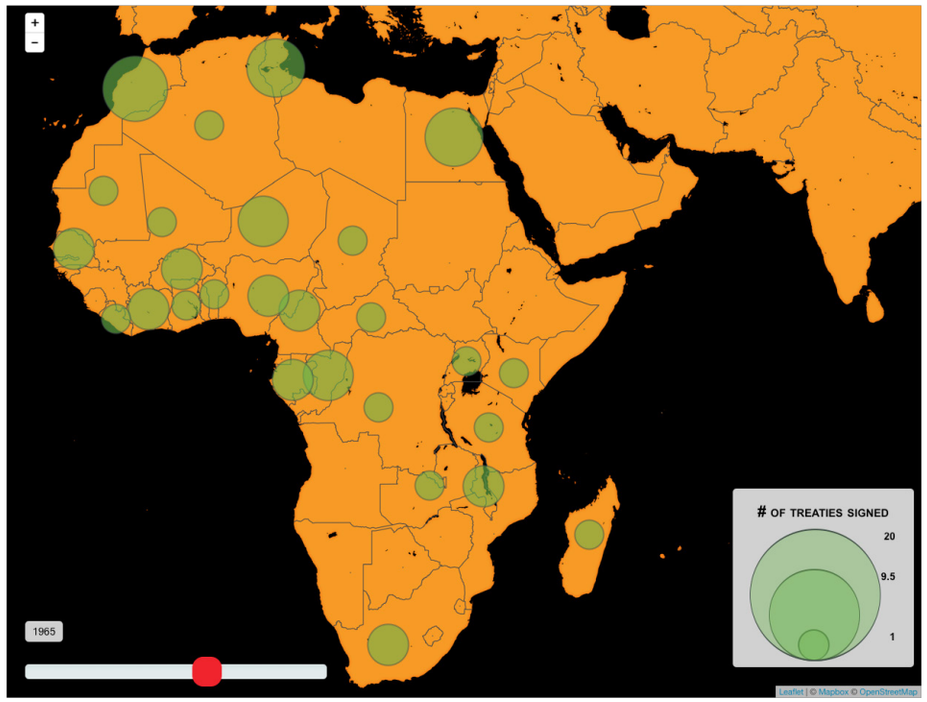
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(Shillington, 1989, p. 374). By 1965, 38 African countries had achieved independence (Shillington, 1989, pp. 373–406).

During this period of decolonisation, the Bureaux Internationaux Réunis pour la Protection de la Propriété Intellectuelle (BIRPI), the precursor to WIPO, worried that newly independent African countries would abandon the international IP regime. By this time it was widely recognised that developing countries benefited from relaxed IP protections. Additionally, the international IP regime maintains a Western paradigm of creativity and ownership that does not reflect African realities.

In March 1960, BIRPI sent a letter to newly independent African countries suggesting that they formally declare continued adherence to the international IP regime, for the sake of "legal security" (Peukert, 2016, p. 51). Around this time, a number of transnational organisations held seminars in Africa, promoting robust IP protections as essential for economic prosperity (Peukert, 2016, pp. 52–53). As a result, most newly independent countries declared membership in the international IP regime shortly after gaining independence.

Figure 2: African IP treaty signatory landscape in 1965



Commentators point out that these attempts to stabilise international IP law were a form of neo-colonialism (Lazar, 1969; Peukert, 2016, p. 51; Rahmatian, 2009). Treaty membership imposed the same legal obligations as under colonial control, guaranteeing foreign ownership rights. At the same time, newly formed countries were prevented from developing IP policy to address local needs, including providing access to knowledge for education or protecting indigenous knowledge. Some of the countries were persuaded or pressured into adopting minimum standards which were not appropriate or even required of them, i.e., standards they were not, as least-developed countries, required to adopt (Deere, 2008a; Deere 2008b, pp. 241–242). During the colonial era, *tangible* property rights had been the primary legal mechanism used to maintain foreign economic control; now, with decolonisation diluting some of the primacy of tangible property rights as economic control mechanisms, *intangible* IP rights began to come to the fore (Rahmatian, 2009, p. 42).

By 1965, 27 countries, roughly half of the continent, had ratified one or more international treaties, typically the Paris Convention (1883) and/or the Berne Convention (1886). On average, these 27 countries had ratified 1.8 treaties, with a median of 1 treaty. The number of African members in Paris grew to 22 countries, while African membership in Berne grew to 13 countries.

The number of multilateral IP treaties also grew during this period to include the Rome Convention for the Protection of Performers, Producers of Phonographs, and Broadcasting Organisations (1961), ratified by Congo and Niger. The Universal Copyright Convention (UCC) (1952) also gained traction in Africa, ratified by Ghana, Liberia, Malawi, and Nigeria.

The period 1966 to 1995: Limiting African influence: Stockholm, WIPO and TRIPS

In the summer of 1967, BIRPI member nations met in Stockholm for one of the last rounds of revisions to Paris and Berne. During the negotiations, developing countries, having finally received a voice at the table began to express their concerns. As a result, a less stringent "Protocol Regarding Developing Countries" was negotiated into Berne, which included a shorter copyright term and compulsory licensing (A compulsory licence is a non-voluntary licence, granted upon application, in specified circumstances to facilitate access to technology where the right-holder has refused to grant a licence. This enables developing countries to access technology which would otherwise not be available to them).[2] Of the 13 African signatories to Berne at the time, 11 countries declared their intention to follow the Protocol.[3]

2 See Protocol Regarding Developing Countries, Berne Convention for Protection of Artistic and Literary Works, as revised at Stockholm, 14 July 1967: http://www.wipo.int/wipolex/en/details.jsp?id=12801

3 See World Intellectual Property Organisation (WIPO) (n.d.c).

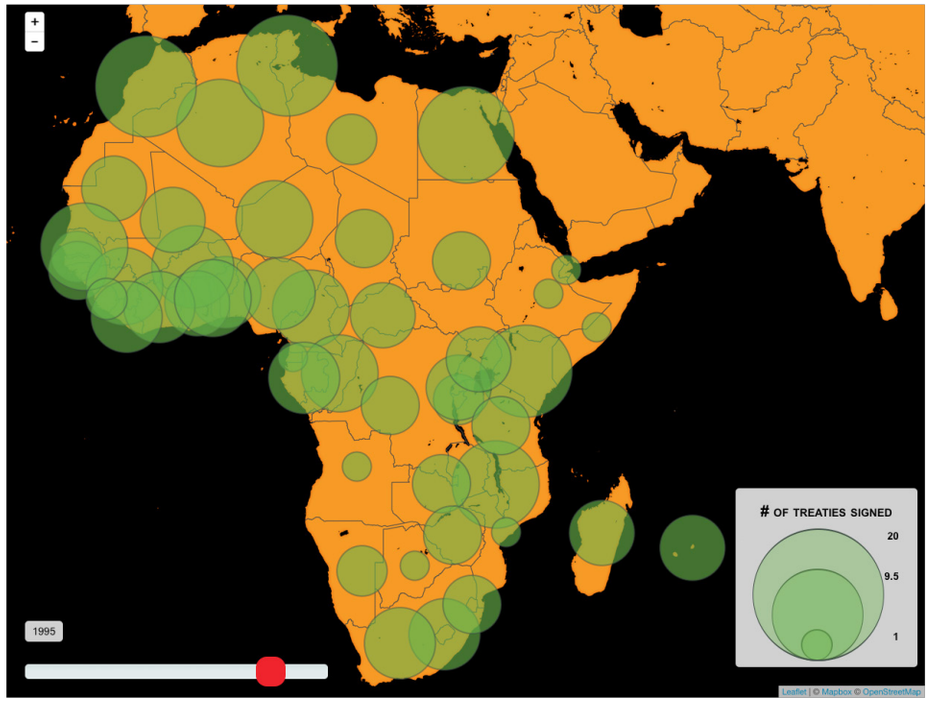
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Many European countries did not approve of the Protocol, and at the next revision conference in Paris (1971), major revisions were made to create a global IP regime and close loopholes used by developing countries (Peukert, 2016, p. 54). These revisions aligned the more permissive UCC with Berne and implemented a more complicated and restrictive developing country protocol. However, few countries implemented this revised protocol. Some scholars have shown that the limited utility of this protocol was to some extent due to its complexity and certain unworkable provisions (Štrba, 2012).

The 1967 Stockholm conference brought another significant change to the international IP treaty landscape, in the form of establishment of WIPO. WIPO took over from BIRPI in 1970 as the custodian of the Berne and Paris conventions and related IP treaties (Frankel & Gervais, 2016, p. 6). In 1974, WIPO became part of the United Nations. Prior to this, it was an intergovernmental organisation. By 1995, the 1967 UN Convention on WIPO (the treaty establishing WIPO) had achieved the highest level of adoption of any treaty at the time in Africa, with 43 member countries. The Paris Convention had the second highest adoption rate in Africa by 1995, with 39 ratifying counties, while the Berne Convention had 35 African adopting countries.

The period before TRIPS (which came into effect on 1 January 1995) saw the number of IP treaties increase. African countries ratified 13 new treaties in this period, for a total of 26 treaties in force by the end of 1995. Most of these new treaties addressed details of the industrial property and copyright regimes that were not specified in Paris or Berne. Other treaties broke ground on new areas of IP, including plant breeder's rights in the UPOV Convention (1961, 1971), and the Nairobi Treaty on the Protection of the Olympic Symbol (1981).

Figure 3: African IP treaty landscape in 1995



It is important to note that African countries had limited involvement with the initial negotiations for these 13 new treaties. On average, fewer than eight African countries participated in the forming each of these treaties. Significantly, of these participating countries, few chose to be signatories. Fewer than three African countries, on average, signed the treaties on ratification. African countries were most represented at the diplomatic conferences for the 1981 Nairobi Treaty (18 participants, eight signatories), the 1989 Washington Treaty (16 participants, four signatories), and the 1972 Patent Cooperation Treaty (PCT) (15 participants, six signatories). African countries were least represented at the 1978 and 1991 UPOV conferences (one participant, one signatory), the 1977 Budapest Treaty (two participants, one signatory), and the 1989 Madrid Protocol (three participants, three signatories). Notably, the aforementioned Nairobi Treaty (which had relatively strong African participation, with 18 participants and eight signatories) is among the least important for African economic and cultural development because it addresses a single specific issue: the use of the Olympic symbol. And the aforementioned Washington Treaty (16 African participants, four signatories) is not yet in force despite being formed in 1989. African countries were, thus, most-represented in the negotiations that mattered least.

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Despite these challenges, the international IP regime continued to expand across the continent. By 1995, 48 African countries had ratified one or more treaties, with half of these countries having ratified five or more treaties. On average, African countries were bound by just over five treaties. The average country varied from the mean by (i.e., the standard deviation was) almost three treaties, indicating relatively large differences in treaty adoption. The five core instruments that had been signed by the majority of African countries by the end of 1995 were: Paris, Berne, the Patent Cooperation Treaty (PCT), the UN Convention on WIPO, and TRIPS.

The key IP treaty development in this period up to the end of 1995 is TRIPS. After the creation of WIPO in 1967, the developing world had become more vocal on IP issues. WIPO's structure had given developing countries a greater voice, making it harder for Western countries to implement their IP agenda. The developed world thus sought new strategies to limit developing-world influence. Developed nations brought IP into the realm of international trade, where their pre-eminence gave them greater influence, leading to the negotiation of the TRIPS Agreement as part of the creation of the WTO.

Negotiated during the establishment of the WTO, TRIPS is the most comprehensive and important IP treaty to date (Deere, 2009; Frankel & Gervais, 2016, p. 29). It includes and extends the previous IP regime under the Paris and Berne Conventions. Because the TRIPS Agreement was included as Annex 1C in the Marrakesh Agreement that founded the WTO, countries that wished to participate in global trade were required to adopt TRIPS. The Marrakesh Agreement was signed in 1994, and in 1995 it had legal effect in 33 African countries.

The TRIPS Agreement includes an enforcement mechanism, allowing infringing states to face trade sanctions before a WTO tribunal. The Agreement faced a crisis shortly after enactment, because its provisions compelled developing nations to purchase expensive HIV/AIDS treatments from Western patent-holders. In 1995, UNAIDS estimated that 4,039,000 people in Africa were living with HIV, with 181,200 deaths recorded on the continent in that year alone (UNAIDS, n.d.a, n.d.b). Millions of Africans died for lack of access to affordable anti-retroviral drugs in late 1990s, and it was only in 2001, via the WTO Doha Declaration, that it was made clear TRIPS did not prevent countries from taking measures to protect public health.

Specifically, the Doha Declaration's paragraph 6 mandated that a solution be found for countries with limited pharmaceutical manufacturing capacity which curtailed the benefits that they could garner from the use of compulsory licences. After the Declaration, in August 2003, the WTO adopted a decision on the Implementation of paragraph 6 of the Doha Declaration on the TRIPS Agreement and public health (known as the "2003 Waiver"). Pursuant to a 2005 WTO Decision, the waiver has since been converted into an amendment to the TRIPS Agreement, as of 23 January

2017, after two-thirds of WTO Member States had accepted it. These accepting states included the following 16 African states: Botswana, Central African Republic, Congo, Cote d'Ivoire, Egypt, Gabon, Kenya, Lesotho, Malawi, Nigeria, Rwanda, Seychelles, Sierra Leone, South Africa, Uganda and Zambia. The amendment applies to those countries who accepted it, as of that date. Other WTO Member States have until 31 December 2019 to accept it and will remain subject to the waiver until then. However, the solution offered by the Declaration and amendment has proven cumbersome. For example, it requires that both the exporting and importing countries have to issue compulsory licences and advise the TRIPS Council of the import and export. Due to its complexity and laborious nature it has only been used once, by Rwanda and Canada (Abbott & Reichman, 2007; Andemariam, 2007; Ncube, 2018, pp. 686–687; Outtersen, 2010).

The period up to 1995 also saw the virtual completion of the African independence project. The Cold War came to an end in the period 1989-92, and this new geopolitical reality led to the spread of democracy and increasingly diverse participation in the global economy. Namibia gained independence in 1990, and Eritrea in 1993, and apartheid in South Africa came to an end in 1994. The only new African country that has come into being since the early 1990s is South Sudan, which gained independence from Sudan in 2011.

The period 1996 to 2015: Africa rising

Rapid and sustained economic growth in Africa over the past two decades has led some commentators to proclaim that Africa is "rising" (*Economist*, 2011). Other observers, however, warn that while there is indeed growth (Fosu, 2015), the Africa rising narrative fails to recognise the lack of structural change (Jerven, 2015) with African economies still largely reliant on exporting resources and importing finished products (Taylor, 2014). Innovative responses to these structural challenges range from scaling up traditional textile products to MPESA, Kenya's mobile money transfer system (Adewopo et al., 2014; Mworia, 2016).

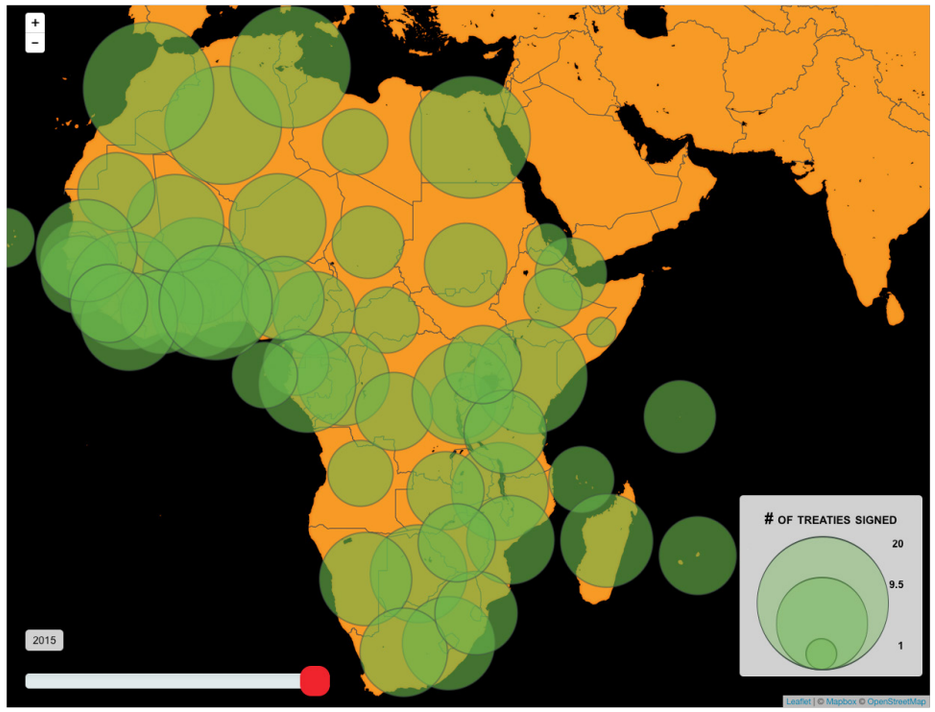
Also in this context, there is increased international focus on access- and benefit-sharing of genetic resources, with which Africa is richly endowed. This focus led to the adoption of the 2010 Nagoya Protocol, a supplementary agreement to the Convention on Biological Diversity (CBD). The Protocol provides mechanisms to protect, ensure local community control of, and fairly reward use of, traditional knowledge (TK), acknowledging its roles in sustainable development, including responses to climate change.

While research is revealing how many African innovators are taking a collaborative approach to IP (De Beer et al., 2014), IP treaties continue to saturate the continent. Earlier in this article, in Table 4, we saw the high rates of subscription by African countries, in 2015, to most international IP treaties.

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By 2015, all African countries except for South Sudan were party to one or more treaties. On average, African countries were bound by nine treaties, with a standard range of between five and 14 treaties. Half of all countries had signed eight or more treaties, with Morocco having signed the highest number: 20 treaties. Morocco was also involved in negotiation of the controversial Anti-Counterfeiting Trade Agreement (ACTA), a separate agreement which has not come into force (and which was thus was not covered in our dataset). Most African countries are now covered by TRIPS. Of the 10 countries that are not members, all but four have ratified the Berne and Paris Conventions. Eritrea, Ethiopia, Somalia, and South Sudan are the only countries not bound to these foundational IP norm-making instruments.

Figure 4: African treaty landscape in 2015



At the same time, some new approaches towards treaty relations have emerged since the early 2000s—most notably via the aforementioned Doha Round of WTO TRIPS talks. Several important issues surfaced at these talks even though they were never completed. As stated above, one of the successful outcomes was the WTO Doha Declaration of 2001 was intended to allow developing countries to more easily gain access to generic versions of patented anti-retroviral medicines to treat the AIDS epidemic (Love, 2011). The leadership of African states in the adoption of the Doha Declaration, beginning with Zimbabwe's call for a special TRIPS Council

session on access to medicines, is well-documented (Odell & Sell, 2001 p. 85). In addition, within WIPO, African states' contribution to the adoption of the 2005 WIPO Development Agenda is also well-chronicled (Kongolo, 2013a). However, as previously noted, only 16 African countries have accepted the 2005 WTO Decision that culminated in the TRIPS Amendment which came into force in 2017. In view of the African continent's significant contribution to the initial impetus to adopt the Doha Declaration, the low uptake raises the question of why this impetus has not been reflected in the uptake of the 2005 Decision. Part of the answer to this conundrum is that the waiver solution has proven notoriously laborious and frustrating for developing countries, resulting in its minimal usage as noted above.

4. Conclusion: Opportunities for innovation

Consideration of the 131-year history of IP treaty adoption across Africa, from 1884 and 2015, provides insights into colonial, neo-colonial, independence-era and "Africa rising" patterns of African countries' engagements with the international IP system. The developed world continues, to a great extent, to impose IP norms that benefit rich-country rights-holders, while limiting African participation in negotiating new treaties. As a result, most international IP instruments do not reflect or support the realities in many African countries.

But despite the saturation of the African continent by rich-world-driven IP treaties, opportunities still exist for innovation by African lawmakers and policymakers. Although international norms are largely set by TRIPS, African countries vary considerably in their membership in a number of other relevant treaties. Additionally, implementation and enforcement, on the ground, vary from country to country. Made-in-Africa approaches to IP lawmaking and policymaking can undoubtedly produce benefits in terms of more inclusive innovation and, in turn, more inclusive and sustainable technological and economic development.

Our database potentially provides the beginnings of a tool through which we, and other interested researchers, can seek to use inferential statistics to examine potential relationships between nations' membership in certain IP treaties and: measures of human development; measures of innovation; and metrics of economic growth. Also, we used treaty ratifications as a proxy for the legal status of IP laws within each country. WIPO collates comprehensive and up-to-date information on each Member States' IP laws, thus providing potential for rich, qualitative legal assessments of nation laws and their degree of response to local realities.

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Patterns of Innovation and Knowledge in Two Ethiopian Informal-Sector Clusters: A Study of the Shiro Meda Handloom-Weavers and Merkato Shoemakers

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Abstract
This article provides findings from a study of innovation and knowledge management practices in two informal-sector micro and small enterprise (MSE) clusters in the Ethiopian capital, Addis Ababa: a handloom-weaving cluster and a shoemaking cluster. The activities in these two clusters were studied in order to explore the patterns of innovation in the MSEs, and to identify factors that influence collaboration and the spread of knowledge among the enterprises. The research also explored the enterprises' knowledge appropriation behaviours and perspectives in relation to their informal-sector innovations, i.e., their orientations towards both informal knowledge appropriation mechanisms and formal tools of intellectual property (IP) protection.

Keywords
innovation, knowledge-sharing, knowledge appropriation, intellectual property (IP), informal sector, micro and small enterprises (MSEs), clusters, Shiro Meda cluster, Merkato cluster, handloom-weaving, textiles, cotton, shoemaking, footwear, leather, Addis Ababa, Ethiopia

DOI: https://doi.org/10.23962/10539/26170

Recommended citation
Belete, W. (2018). Patterns of innovation and knowledge in two Ethiopian informal-sector clusters: A study of the Shiro Meda handloom-weavers and Merkato shoemakers. *The African Journal of Information and Communication (AJIC)*, *22*, 83–109. https://doi.org/10.23962/10539/26170

Acknowledgements
The research on which this article is based was carried out under the auspices of the Open African Innovation Research (Open AIR) network, with financial support from Open AIR, the Social Sciences and Humanities Research Council (SSHRC) of Canada, the International Development Research Centre (IDRC), and the UK Department for International Development (DFID). The findings and analysis provided in this article are those of the author, and are not representations of the views of any of the funders. This article draws on the contents of a 2018 Open AIR Working Paper (Belete, 2018) by the same author.

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1. Introduction

Background

Much has been written in recent decades about the importance of innovation for economic growth. Innovation is considered the foundation of competitiveness of firms and a crucial element in the process of improving the long-run economic performance of nations (Dosi & Nelson, 2010; Fagerberg & Verspagen, 2002; Freeman, 1982). However, most of the research work on understanding the process of innovation and its relationship to growth and development has been conducted in economically advanced countries, where technological change takes place primarily through research and development that seeks to push the global knowledge frontier further.

In contrast, in developing countries, technological change occurs primarily through adopting and adapting existing technologies. In a developing-country context, technological progress primarily involves gaining mastery over products and processes that have already been put to use in more technologically advanced countries (Chaminade et al., 2009; UNCTAD, 2007; Westphal et al., 1985). This difference demonstrates the importance of understanding the nature of innovation in developing countries—and the importance of using a different lens from that which one would use in innovation studies conducted in more mature economies.

In low-income countries, micro and small enterprises (MSEs), most of which operate in the informal sector, play a crucial role in innovation. These enterprises are also important providers of employment and livelihoods to a large number of the poor. The MSEs are engaged in various innovative activities aimed at contributing to their growth and competitiveness.

The study on which this article is based examined the factors that affect MSE innovation in a low-income country, Ethiopia, through focus on informal MSEs in two informal-sector clusters: a handloom-weaving cluster and a leather footwear cluster. The study findings, as outlined in this article, provide enhanced understanding of the patterns of innovation in Ethiopian MSEs operating in informal settings, and the findings also identify factors that influence collaboration, the spread of knowledge, and knowledge appropriation, by such enterprises.

Objectives

The objective of the study was to contribute to the current understanding of the processes of innovation and knowledge management in African informal-sector MSE clusters through study of two such clusters in the Ethiopian capital Addis Ababa. Specifically, the study sought to:

- examine the empirical evidence related to innovation in informal MSEs in the two clusters, and identify factors that influence their innovative performance;
- determine the types of knowledge-sharing mechanisms and interactions among the informal MSEs working in the two clusters; and
- investigate the forms of knowledge appropriation, both informal and formal (including intellectual property (IP) rights protections), being practised in the two clusters.

Methodology

The study focused on the Shiro Meda handloom-weaving cluster and Merkato leather-footwear manufacturing cluster, both located in the Ethiopian capital city, Addis Ababa. Data were collected through interviews with individuals owning, or employed by, the MSEs in the two clusters, and with government officials. The interviews were conducted using structured interview guides (see Appendices). The interviews with MSE owners and workers sought information on the backgrounds of the MSEs, details about their enterprises, and in-depth information about the enterprises' activities and innovations (in terms of production methods and inputs, product characteristics, and marketing activities). The interview questions also sought to find out about the enterprises' networking and collaboration modalities within their respective clusters, and their methods of knowledge appropriation. The interviews held with government officials focused on government policies, programmes and initiatives which impact on activities of the MSE sector.

Interviews were conducted with 21 weavers in the Shiro Meda cluster, 14 shoemakers in the Merkato cluster, two patent administrators in the Ethiopian Intellectual Property Office (EIPO), a technology transfer director in the Ministry of Science and Technology (MOST), and an expert in the Federal Micro and Small Enterprises Development Agency (FeMSEDA).

All the weavers and shoemakers included in the interview sample were men. The women in the Shiro Meda weaving cluster with whom I could make contact were all engaged in cleaning and spinning of cotton, not weaving. The weaving was found to be predominantly a male job. And in the Merkato footwear cluster, while documents reviewed for this study, and my observations, confirm that women take part in the process of shoemaking in that cluster, my attempts to interview female shoemakers were unsuccessful. In selection of the MSE interviewees, assistance was received from individuals who had acquaintances in the two clusters.

In addition, primary document data on the two clusters were collected from documents published by government offices and other official bodies. I also consulted relevant secondary literature available on the internet: published books, journal articles, and reports.

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2. The MSE sector in Ethiopia

Nature and role of MSEs in the national economy

MSEs play a crucial role in the Ethiopian economy, because of their contributions to gross domestic product (GDP) and their role in poverty reduction and improvement of income distribution. In 2013 MSEs contributed 30% of the GDP share of Ethiopia's manufacturing industries (MoFED, 2013). More than 70% of MSEs in Ethiopia were found, in 2003, to be engaged in the following: production of textiles; food and beverage processing; production of leather products, including footwear; and manufacturing of wood and wood products (CSA, 2003). MSEs are also strongly present in the services sector. According to a survey conducted by Ethiopia's Central Statistical Agency (CSA) in 2002-03, a large concentration of MSEs was found in the country's trade, hotel, and restaurant services sub-sectors.

According to the 2011 regulation that established the MSE support agency FeMSEDA, a *micro* enterprise is defined as an enterprise with: five or fewer employees, including the owner and owner's family members who work in the enterprise; and (for a services enterprise) total capital not exceeding ETB50,000 (approximately USD1,800 in 2018) or (for an industrial enterprise) capital not exceeding ETB100,000 (USD3,600). A *small* enterprise, meanwhile, is defined as having between six and 30 employees, and capital of ETB50,001 to ETB100,000 (USD1,800 to USD3,600) in the service sector, and ETB100,001 to ETB1,500,000 (USD3,600 to USD54,000) in the industrial sector (FDRE, 2011b).

Urban unemployment and underemployment are serious social problems in Ethiopia. The labour force is growing much more rapidly than the population as a whole, because of Ethiopia's demographic profile, which is characterised by many more young people entering the workforce each year than old people leaving it (FDRE, 2009). Rural-to-urban migration is also increasing, driven by the dwindling amount of farmland available to the rural population and low levels of agricultural productivity. Informal-sector MSEs give the urban poor, unable to find jobs in the formal sector, the opportunity to take part in paid employment activities, to expand their alternatives for supporting their families, and to contribute to national economic development. Furthermore, the MSE sector provides a breeding ground for innovative entrepreneurs.

Many MSEs in the Ethiopian manufacturing sector, especially those grouped under cottage and handicraft industries, specialise in a variety of simple items made by hand. These products, which result from labour-intensive activities, are not easily produced by larger enterprises engaged in mechanised production methods. For instance, the expert in FeMSDA who was interviewed for this study, and some of the handloom-weavers interviewed in the Shiro Meda cluster, mentioned that Chinese enterprises try to produce imitations of Ethiopian traditional clothes at an industrial

scale but cannot compete with the quality of the clothes produced by the handloom-weavers. The interviewees said consumers see the Chinese products as being low-quality, cheap substitutes for the handmade products, giving the local handloom-weaving MSEs a competitive advantage in the market.

The MSE sector in Ethiopia is dominated by informal-sector enterprises, and there is a wide range of estimates of the size of the country's informal sector. The wide variations in the estimates would appear to be the result of variances in the approaches followed, in seeking to measure informality, by government agencies, international organisations, and individual researchers. According to a nationwide urban informal-sector survey carried out by Ethiopia's CSA in 2003, the number of people engaged in informal-sector activities was 997,380, of which 799,353 (80.15%) were enterprise-owners and 198,027 (19.85%) were persons working under employment agreements (CSA, 2003). This put informal-sector employment at 50.6 % of total urban employment during the survey period. The survey also found that the majority (51.27%) of the informal-sector workforce was engaged in crafts and related trades. These craft and related enterprises were found to include: the home-based workshops of traditional artisans in weaving, shoemaking, shoe-repairing, tailoring, hairdressing, carpet-making, pottery, basketry, and embroidery; small maintenance and repair shops for electronics; and enterprises engaged in manufacture and sale of local beverages.

A 2014 CSA survey put the share of urban informal-sector employment within total urban employment at 24.9% (CSA, 2014). However, some government documents and reports by international organisations put the figure for informal-sector activity in urban Ethiopia at a much higher level. For instance, in the National Employment Policy and Strategy of Ethiopia, it is stated that the informal sector on average accounts for 71% of urban employment in Ethiopia (FDRE, 2009). (The variations in estimates result, to some extent, from the fact that one can define formality in terms of various characteristics, including company registration, payment of taxes, management structure, contractual arrangements with employees, and market orientation.)

Important to conceptualising the informal sector is cognizance of the realty that informal enterprises typically operate along a continuum, between informality and formality, whereby different activities and actors sit at different locations along the continuum (De Beer et al., 2013; Kraemer-Mbula, 2016; ILO, 2002; Steel & Snodgrass, 2008). For instance, in Ethiopia, there are a number of informal-sector MSEs that sometimes work for formal enterprises under sub-contracts. Informal-sector footwear manufacturers produce some well-known brands of shoes through sub-contract agreements with formalised medium- and large-scale shoe enterprises. And many traditional weavers in the informal sector produce fabrics for fashion designers who operate in the formal sector. The fashion designers then market the

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final products under their own trademarks. Many MSEs have relations with formal-sector input suppliers, with service providers, and with wholesalers and retailers of final products.

Government policies

The first government strategy dedicated to advancing MSE growth in Ethiopia was the federal MSE Development Strategy of 1997 (FDRE, 1997), accompanied by a set of sub-national strategies for the regions. The focus areas of the strategy included: encouraging exploitation of local raw materials; correcting the preferential treatment accorded to bigger enterprises; export promotion; creation of long-term jobs through skills-upgrading programmes; and strengthening the use of appropriate modern technologies. The strategy supported networking of small and fragmented enterprises within sectors, regions, or other localities. In 2011, the government published a revised MSE support blueprint, the Micro and Small Enterprise Development Policy and Strategy, which places emphasis on: enhancing the competitiveness of MSEs; ensuring continued rural development via sustainable growth of MSEs; and making the MSE sector a foundation for industrial development. The revised strategy also prioritises the role of technical and vocational education and training (TVET) institutes in skills development and technology-sourcing for MSEs (FDRE, 2011).

The First Growth and Transformation Plan of the country, implemented during the period 2010-11 to 2014-15, brought some changes in the MSE sector through skills development and promotion of entrepreneurship (MoFED, 2010). The Second Growth and Transformation Plan (GTP II), which is currently under implementation and runs from 2015-16-2019-20, points to the critical role of MSEs in employment generation, promotion of entrepreneurship, and broadening the base for value addition in the domestic private sector (NPC, 2015). The country's Industrial Development Strategy, and Science, Technology and Innovation Policy, stress the need for strengthening MSEs to enhance their role in industrial development (FDRE, 2002; 2012).

The government has established several organisations mandated to support MSE development, including: the aforementioned FeMSEDA, the Regional Micro and Small Enterprises Development Agencies (ReMSEDAs), and the Handicrafts and Small-Scale Industries Development Agency. National development agencies and international organisations are also actively involved in provision of basic business skills training to Ethiopian MSE operators (Debela, 2015; UNDP, 2015).

MSEs' human capital

MSEs in Ethiopia are mostly family-owned, and are characterised by low levels of human capital, which undermines their capacity for technological absorption and innovation (Belete, 2015). According to a survey conducted by the Ethiopian Ministry of Urban Development and Construction in 2013, 33% of the owners of 3,000 MSEs

included in the survey had attended only primary-level education (MUDC, 2013). A 2010 report by the Ministry of Education showed the shortage of trained manpower in Ethiopia, finding that, in 2009, the net enrollment rate for secondary education in the country was only 12.6%, while the total number of students enrolled in TVET institutes was only 717,603 (MOE, 2010). It is not common for Ethiopian MSEs to invest in formal training of their employees. In most informal-sector MSEs, as the research findings outlined below will confirm, the workers get their skills through engagement in daily work processes and interaction with more experienced workers. The training normally takes place through working alongside a skilled worker, observing his or her work, and gradually taking over the job.

MSEs' access to finance

According to a report by the World Bank (2015), financing is perceived as the main business constraint by 41% of micro, and 36% of small, enterprises in Ethiopia, compared to Sub-Saharan African averages of 24% and 20% respectively. It has been found that Ethiopian MSEs typically have no external financing, as a result of either being rejected for loans or not even applying due to terms and conditions that cannot be met (World Bank, 2015). The existing financial system of the country is not designed in a way that addresses the needs of MSEs (MOST, 2010).For many small businesses, the personal funds of the founders, and of their families and friends, represent the key source of finance at the start-up stage of enterprises. These funds are often insufficient to cover the needs of the enterprises as they expand and show increasing promise, severely constraining enterprise growth (Carpenter &Peterson, 2002).

Lack of incentive schemes

There are no targeted incentives for the promotion of innovation in Ethiopian MSEs. However, Ethiopia's Investment Incentives Regulation (FDRE, 2014) provides exemptions from customs duty for imports of machinery, equipment and accessories used in workshops and laboratories. This presumably has a positive effect on the cost of technology acquisition by certain MSEs. Furthermore, the Investment Incentives Regulation provides exemptions from income tax for limited periods of time for investors in certain targeted areas of manufacturing, which may encourage some MSEs to invest in new technology.

Entrepreneurship support

Ethiopia has a long history of entrepreneurship, dating back to the medieval and mercantile eras. However, until recent years, there was a lack of comprehensive entrepreneurship support to MSEs in Ethiopia, with interventions limited to training programmes (UNDP, 2015). In recognition of this gap, there have been some recent initiatives aimed at developing MSE entrepreneurship. One such initiative, running since 2013, is the Entrepreneurship Support Programme, a joint project by the United Nations Development Programme (UNDP) and the Ethiopian Government.

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The project supports the building of entrepreneurial skills and mindsets within MSEs, particularly women and youth, and supports the government's efforts to establish training and service institutions and financial support for entrepreneurship (UNDP, 2015; n.d.).The government has also initiated a Women Entrepreneurship Development Project, with World Bank support, that aims to increase the earnings and employment of women in urban areas through tailored financial instruments, developing women's entrepreneurial skills, and supporting cluster, technology and product development (FeMSEDA, 2012).

MSEs' linkage with technology development organisations, educational institutes

The Government of Ethiopia has set up Technology Institutes in selected sectors—such as textiles, leather, metals, engineering and agro-processing—that are responsible for technology acquisitions and transfer in their respective industries. Moreover, the country's TVETs are expected, in terms of the state TVET Strategy (MOE, 2008), to transfer technologies to MSEs in order to, among other things, increase their productivity and improve the quality of their products and services. However, due to lack of the required capacity on the part of the TVETs, and weak TVET-MSE linkages, TVETs have not been able to adequately fulfill their MSE support mandates. Collaboration between MSEs and the Technology Institutes is also weak (MOST, 2013).

3. The Shiro Meda and Merkato MSE clusters

The two small-enterprise clusters studied, the Shiro Meda and Merkato enterprise clusters in Addis Ababa, both spontaneously developed over long periods of time. In the Shiro Meda handloom-weavers cluster, there is a large concentration of weavers who originally came from southern Ethiopia. It has been estimated that there are more than 20,000 handloom-weavers in Addis Ababa's Gulele subcity, the subcity of which Shiro Meda is part (Ali, 2007). In the 19th century, when Ethiopia was ruled by Emperor Menelik, a large number of weavers, mainly from the Dorze ethnic group of Gamo Highlands in the south, came to Addis Ababa and settled at the foot of Entoto Mountain, where the Shiro Meda cluster is situated. These people, who were skilled in the art of weaving, became the major producers of traditional clothes for the city's dwellers. Nowadays people use the term "Dorze" to refer to both the weaving community and to all the people who originally came from the Gamo Highlands (Prouty & Rosenfeld, 1981).

Although there are weavers in different parts of Addis Ababa who come from other ethnic groups, the Dorze weavers from the Gamo Highlands dominate the field. There are numerous shops for traditional textiles located in Shiro Meda. The streets are lined with small stores selling different varieties of traditional Ethiopian clothes. The neighborhood is identified with weaving and is considered by many people in Addis Ababa as a major shopping centre for traditional clothes.

The other cluster, the Merkato shoemaking cluster, is—based on my observations and on unofficial estimates communicated to me—home to around 5,000 MSEs engaged in either manufacturing or repairing leather footwear. Most of the enterprise owners and employees in the cluster come from the Gurage ethnic group. Suppliers of inputs, and other service providers for the footwear manufacturers, are also located in the cluster. Therefore, the shoe producers in the cluster buy their raw materials, labour supplies, and other services—such as machinery and equipment maintenance, and design services—from within the cluster. The MSEs sell their products through the wholesalers that are located around the cluster. These wholesalers then distribute the shoes to the Merkato retail shops and elsewhere. The Merkato shoe manufacturers interviewed for this study were located in a part of Merkato known as "Shera Tera".

As alluded to above in the "Methodology" sub-section, the two clusters experience different competitive environments. The MSEs in the Merkato footwear cluster face competition from medium- and large-scale footwear manufacturing enterprises outside the cluster, and run by educated entrepreneurs, which frequently introduce new product designs and use modern production methods and marketing strategies. There are also imported shoes made available in the domestic market, competing with the Merkato shoemakers' products.

In contrast, the MSEs in the Shiro Meda handloom-weaving cluster operate in the absence of a strongly competitive environment. While there are a few modern fashion designers, operating outside the cluster, who started their businesses inspired by the traditional designs of the weavers, these designers tend to be collaborators with, rather than competitors to, the Shiro Meda weavers. The fashion designers procure from the weavers, relying on the weavers for certain fabrics and embroidery skills.

4. Findings and analysis

Size and age of the MSEs

In the Shiro Meda cluster, the number of people working in the weaving enterprises studied ranged between two and four. The oldest weaving enterprise included in the study was 33 years old, while the youngest enterprise was eight years old, its owner having completed his apprenticeship with another enterprise in the cluster and then become an independent weaver.

In the Merkato footwear cluster, of the 14 shoemakers interviewed, 10 were owners of enterprises while the remaining four were employees. The smallest enterprise was operated only by the owner, while the three largest enterprises had six employees each. The shoemaking MSEs ranged in age from 19 years to five years.

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Financing

In the Shiro Meda weaving cluster, the owners of the studied enterprises had all obtained their financing from informal sources. Sixteen of the interviewees had started their businesses with money obtained and/or borrowed from their fathers and other relatives. The remaining five had used savings from the small amounts of money they had earned while serving as apprentices to senior weavers. They had used their savings to acquire the materials required to start their own weaving businesses.

Meanwhile, the main source of capital for expansion of the weaving enterprises was found to be rotating funds, known as an "*iqubs*", established by small groups of people. In Ethiopia, *iqubs* are important sources of finance for people who do not have access to credit from formal financial institutions, allowing members to save for when they need to make large cash outlays. Each week or month, members of an *iqub* contribute a specified amount of money, and the total money collected is then given to one of the collective's members. This continues until each member is paid the amount equivalent to his total contribution. None of the Shiro Meda interviewees had secured access to financial services from banks or micro-finance institutions.

In the Merkato shoemaking cluster, the main sources of finance—for all of the interviewees—for starting and expanding their businesses, was money obtained from family members and their own savings. Due to their informality, the enterprises cannot fulfill the requirements necessary to get loans from financial institutions.

Choice of business location

In the Shiro Meda weaving cluster, all 21 of the weavers who were interviewed, when asked for their reasons for starting their businesses in the cluster, gave more or less the same reasons. The major reason was that Shiro Meda is a place where people from the weavers' ethnic group, the Dorze people—including their fathers and other family members—had already located their businesses. Being close to their relatives and people from the same ethnic group was said to have special value to the weavers. They said they interact with the Dorze community members in various ways that directly or indirectly benefit their work and their family lives. In addition, a large number of input suppliers, and shops which sell traditional clothes, are located in Shiro Meda. The weavers said they buy most of the materials they need in their production processes from within the cluster, near their working areas.

In the Merkato cluster, the shoe manufacturers interviewed explained that they had located their businesses in Merkato because they wanted to be close to other shoe-manufacturing friends and family members, who had started their businesses before them in that same cluster. As additional reasons, they mentioned proximity to input suppliers and proximity to wholesale and retail shoe shops.

Products

The main products of the Shiro Meda handloom-weavers are fabrics used to make the elements that go into women's and men's traditional Ethiopian national dress, the *yehabesha libis*. The weavers make fabrics for the women's traditional dresses, for the *netela* (a white scarf worn by women), for men's waistcoats, and for *gabi*—the heavy white wrap used by both men and women to protect themselves from the cold. The handwoven fabrics are also used for household products such as blankets, cushion covers, tablecloths, and window curtains.

The dresses made by the weavers are usually decorated with colorful embroidery called "*tibeb*". The weavers said they target the needs of people of different income levels. They seek to satisfy the demands of the middle- and high-income urban dwellers (who can afford higher-quality fabrics), while at the same time also supplying products, made of lower-quality fabric, that are affordable to lower-income groups in the city. To a certain extent, their products are also exported abroad to meet demand from Ethiopians in the diaspora.

It was found in the interviews that local demand for these handwoven traditional costumes is not at present being undermined by imported, factory-produced imitations. The weavers interviewed said that although the prices of the imported imitations are cheaper, customers prefer the locally produced, handwoven products—due, to a great extent, to the superior quality of the weavers' handwoven fabrics and the special appearance of the weavers' embroidery. Traditional clothes have deep meaning for Ethiopians, and this has helped keep the attachment to handwoven goods alive. The ecclesiastical dresses worn by priests of the Ethiopian Orthodox Church are products of handloom-weavers. Many Ethiopians also appear in religious festivals, weddings, funerals and other occasions dressed in traditional costumes. The way the *netela* (scarf) is worn changes according to the occasion. When a woman is going to church, the *netela* is opened up and the pattern lies on both shoulders. For funerals, as a sign of mourning, the *netela* is worn with the patterned end to the face. In casual contexts, the pattern is worn over the left shoulder.

In the Merkato footwear cluster, the main product of the enterprises studied is men's leather footwear. Except for a few cases, the uppers and inside lining material of the men's shoes produced are 100% pure leather. In the case of women's and children's shoes, it is common to use synthetic-leather components.

Production processes

In the Shiro Meda cluster, the weavers use traditional treadle handlooms. Weft threads are wound onto a bobbin (spindle) which is then put into a shuttle. The warp on the treadle loom is lifted by foot pedals which lift each of the shafts. Threads of

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the warp are alternately selected by hand to be lifted and lowered while the weft is passed between the threads with the shuttle. Traditionally, the weaving equipment was constructed from local materials such as eucalyptus and bamboo. Recently, however, some government institutions have introduced handlooms with metallic frames, and many weavers now use these metallic-frame handlooms, which are easy to dismantle, reassemble, and move from place to place. In the metal-framed looms, there are some improvements in how the shuttle works. However, the main technical features of the handloom have remained unchanged for generations.

The main raw material used by the Shiro Meda weavers, traditionally and today, is cotton yarn, both locally produced and imported. For embroidery, the weavers tend to also use silk, rayon, acrylic and wool yarn. Machine-spun cotton is often used both for warp and weft, but at the same time it is still common for handspun cotton to be used for weft. (Women clean the cotton from the seeds and rub the cotton with their fingers to pick out the seeds. Then they spin the cleaned cotton to make a weft.) The weavers complained that, in many cases, the quality of cotton in the market is sub-standard, which reduces the quality of fabrics they produce. In order to produce good-quality fabrics, a weaver thus needs to have knowledge of how to select good-quality cotton.

In the Merkato shoemaking cluster, the main pieces of equipment used are stitching machines, mechanical presses, grinders, skiving (cutting) machines, and shoe lasts. Most of these tend to be second-hand. It was found during the interviews that, due to financial constraints, the enterprises studied could not purchase all of the required machinery when they started their businesses, even if there were local suppliers of second-hand equipment in their vicinities. Only gradually, over time, did they manage to equip their workshops with the basic equipment required. For two of the interviewees, it took more than a decade to acquire the machinery they use today. They started their enterprises with minimal machinery, and depended on leased machines or outsourcing of work. The additional machines they acquired over the years have helped them to improve product quality and reduce production costs, thereby enhancing their market competitiveness.

The Merkato cluster shoemakers were found to use the services of modifiers of shoe "lasts": foot-shaped pieces of wood or metal. Modifiers give old lasts new shapes in order to produce new shoe designs. The lasts are adjusted by grinding their surfaces to modify them into the shape of the intended new shoe design. These modifications help the footwear producers to forego the cost of acquiring new lasts.

The shoemakers use both locally made and imported raw materials. The rubber soles, and leather used for upper parts and lining, are supplied by local producers, while

such materials as PVC soles, adhesives, and eyelets are imported from abroad. Retail shops located in the Merkato cluster make these materials available.

The use of high-quality raw materials was reported by the shoemaker interviewees to be one of the major factors in improvement of the quality (i.e., durability, in the eyes of most consumers) of shoes produced. The main inputs in leather shoe-manufacturing are hides and skins, which are acquired from local sources. The quality of this local leather was, in the past, often sub-standard, due to poor animal husbandry practices, lack of adequate slaughter facilities, poor post-slaughter preservation, and poor handling, tanning and processing techniques (MOA, 2013).

The interviewees said that in recent years there have been some improvements in the quality of leather available in the market. According to the respondents, if one has knowledge of how to carefully inspect the leather raw material, it is possible to get high-quality inputs and thus produce good-quality outputs. (In recent years, the quality of shoes produced in Ethiopia has shown improvement sufficient to improve export and trade with some European countries and the US. For example, between 2011 and 2012, Ethiopian shoe exports through the African Growth and Opportunity Act (AGOA) increased more than tenfold—from USD630,000 to nearly USD7 million (USAID, 2014).)

Thus, in both clusters, it was found that knowledge of how to evaluate the quality of input raw materials is centrally important to the competitive advantage and success of enterprises.

Education and learning

It was found that almost all of the weavers interviewed in the Shiro Meda cluster learned the skill of weaving as young boys, from their fathers, immediate family members, or friends and acquaintances of their families. The vast majority learned directly from their fathers. In the words of interviewee 4 (2016):

> I started learning the technique of weaving when I was 10 years old. I used to sit next to my father and was watching every step in the weaving process. I also helped out with winding the bobbins. Then I learned counting the threads for different types of cloths. (interviewee 4, 2016)

Nowadays, however, it would appear that many weavers have decreasing interest in teaching their own sons the skill of weaving. The weavers interviewed said they want their sons to pursue their formal education and start work in professions, as they view weaving as an insufficiently profitable line of work. They complained that too high a proportion of the price paid by the final consumers is retained by shop-owners, dressmakers, and others in the fashion business.

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But there was one interviewee, a young weaver, who was optimistic about business possibilities based on traditional weaving, though with elements of modernisation and via a connection to a training institute and a successful designer:

> My friend is studying fashion design in a private institute run by a known female designer. His ambition is to expand his business and get more young customers by giving a modern touch to his work. He insists that I should also join the institute so that we will be partners in the business. (interviewee 18, 2017)

The non-codified, informal, *tacit* knowledge that the weavers gain through experience was seen as the most valuable asset of the enterprises. Experienced weavers have good understanding of how every step in the weaving process determines the characteristics of the final product. From weaving lower-grade coarse cloth, to producing a range of medium-quality and fine fabrics, a great variety of cloths can be produced on the handlooms. The best-quality weaving produces dense and smooth fabric. According to interviewee 8 (2016):

> My weaving skill has shown a significant improvement over the years. If you compare my work with those of junior weavers, you can see a big difference. When I was a young weaver, the *netelas* I made were very coarse and it was difficult for me to sell some of them. But now I can easily sell my *netelas* and *gabis* and the customers admire the quality of the fabrics I make and the attractiveness of the patterns. (interviewee 8, 2016)

Six of the 21 weavers included in the study said they had never attended formal education, i.e., they had no exposure to codified, formalised, *explicit* knowledge of weaving or related skills. However, all six had learned how to read and write through their own efforts. Eleven of the interviewees had between two and six years of schooling. One of the interviewees was an extension student at a TVET institute. Three were pursuing their high school education via night school and distance-learning programmes.

The relatively better-educated weavers were found to have more innovative and entrepreneurial tendencies. They were found to be taking various measures to differentiate themselves, through introducing product or market innovations. For instance, the interviewee attending a TVET institute, and the three who were taking steps to complete high school, were found to be more active than the other 17 less-educated weavers in experimenting with non-cotton yarns such as rayon and acrylic.

These four better-educated interviewees were also found to be introducing new designs (e.g., to target young consumers) more frequently than the other 17 weavers.

In the Merkato footwear cluster, it was found that the ways in which knowledge is shared and imparted has similar features to those in the Shiro Meda weaving cluster. All of the shoemakers interviewed said they acquired their knowledge of shoemaking from their parents and/or through apprenticeships with people connected to their families. Only one of the interviewees had received formal training: a short-term course in shoemaking, after he started his business, from the government-run Leather and Leather Products Technology Institute (since re-named the Leather Industry Development Institute).

The lowest duration of schooling among the shoemaker interviewees was eight years, and the highest qualification was a diploma from a TVET institute. A common view among the interviewees was that there is a relationship between enhanced performance of MSEs and the level of schooling/training received by the owners. According to interviewee 27 (2017):

> I have a cousin who started the business much later than I did. However, his volume of production is much higher than mine and his products are of better quality. We admire him for his excellent marketing skills. All this is because of his higher level of education than many of us who operate in this area. (interviewee 27, 2017)

Business interactions and knowledge-sharing

It was found that the interactions of the Shiro Meda weavers amongst themselves, with middlemen, with shop-owners, and with input suppliers, facilitates the sharing of information on markets for traditional clothes; sources of good-quality inputs; and sources of well-priced inputs. The weavers said that Sundays and Mondays are the days when they have the most opportunity to interact amongst themselves, either in the marketplaces or in other areas where they socialise. During these times, the subjects of discussion range from the family lives of the weavers to information on markets for both procuring raw materials and selling final products. In the words of interviewee 9 (2016):

> When I meet my friends in places where we gather for local drinks, we exchange information about our work. This includes weaving techniques, suppliers of good quality cotton, thread and other inputs. I always share information with my relatives and close friends on these issues. (interviewee 9, 2016)

The weavers interviewed appeared to share an understanding that whatever competitive advantage they have over weavers in other clusters rests to a great extent on their non-codified, experience-based, tacit knowledge—and that there is significant power in deciding with whom to share this valuable knowledge. It was found that they clearly favour sharing of their knowledge and skills with apprentices,

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close relatives, and others with whom they have close social ties. As mentioned above, the weavers in the cluster predominantly belong to a single ethnic group, the Dorze—an element facilitating forging of social ties.

None of the weavers interviewed had exclusivity agreements with dressmakers or other dealers of traditional clothes (though it was said that other weavers, not among the interviewees, had such agreements). The weavers included in this study said they sell their fabrics to middlemen; to shop-owners; and, every Sunday at the open market in Shiro Meda, directly to final consumers. Only interviewee 18 (2017) spoke of receiving orders, and only very occasionally, from dressmakers. There are some Ethiopian retailers of traditional hand woven clothes who sell via websites, but none of the interviewees had received an order from an online retailer.

In the Merkato footwear cluster, it was found that there is stiff competition among the shoemakers—a much more competitive environment than that in the Shiro Meda weaving cluster. It was found that a large number of shoemakers compete in the same market, forcing them to use various tools to try to win customers. It was found that this high level of competition limits the sharing of knowledge and exchange of information between the MSEs in the cluster. And unlike in the case of the Shiro Meda weavers, ethnic-solidarity dimensions were not found to facilitate collaboration and knowledge-sharing (as stated above, most of the Merkato cluster's shoemakers are from the Gurage ethnic group). Instead, it was found that the shoemakers rely to a great extent on collaboration with the suppliers of inputs, and with their clients (retailers and wholesalers). For instance, it was found that the MSEs tend to have long-term relationships, based on trust, with retailers and wholesalers. The interviewees said they typically do not receive full outright payment from the retailer or wholesaler when they deliver the shoes, mostly receiving partial payments on delivery and collecting the balance after sales have been made.

Another form of interaction found to be important in the Merkato shoemaking cluster is that between the MSEs and the providers of technical services in the cluster. The relationships of the MSEs with last modifiers, skivers (who slice/scrape away edges), and repair and maintenance workers, was said to contribute to enhanced productivity and improved efficiency.

The cluster members were found to have very limited interaction with training institutes and technology development centers. As noted above, only one of the interviewees of this study benefited from a training programme offered by a government institute (the Leather Industry Development Institute).

(As mentioned above, in some cases, the medium- and large-scale footwear manufacturers subcontract production to small and micro units in Merkato. There is a mutual benefit in such arrangements. The subcontractors reduce their production

costs while the MSEs benefit from utilisation of their production capacity, particularly in low-market seasons. Subcontracting can also reduce the capacity-building period needed for SMEs to develop: the desired levels of product quality and design; the ability to meet stated delivery times; and their ongoing innovation and differentiation capabilities (Ogot, 2012). Various well-known shoe brands in Ethiopia are produced by the MSEs in the Merkato cluster through subcontracting. However, it is only a very limited number of enterprises that have managed to get into this network and benefit from such subcontracting activities. None of the enterprises included in this study were found to be benefitting from such subcontracting arrangements.)

Design innovations

Among the interviewees in the Shiro Meda weaving cluster, it was found that innovation in design is widespread and is seen as constituting a means of securing decisive comparative advantage over competitors. Silk, rayon, acrylic and wool yarns are used for making the aforementioned *tibeb* (embroidery designs). Dresses may be embroidered around the collar, on the sleeves, on the hems, and on the front. The traditional *netelas* (scarves) for women have bands of multicoloured designs on the edges (see Figure 1 below). The traditional waistcoats for men are also decorated with embroidery, and some decorations are also used on the ends of the aforementioned *gabi* (wrap).Embroidery is also used on bed covers, pillow covers, tablecloths, and window curtains.

Figure 1: Embroidery designs on *netelas* in the Shiro Meda cluster



Source: Author fieldwork, 2017 Photo: Wondwossen Belete

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The weaver interviewees said they believed that one must know many embroidery designs in order to be competitive and stay in business, and that creation of new patterns and color combinations requires special skills. Although there are some common designs, there is no limit to the kinds of designs that can be created by the weavers. And it was felt that the intricate designs, resulting from the creative talents of the weavers, cannot be replicated by modern textile factories, i.e., the aesthetic value and quality of the power-loom sector's imitations of Ethiopian traditional costumes are not comparable to the products of the handloom sector.

Design is also an important source of competitiveness in the Merkato shoemaking cluster. It was found that there are freelance designers in the cluster who provide new shoe designs to the MSE manufacturers. In most cases, the designs are copies of imported shoe designs, which are new to the local context. In some cases, the designers also use their own talents to create new designs. The one interviewee who had received short-term formal training in shoemaking from the Leather Industry Development Institute was found to be using both his own designs and the designs of freelance designers in order to increase the range of shoe types he produces. He said that even if he produces shoes which are comfortable and durable, the young customers will not be interested in them unless they are in the latest styles.

Interviewees stated that the costs associated with the introduction of new designs arise not only from the payments to freelance designers but also from investment in an increased number of shoe lasts. Although many styles of shoe can be made on the same last, it is still necessary to increase the number of lasts to produce shoes with different toe shapes. This means additional investment by the shoemakers, either for acquisition of new shoe lasts or modifications of existing ones.

Knowledge appropriation

There is a large body of literature on the use of formal IP rights and other forms of knowledge appropriation, including informal-appropriation approaches, by developed-world, formal-sector enterprises. In contrast there is much less literature on knowledge appropriation modalities deployed by developing-world, informal-sector MSEs. It is only recently that scholars have started addressing this area. De Beer, Fu and Wunsch-Vincent (2013), in their review of existing concepts, metrics and policies relevant to interrogating innovation and IP in the informal sector, outline a range of mechanisms for appropriation of benefits from informal-sector innovation. And studies by Essegbey, Awuni, Essegbey, Akuffobea and Micah (2014), Bull, Daniel, Kinyanjui and Hazeltine (2014), and Kraemer-Mbula and Tau (2014), have explored use of various knowledge appropriation tools in the informal-economy contexts of, respectively, herbal medicines in Ghana, metal manufacturing in Kenya, and manufacture of homecare and beauty products in South Africa.

At the core of Ethiopia's IP system is its 1995 Proclamation Concerning Inventions, Minor Inventions and Industrial Designs (TGE, 1995). In a provision potentially favourable to MSEs, the 1995 Proclamation provides for *utility model* protection, whereby minor inventions that would not be patentable can be protected by a utility model certificate provided that the invention is(1) new in Ethiopia, and (2) has industrial applicability. Both product and process improvements qualify for utility model protection in Ethiopia.

Another type of formal IP protection provided for by the1995 Proclamation that is potentially relevant to MSEs is *industrial design* protection for the ornamental or aesthetic aspect of products. According to one of the patent administrators interviewed at the EIPO for this research, there have been numerous industrial design registration applications for designs used in Ethiopian traditional clothing, but none from traditional weavers of the sort working at the Shiro Meda cluster. According to the EIPO interviewee:

> Among the applications we received for industrial design registration, 19 of them are for the protection of new patterns of traditional Ethiopian clothes. However, none of the applications are filed by traditional weavers. Fashion designers who have business relationships with the weavers filed most of the applications to get protection through registration. (interviewee 37, 2017)

(None of the Shiro Meda traditional weavers interviewed for this study spoke of supplying designs to fashion designers who had subsequently sought industrial design protection for the designs, but it is possible that some of the weavers' designs had been the subject of such applications. Some of the weavers said that they were aware of fashion designers seeking to use the formal IP tool of *trademark* protection to protect marks affixed to their products, as one of their market strategies.)

The weavers interviewed were found to rely on informal modes of knowledge appropriation in their efforts to maximise economic benefit from their innovative designs. For example, the weavers rely on *lead time* as a means of getting reward for their design innovations, i.e., the weavers enjoy competitive advantage until others copy the design. When asked whether they would ever seek to protect their designs through formalised industrial design registration, the weavers interviewed answered that they would be glad to use the opportunity. They stated that they would expend increased time and effort on design creation if there were a system which protected their designs from being easily copied by others. However, after they were briefed about the process that would need to be followed for formal IP protection of their designs, they became doubtful that they could effectively use the formal IP system, given the costs involved, the time-consuming examination process, and other associated bureaucratic issues.

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In the Merkato footwear cluster, it was said by the interviewees that some of the designs produced by freelance designers in the cluster had been registered at the EIPO. (Indeed, the footwear sector was found to be one of the major users of the formalised industrial design IP protection system in Ethiopia. A number of individual footwear designers, and shoe-manufacturing enterprises who employ the services of designers, have registered their designs at the EIPO.) According to the Merkato interviewees, copying of others' designs was, until recently, a common practice among designers. Nowadays, however, more and more designs are registered at the EIPO, with the effect of excluding others from producing shoes with similar designs.

(The law in Ethiopia requires that in order to get industrial design protection through registration, a design must be different from other designs known (1) in Ethiopia, and (2) abroad. However, in practice, when the EIPO *Gazette* publishes designs for which applications have been filed and invites statements of opposition against registration, the circulation of the *Gazette* is mainly in Ethiopia. Thus, only in rare cases does the EIPO receive statements of opposition from abroad, where many of the designs originate. Thus, in effect, novelty is judged only against designs already present in Ethiopia, making it easy for copies of foreign shoe designs to get industrial design protection in Ethiopia.)

Nevertheless, for the interviewed shoemakers, the predominant approaches to knowledge appropriation were found to be informal. Most of the shoemakers use their own distinctive marks to distinguish the shoes they produce from the products of others. A multitude of marks can be found on the shoes in the Merkato cluster, embossed on the leather uppers through use of a mechanical press, or fixed on the insole via prints on synthetic fabric or plastic. The Merkato shoemakers pointed out that they cannot seek to formally register their marks as trademarks because, as informal entities, they do not have business licences from the government—one of the requirements for filing a trademark registration application. The interviewees said that as long as they produce shoes with reasonable quality and contemporary-looking designs, the wholesalers and retailers were happy to market their products carrying their specific, non-trademarked marks. Meanwhile, because some of the larger, more formalised shoe enterprises connected to Merkato have managed to formally register trademarks, when the Merkato shoemaking MSEs receive production sub-contracts from these formalised entities, the shoemakers sometimes have to add the appropriate mark to the shoes before delivery.

5. Conclusions

Patterns of innovation

The findings show that the studied MSEs engage in several modes of innovation which help them to improve their competitiveness and exploit opportunities in the market. The improvements they make in the quality of their products, and the appealing designs they create or imitate from foreign products, are manifestations of their innovativeness. Both *product innovations* and *market innovations* give the MSEs a competitive edge in the market and help them to sustain their businesses. *Process innovations* by the MSEs—in the form of, for instance, deployment of new machinery or modification of existing means of production—are also among the factors for improvement of the quality of the traditional clothes and footwear produced in the two clusters covered by this study.

Patterns of knowledge

The importance of informal training for innovativeness is most clearly seen in the Shiro Meda handloom-weaving cluster. Although most of the weavers in the cluster do not have long years of formal schooling, they benefit from informal knowledge-acquisition processes—through which they gain tacit knowledge—that are integrated with their day-to-day activities. Channels of knowledge transfer in the two MSE clusters studied are mainly established through social interactions and informal communication networks. Such informal interactions and networks have, in some cases, important roles in determining MSE innovation and growth.

While formalised IP protections—via registrations of industrial design and trademarks—are playing some role in the dynamics and activities of both clusters (particularly in the Merkato shoemaking cluster), the studied MSEs in both the clusters rely primarily on informal knowledge appropriation modalities, such as lead time and unregistered marks. The MSEs studied are among the smallest and least-formalised players in their respective product value chains, and thus they do not have the resources and levels of formalisation necessary to fruitfully participate in most elements of the formal IP system.

But at the same time, the informal MSEs studied do engage, to varying and shifting degrees, in service provision to much-more-formalised entities—evidence that supports the conceptualisation, cited near the beginning of this article (with reference to the work of De Beer et al., 2013; Kraemer-Mbula, 2016; ILO, 2002; Steel & Snodgrass, 2008), of innovative informal-sector enterprises as operating at various, and shifting, points along a continuum between informality and formality.

Relevance to policymaking

The Ethiopian Government's policy approaches relevant to the MSE sector have not, to date, been characterised by a sufficiently holistic understanding of the challenges, needs and expectations of the enterprises and workers in the informal sector. An

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apparent lack of evidence-based analysis in support of policymaking has contributed to this disconnect between government policies and the realities of the informal sector. In designing policies to foster innovation and sustainability in Ethiopia's informal sector, there is a need, going forward, for clearer focus on the nature and dynamics of the MSEs that dominate this sector, of the processes of learning and innovation in these MSEs, and of interactions between these informal-sector MSEs and more-formalised entities.

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Appendices

Interview guide - MSEs

I. General background

Name of interviewee:
Place and date of birth:
Gender:
Address:
Education level:

II. Information about the enterprise

1. What are the products of your enterprise?
2. What is the main type of work you do in your enterprise?
3. When did you start this enterprise?
4. Why did you choose this activity from others?
5. Why is theenterprise located at its present site?
6. How much was the initial capital of the activity/enterprise?
7. What was the major source of this capital?
8. Is your enterprise registered with a government agency?
9. Does the enterprise maintain a formal book of accounts in accordance with government guidelines?
10. Do you have employees in your enterprise?
11. If yes, how many of them are permanent employees?
12. How many of the people working in your enterprise are unpaid?
13. What are the most difficult problems affecting the current operation of your activity/enterprise?

III. Production methods and inputs

14. What types of equipment does your enterprise use in the production process?
15. Does the enterprise own or rent the main equipment/machinery in use?
16. What is the main source of supply of machinery and equipment?
17. Have you recently acquired any new equipment?
18. Have you recently introduced changes in your production methods?
19. If the answer to the above question is yes, who developed these new production methods which you adopted?
20. What motivated you to introduce the new production methods?
21. Where do you procure/obtain most of your raw materials or intermediate inputs?

IV. Product characteristic and marketing

22. Have you recently introduced new products or product designs?
23. Have you recently made any improvements of existing products?
24. If you have introduced new products or made improvements to existing ones, what motivated you to do so?
25. To whom doyousellyour product?
26. Are the products of your enterprise exported (directly or indirectly)?
27. Does the enterprise produce on advance order?
28. How much was the gross value of your sales/income last year?

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V. Networking and collaboration

29. Do you have access to external sources of knowledge and information?
30. If yes, how important are these external information sources to your enterprise's activities?
31. Does your enterprise have any interaction with universities, government research organisations and industry development institutes?
32. Did your enterprise collaborate with other micro and small enterprises, which operate in your field of activity, to address common challenges?
33. Do you have interactions with owners or employees of other enterprises to share ideas, information and best practices?
34. How did you acquire the skills you are applying in your job?
35. Have you had any vocational/technical training?
36. Have you ever participated in tailored trainings seeking to resolve problems regarding access to credit, procurement of raw materials, marketing, technological innovation, etc.?

VI. Intellectual property rights

37. Do you think new knowledge and ideas should be privately owned or freely and openly shared with others?
38. Do you think appropriation of innovations has an impact on profitability of business?
39. Have any of your new products been imitated by other enterprises without your consent?
40. Have you ever shared any of your production methods with other producers?
41. Do you have knowledge of the intellectual property system?
42. If the answer to the above question is yes, have you taken any steps to legally protect your enterprise IPRs?

Interview guide - government

Name of government institute:
Name of interviewee:
Department/Directorate/Section of interviewee:
Position:
Address:

I. General information about the institute

1. Is the institute organised as a federal government agency or a regional government agency?
2. What are the major activities of the institute?
3. Who are the stakeholders of the institute's activities?

II. Innovation support scheme

4. Does your institute provide support to promote MSE innovation?
5. If your institute provides financial support to MSEs, what criteria are used to select the recipients of support?
6. If your institute provides training to MSEs owners/employees, please explain the areas of training?
7. Does your institute provide information on markets, buyers and technology to MSEs?
8. What advisory services are provided by your institute to MSEs?

III. Government policies

9. What micro and small enterprise sector specific policies are in place in the country?
10. What are the priorities in terms of developing the innovation capacities of MSEs?
11. Do you think the country's development policies address the needs of MSEs?
12. How do you see the impact of government policies and regulations on the performance of MSEs in the informal sector?

IV. Scope and impact of MSE innovation in the country

13. What are the types of innovative activities performed by MSEs in the country?
14. What are the major constraints to innovation activities of MSEs in Ethiopia?
15. What are the main barriers to collaboration between MSEsanduniversities/research organisations in the country?
16. What are the major constraints or barriers that particularly affect the dissemination of MSE innovation?

V. Intellectual property rights

17. Do you think the existing intellectual property system is, on its own, adequate to protect innovation by MSEs?
18. If your answer is yes, in your view which IP protection mechanisms are better suited to the needs of MSEs?
19. What are the main shortcomings in IP laws and regulations that affect the ability of MSEs to use the IP system effectively?
20. If you think the formal IP protection mechanism is not appropriate for the kinds of innovation by MSEs, whatalternative appropriation mechanisms do you see as suitable to protect MSE innovations?

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Adoption of Electronic Fiscal Devices (EFDs) for Value-Added Tax (VAT) Collection in Kenya and Tanzania: A Systematic Review

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Abstract
Domestic revenue collection through taxation is still below its potential in many Sub-Saharan African countries. In an attempt to boost their tax revenues, many national governments have deployed electronic fiscal devices (EFDs) to improve value-added tax (VAT) collection. However, there is evidence indicating that the deployment of EFDs in some African countries has encountered substantial challenges. Using the systematic review method, the research described in this article investigated challenges encountered in adoption of EFDs in Kenya and Tanzania. The review concludes by modelling recommendations, extracted from seven existing studies, in terms of the technology-organisation-environment (TOE) framework (Tornatzky & Fleisher, 1990). This model is an effort to provide a potential guide for successful EFD adoption in East Africa.

Keywords
electronic fiscal devices (EFDs), electronic tax registers (ETRs), value-added tax (VAT), tax collection, information and communication technology (ICT), technology-organisation-environment (TOE) framework, Kenya, Tanzania

DOI: https://doi.org/10.23962/10539/26169

Recommended citation
Eilu, E. (2018). Adoption of electronic fiscal devices (EFDs) for value-added tax (VAT) collection in Kenya and Tanzania: A systematic review. *The African Journal of Information and Communication (AJIC)*, *22*, 111-134. https://doi.org/10.23962/10539/26169

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1. Introduction

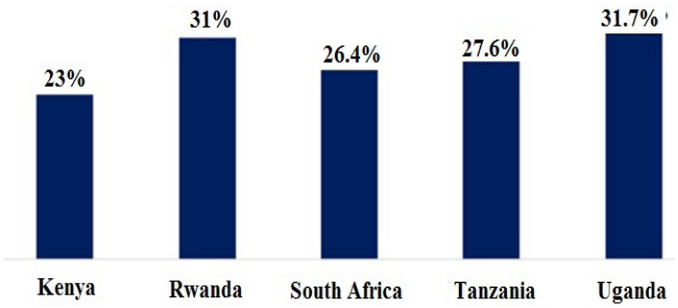
Tax collection in Sub-Saharan Africa

Tax revenue is a vital pillar in support of economic growth in developing countries. Taxation is the main source of central government revenue for state-building, elimination of long-term dependence on foreign assistance, increasing the fiscal effects of trade liberalisation, and providing much-needed public goods and services (Fjeldstad, 2011; Mascagni et al., 2014; OECD, 2011). Tax-to-GDP ratios in many developing countries are much lower than in developed-world countries, i.e., the members of the Organisation for Economic Co-operation and Development (OECD) (Mascagni et al., 2014). The African Development Bank (2011) found that between 2006 and 2008, the countries of the East African region—Kenya, Tanzania, Uganda, Rwanda and Burundi—had tax-to-GDP ratios ranging from 12.3% to 22.1%. Meanwhile, OECD countries and South Africa had tax-to-GDP ratios averaging 35.6% (AfDB, 2011).

In Sub-Saharan African countries, total tax revenue collected typically only funds 30% to 40% of the national budget (Ebeke & Ehrhart, 2010), forcing most of these countries to seek budget supplements from donors. According to the World Bank (2010), Sub-Saharan Africa received USD40.1 billion in aid in 2008 alone. "Tax effort" indices—i.e., tax revenue collected as a percentage of total estimated tax revenue potential—are also lower in Sub-Saharan Africa than in OECD countries (10-20% in Sub-Saharan Africa compared to 30-40% in the OECD) (Mascagni et al., 2014).

In an attempt to increase tax revenues, a number of Sub-Saharan African countries have introduced new taxes, including value-added taxes (VATs). Generally referred to as a tax on consumption, a VAT is an indirect tax levied on the production, distribution and consumption stages of products and services. In 2013, as shown in Table 1, VAT was estimated to be contributing 31.7% of total revenue in Uganda, 31% in Rwanda, 27.6% in Tanzania, 26.4% in South Africa, and 23% in Kenya (URA, 2013).

Figure 1: VAT contribution to total revenue



Source: URA (2013)

However, authorities in these same countries are grappling with the challenge of significant levels of non-compliance among VAT-payers and potential VAT-payers. For example, in Kenya between 2000 and 2003, 30% of the total tax revenue came from VAT, but this percentage had declined to 23% by 2013, with one of the reasons for the decline being a high rate of VAT non-compliance (Mativo et al., 2015; URA, 2013).

Tax collection via electronic fiscal devices (EFDs)

While there are a number of ways in which countries can reduce VAT non-compliance, it is difficult to conceive of an efficient and effective tax administration that can perform its tasks without making substantial use of information and communication technology (ICT) (Eilu, 2018). Accordingly, several tax authorities in Sub-Saharan Africa have deployed electronic fiscal devices (EFDs) (Casey & Castro, 2015). EFDs are computerised devices used by tax bodies to monitor the business transactions of each registered business. One form of EFD is an electronic cash register (ECR), which is a point-of-sale terminal that records information from barcode scanners, weighing scales, and credit and debit card machines. Another form of EFD is an electronic tax register (ETR), which is like an electronic cash register but with one distinct difference: the ETR calculates the tax value for every transaction made and stores this information in a permanent memory that can only be accessed by the tax body.

EFDs were first used in the 1980s, in Japan and several countries in Europe. In recent years, there has been accelerated deployment of EFDs in Sub-Saharan Africa (Casey & Castro, 2015). In 2005, Kenya became the first East African country to implement EFDs, followed by Tanzania in 2010 and Rwanda in 2014 (Casey & Castro, 2015). The deployments of EFDs in Kenya and Tanzania have encountered significant challenges. Casey and Castro (2015) attribute the difficulties to factors such as lack of effective compliance-monitoring, lack of effective follow-up strategy, and absence of enforcement measures.

In Kenya, EFDs (i.e., ETRs) were mandated by *Gazette* Notice No. 47 of 22 October 2004. During the initial implementation stages, beginning in 2005, there was wide scepticism in Kenya regarding the value of EFDs, and this scepticism has persisted (Mativo et al., 2015). Casey and Castro (2015) observe that in Kenya, since the introduction of EFDs in 2005, there has been no sustained tax revenue increase, suggesting the introduction of EFDs has not brought any substantial gains.

In Tanzania, EFDs (i.e., ETRs) were introduced in 2010, with the stated objectives of improving VAT collection through eliminating non-issuance of receipts, eliminating under-invoicing of sales transactions, improving filing process of VAT returns, and assisting traders in keeping proper business records (Kapera, 2017). There is evidence that the initial EFD deployment was undermined in Tanzania by compliance

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challenges and lack of effective follow-up and enforcement (Casey & Castro, 2015; Naibei et al., 2012).

In Rwanda, deployment of EFDs (i.e., ETRs) started in March 2014. By September of that year, 3,943 VAT-collecting firms had active EFDs, representing 77.8% of all VAT-registered firms. However, a study found out that the introduction of EFDs had led to only a 5.4% increase in VAT revenue, much lower than the expectation by the Rwanda Revenue Authority (Steenbergen, 2017). In reference to the EFD deployment in Rwanda, Steenbergen (2017) states that "the overall effect of EFDs on tax yields has been disappointing" (2017, p. 21).

A systematic review: EFD challenges in Kenya and Tanzania

For my study, I used the systematic review method, which requires a step-by-step, comprehensive, and detailed literature search based on a clear research problem, clear research objectives and clear research questions. The goal of a systematic search of literature is to fuse and evaluate all relevant studies on a particular topic, based on the research questions. In this study, the systematic review focused on reviewing the findings of studies that have assessed EFD implementation in Kenya and Tanzania—the first two countries in East Africa to adopt EFDs.

The systematic review generated data from seven existing studies looking at both the challenges, and recommendations for improvement, of EFD adoption in Kenya and Tanzania. After summarising and analysing that data, I subjected the data to an additional level of analysis, in order to generate a proposed model for successful EFD adoption in East Africa. In generating that model, I relied on the technology-organisation-environment (TOE) framework developed by Tornatzky and Fleisher (1990). I used the TOE framework to provide a taxonomy for classifying the different requirements for adopting EFDs in East Africa.

2. The technology-organisation-environment (TOE) framework

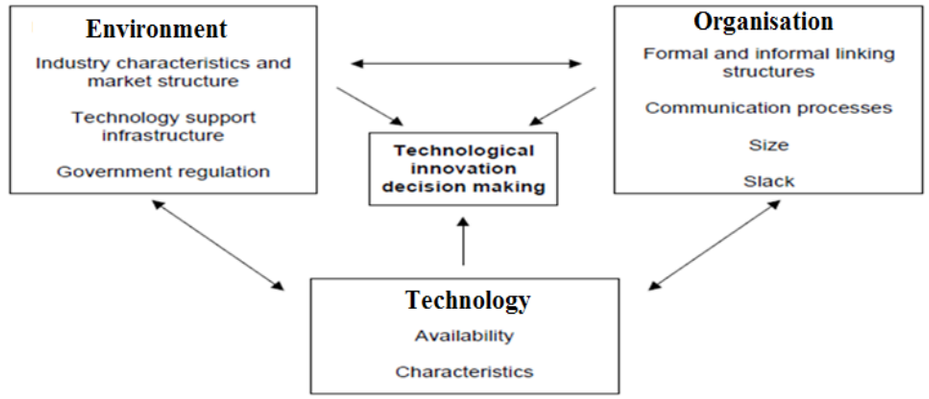
Many theories have been developed for understanding the dynamics of technology adoption. The most-used theories are the technology acceptance model (TAM) (Davis, 1986; 1989; Davis et al., 1989), the theory of planned behaviour (TPB) (Ajzen, 1985; 1991), the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), the diffusion of innovation (DOI) model (Rogers, 1995), and the TOE framework (Tornatzky & Fleischer, 1990). The DOI and TOE frameworks can be applied at both individual and firm levels, while the remainder of the above-listed theories are applicable only at the individual level (Oliveira & Martins, 2011).

In their individual capacities, these theories cannot account for all of the dynamics of adoption of new technology in a country, because of each country's particular social, cultural, political and economic dynamics. DOI attempts to cover a number of critical requirements that aid technology adoption in a developing-country setting,

but Hoti (2015) argues that the DOI model should be combined with other contexts or factors for a more holistic adoption picture. It is in line with this argument that Hoti (2015) recommends the TOE framework, which includes the environmental context that in many respects is not included in DOI. TOE defines the process by which a firm adopts and implements technological innovations, considering the influences of the technological, organisational, and environmental contexts (Tornatzky & Fleischer, 1990). According to Oliveira and Martins (2011), the TOE framework provides a good understanding of IT adoption decisions in different contexts, and it provides a taxonomy for classifying adoption factors in their three respective contexts—a quality many other models do not have.

In the TOE model, the *technology (T)* context refers to characteristics of the technologies available for possible adoption by the organisation, and the current state of technology in the organisation. This current state of technology can be expressed in both material (e.g., equipment owned by the organisation) and immaterial (e.g., methods currently in use) terms. The *organisation (O)* context consists of the organisational structure; the presence of innovation-enabling processes such as informal communication and strategic behaviour of top management; and the amount of extra resources available for use internally within the organisation. The *environment (E)* context combines factors such as market structure and characteristics; the external support available for adopting new technologies; and government regulations. As seen in Figure 2 below, the three TOE contexts are posited to interact with each other and to influence technological innovation and decision-making, which in turn impact adoption dynamics (Tornatzky & Fleischer, 1990).

Figure 2: TOE framework (Tornatzky & Fleischer, 1990)



Source: Tornatzky and Fleischer (1990, p. 76)

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TOE theory has been used by a large number of technology adoption studies, e.g., investigations of adoption of electronic data interchange (EDI), adoption of open systems, and e-business adoption. Most of these studies applied the TOE framework in a developed-country setting. As far as I am aware, there has been little or no application of this model in Sub-Saharan African national settings.

3. Research design

As stated above, the research method followed was a systematic review. The systematic review method has its roots in criticism from scholars towards non-systematic, narrative-style literature reviews (DFID, 2013). Scholars have criticised narrative-style literature reviews on the grounds that they are insufficiently rigorous (DFID, 2013). A systematic review involves a step-by-step plan based on a clear research problem and clear objectives and questions (Hagen-Zanker & Mallett, 2013).

Kenya and Tanzania were chosen as focus countries for this study because they were the first East African nations to adopt EFDs, and because their adoption of EFDs was long enough, since 2005 and 2010 for Kenya and Tanzania respectively. There was a substantial body of literature on the progress of the implementations. In the systematic review, I followed the five-stage process proposed by Randolph (2009, p. 4), namely: (1) formulation of the research problem; (2) collection of data; (3) evaluation of the data; (3) analysis and interpretation of the data; (5) public presentation of the data.

Research problem

The research problem I identified was the need to try to develop a model, based on experiences to date in Kenya and Tanzania, for the future of EFD adoption and implementation in East Africa.

Research objectives

In line with this problem definition, the core research objectives were to:

- understand the challenges of EFD adoption that have been identified by existing research in Kenya and Tanzania;
- understand the recommendations that have been made in this literature for successful adoption; and
- develop a model for potential guidance to East African countries that have adopted, or are planning to adopt, EFDs.

Research questions

Accordingly, the three overarching research questions were as follows:

1. Based on the findings presented in the existing literature, what have been the challenges of EFD adoption in Kenya and Tanzania?
2. Based on the findings presented in the existing literature, what recommendations have emerged for more successful EFD adoption in Kenya and Tanzania?

3. Based on the findings presented in the existing literature, what kind of model emerges for successful adoption of EFDs in Kenya and Tanzania and, in turn, for other East African countries?

Data collection

An extensive literature search was conducted to identify studies that have looked at the challenges encountered, and recommendations for improvement, in adoption of EFDs in Kenya and Tanzania. The literature search's selection criteria were directly guided by the first two research questions listed above. The core keywords that were identified and searched for were: Kenya; Tanzania; electronic fiscal devices (EFDs); electronic cash registers (ECRs); electronic tax registers (ETRs); EFD challenges; EFD recommendations.

Data evaluation

The literature reviewed covered journal articles, books, reports, Master's and PhD dissertations/theses, conference proceedings, and websites. Google Scholar was the main tool used for the searching. The selection of literature to be analysed was based on the keywords and how comprehensively each item addressed the first two research questions. Initially, 30 items were found to address some aspects of the keywords. A more refined search was then made across those 30 studies, and it was found that seven studies comprehensively covered the content suggested by the keywords. Therefore, these seven studies were used for data evaluation (see "data evaluation" sub-section below).

I used a simple data extraction table to generate an overview of the data drawn from the seven studies, categorising each study in terms of its: author(s), year of publication, country of study, town/city of study, EFD technology studied, and number of respondents in the study.

Data analysis and interpretation

The data analysis sought both heterogeneity and homogeneity across the studies' findings, in terms of both: challenges identified; and recommendations made. First, the challenges and recommendations presented in each study were represented in tabular form: one table for each study. Then the challenges data were summarised and analysed across the seven studies, followed by summary and analysis of the recommendations data across the seven studies.

Finally, I made use of the TOE framework (Tornatzky & Fleisher, 1990) to generate a taxonomy for classifying the recommendations that emerged from the systematic review, ultimately producing a potential model for successful EFD adoption in East Africa countries.

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Public presentation
This article represents a key element of my implementation of the fifth systematic-review pillar in the process outlined by Randolph (2009): public presentation of data.

4. Data analysis and interpretation part one: The seven studies
As outlined above, the literature search and evaluation identified seven studies that clearly discuss challenges and recommendations in respect of EFD deployment in Kenya or Tanzania. In the group of seven studies, conducted between 2011 and 2017, three are from Kenya, four from Tanzania (see Table 1).

Table 1: The seven studies

Author(s)	Year	Country of study	Town/ city of study	EFD technology studied	No. of respondents
Omweri, Obongo, Obara and Onsongo	2011	Kenya	Kisii	ETRs	98
Mativo, Muturi and Nyang'au	2015	Kenya	Nairobi	ETRs	78
Maisiba and Atambo	2016	Kenya	Uasin Gishu	ETRs	102
Bakar	2014	Tanzania	Tanga	ETRs	36
Siraji	2015	Tanzania	Mwanza	ETRs	205
Kira	2016	Tanzania	Dodoma	ETRs	75
Kapera	2017	Tanzania	Arusha	ETRs	120

Study one: Omweri et al. (2011)
Omweri, Obongo, Obara and Onsongo (2011) assess the effectiveness of ETRs in the processing of VAT returns in Kisii Town in Kenya. The study was conducted on 98 VAT-registered businesses in Kisii town, including: services providers, wholesalers, and large-scale retailers including supermarkets. A number of challenges are identified, and recommendations provided, as shown in Table 2.

Table 2: Challenges and recommendations identified by Omweri et al. (2011)

Challenges
ETRs are expensive
ETRs do not suit their kinds of businesses
ETRs give inaccurate records
ETR machine cannot be used in all businesses
Some businesses already have point-of-sale devices
Recommendations
ETR costs should be payable in instalments
ETRs should be compatible with legacy computer systems in business premises
ETRs should be free
Kenya Revenue Authority (KRA) should introduce cheaper ETRs
KRA should introduce more robust ETRs that have fewer breakdowns
KRA should train VAT-collecting businesses on use of EFDs
KRA should introduce different EFD systems for different businesses
KRA should reimburse ETR servicing expenses

Study two: Mativo et al. (2015)
Mativo, Muturi and Nyang'au (2015) investigate factors affecting utilisation of ETRs among small- and medium-sized enterprises (SMEs) in the central business district of the Kenyan capital, Nairobi. The study involved 78 VAT-collecting businesses. Table 3 summarises the challenges and recommendations identified by the study.

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Table 3: Challenges and recommendations identified by Mativo et al. (2015)

Challenges
inadequate training for VAT-collecting enterprises on use of EFDs
constant changes in technology make the ETR machines obsolete
ETR maintenance services not provided by suppliers
high cost of purchasing the ETR
a large number of enterprises perceive VAT as not important
Recommendations
more training for VAT-collecting enterprises on use of EFDs
provide ETR machines to VAT-collecting enterprises at no cost
sensitise SMEs on importance of VAT
impose penalties for late filing of VAT returns

Study three: Maisiba and Atambo (2016)

The Maisiba and Atambo (2016) study looks at the effect of EFDs on the revenue collection efficiency of the Kenya Revenue Authority (KRA) in Uasin Gishu County. The study targeted a population of 102 respondents, who included employees of KRA and Uasin Gishu VAT-collecting businesses. Results are presented in Table 4.

Table 4: Challenges and recommendations identified by Maisiba and Atambo (2016)

Challenges
usability problems
poor, congested network during peak hours
lack of training of VAT-collecting businesses on use of EFDs
lack of reliable power supply to power the EFDs
Recommendations
make VAT filing and payment easier for VAT-collecting businesses
extend working hours for KRA so as to enable tax filings after business hours
increase training of VAT-collecting businesses on use of EFDs
support cost of stable electricity to power EFDs

Study four: Bakar (2014)

The study by Bakar (2014) assesses the extent to which EFDs leverage VAT collection volume. This study was conducted at the offices of the Tanzania Revenue Authority (TRA) in Tanga City, and 36 VAT-collecting businesses were studied. Although the study found that EFDs had a significant impact on VAT collections, the study also revealed significant challenges in the EFD implementation process which, if addressed, would have positive effects on VAT compliance and revenue volumes. Table 5 presents the challenges and recommendations identified by the study.

Table 5: Challenges and recommendations identified by Bakar (2014)

Challenges
regular EFD breakdowns/malfunctions
battery problems
resistance to EFD use from VAT-collecting businesses
errors in the vendor issuance of receipts
businesses' failure to report EFD faults
lack of knowledge of how to use EFDs, i.e., lack of training of VAT-collecting businesses on use of EFDs
customers not demanding receipts
weak network signals for transmission of electronic reports to TRA
difficulty in monitoring EFDs after working hours
Recommendations
greater government political and financial support for EFD use
sustained training and sensitisation of VAT-collecting businesses, and other relevant stakeholders, on use of EFDs
effective monitoring and evaluation of EFD system
punitive measures against falsified refund claims
forging of better relationship between TRA and VAT-collecting businesses
closer TRA monitoring of EFD-using businesses

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Study five: Siraji (2015)

The Siraji (2015) study focuses on the challenges faced by taxpayers in using EFDs in Tanzania's Mwanza City, Nyamagana District. A sample of 205 VAT-collecting businesses was selected through stratified random sampling and purposive sampling. The study findings are provided in Table 6.

Table 6: Challenges and recommendations identified by Siraji (2015)

Challenges
high cost of EFDs
lack of training of VAT-collecting businesses on use of EFDs
time-consuming EFD operations
power outages
lack of technical support
Recommendations
provide training to VAT-collecting businesses on use of EFDs
subsidise cost of, or remove import tax on, EFDs
deploy TRA liaison officers to build relationships with traders
establish EFD maintenance centres

Study six: Kira (2016)

Kira's (2016) study looks at perceptions of EFD use among VAT-taxpayers in the Tanzanian capital, Dodoma, identifying a number of challenges. The study was conducted on a sample size of 75 VAT-collecting businesses. The challenges and recommendations identified are shown in Table 7.

Table 7: Challenges and recommendations identified by Kira (2016)

Challenges
usability of EFD machines
high cost of EFD machines
EFD network problems
lack of training of VAT-collecting businesses on use of EFDs
insufficient number of EFD suppliers

Recommendations
involvement of VAT-collecting businesses in EFD programme design and implementation
sensitisation, education, and training for VAT-collecting businesses on use of EFDs
reduction of the EFD threshold, so that more businesses can collect and pay VAT
incentives to motivate VAT-collecting businesses' participation
appropriate legislation and regulation in support of EFD deployment

Study seven: Kapera (2017)

Kapera's (2017) study looks at the effectiveness of EFDs in tax collection in Arusha, Tanzania. The study sampled 100 VAT-registered traders and 20 TRA staff, for a total of 120 respondents. The identified challenges and recommendations are in Table 8.

Table 8: Challenges and recommendations identified by Kapera (2017)

Challenges
the high cost of purchasing the devices
lack of training of VAT-collecting traders on use of EFDs
breakdowns in the EFD system
lack of trader motivation to use EFDs
lack of trader trust in EFD system
Recommendations
more fairness in TRA estimations of traders' VAT obligations
provision of more training to VAT-collecting traders on use of EFDs
stronger enforcement of VAT collection laws
improvement of EFD technology

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5. Data analysis and interpretation part two: Across the seven studies

Challenges and recommendations for using EFDs in Kenya and Tanzania

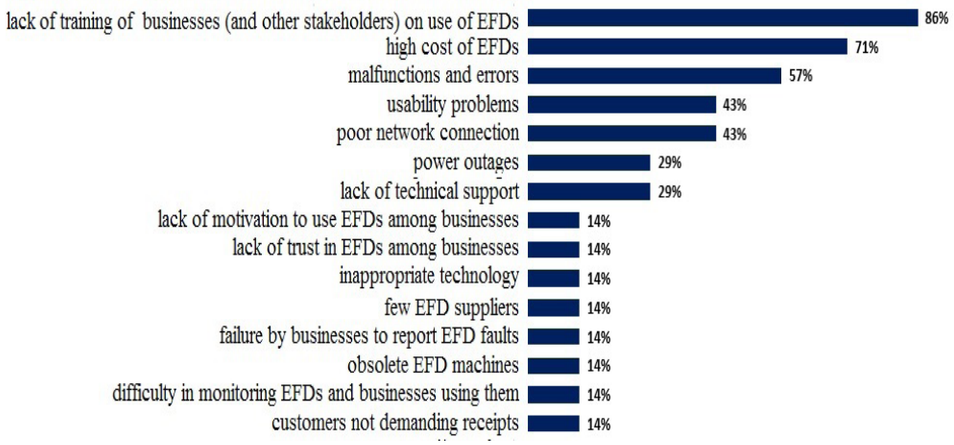
Table 9 lists key challenges encountered by the EFD programmes in Kenya and Tanzania, and the frequency with which each challenge is cited across the seven studies identified via the systematic review.

Table 9: Challenges: Frequency of citation across the seven studies

Challenges	Omweri et al. (2011)	Mativo et al. (2015)	Maisiba and Atambo (2016)	Bakar (2014)	Siraji (2015)	Kira (2016)	Kapera (2017)
usability problems			x		x	x	
high cost of EFDs	x	x			x	x	x
poor network connection			x	x		x	
lack of training of businesses (and other stakeholders) on use of EFDs		x	x	x	x	x	x
few EFD suppliers						x	
malfunctions and errors	x			x		x	x
customers not demanding receipts				x			
difficulty in monitoring EFDs and businesses using them				x			
obsolete EFD machines		x					
power outages			x		x		
lack of technical support		x			x		
failure by businesses to report EFD faults				x			
lack of motivation to use EFDs among businesses							x
lack of trust in EFDs among businesses							x
inappropriate technology	x						

Figure 3 provides percentages for the frequency with which each of the above-listed challenges was cited across the seven studies.

Figure 3: Challenges: Frequency of citation, in % terms, across the seven studies



The results, as indicated in Figure 3, show that in the studies, the most-cited challenge affecting the use of EFDs in Kenya and Tanzania was lack of training of VAT-collecting businesses (and, to a lesser extent, other stakeholders) on the use of EFDs. This challenge was identified in six (86%) of the studies. The second-most-cited challenge was the high cost of EFDs, as identified in five (71%) of the studies. Malfunctions and errors were the third-most-cited category of challenge, identified in four (57%) of the studies. Two challenges—poor network connection and usability problems—were each cited as a challenge in three (43%) of the studies. Two challenges—lack of technical support, and power outages—were each identified in two (29%) of the studies. Other key challenges, each identified in only one study, were: inappropriate technology; lack of trust in EFD system among VAT-collecting businesses; lack of motivation to use EFDs among VAT-collecting businesses; VAT-collecting businesses' failure to report EFD faults; EFD machine obsolescence; difficulty in monitoring EFDs and the businesses using them; lack of customer demand for receipts; and few EFD suppliers.

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Table 10 lists key recommendations for fostering EFD adoption, and the frequency with which each recommendation appears in the seven studies identified via the systematic review.

Table 10: Recommendations: Frequency of citation across the seven studies

Recommendations	Omweri et al. (2011)	Mativo et al. (2015)	Maisiba and Atambo (2016)	Bakar (2014)	Siraji (2015)	Kira (2016)	Kapera (2017)
government political and financial support for EFD programme				x			
sustained sensitisation, education and training of businesses (and other stakeholders)	x	x	x	x	x	x	x
action against tax evasion, false/late filings		x		x			x
better relationship between tax body and businesses, taxpayers				x	x		
strict monitoring of EFDs and EFD-using businesses				x			
subsidised, or free, EFDs	x	x			x	x	
maintenance centres					x		
fair estimates of businesses' VAT collections							x
involvement of businesses in programme design/ implementation						x	
provision of motivation (incentives) to businesses to use EFDs						x	
appropriate legislation and regulation						x	
efforts to address usability problems			x				
after-hours VAT filings			x				
affordable and stable power supply					x		
EFDs compatible with legacy systems	x						
robust EFDs	x						
different EFDs for different businesses	x						

Figure 4 provides a percentage breakdown of the frequencies of the above-listed recommendations across the studies.

Figure 4: Recommendations: Frequency of citation, in % terms, across the seven studies

Results, as indicated in Figure 4, show that the most frequent recommendation, as suggested by all seven studies (100%), was provision of sustained sensitisation, education and training of VAT-collecting businesses (and, to a lesser extent, other stakeholders) on the EFD system. The second-most-frequent recommendation, as suggested by four out of seven (71%) of the studies, was to reduce the cost of EFDs through subsidisation or providing them free-of-charge. The third-most-frequent recommendation was for tax bodies to take stronger action against tax evasion, false filings, and late filings, as suggested by three out of seven (43%) studies. The fourth-most-frequent recommendation, as suggested by two out seven (29%) studies, was creating a good relationship between the tax body and VAT-collecting businesses and taxpayers.

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Recommendations that only appeared once across the seven studies were to: establish EFD maintenance centres; ensure fair VAT collection estimates for businesses; involve VAT-collecting businesses in EFD programme design and implementation; provide incentives to motivate businesses to use EFDs; ensure appropriate legislation and regulation; address usability problems; extend tax authority hours to enable tax filings after business hours; support affordable and stable electricity supply to power VAT-collecting businesses' EFDs and EFD-related systems; make EFDs compatible with legacy systems; introduce more robust EFDs; introduce different EFDs for different types of businesses; ensure strict monitoring of EFDs and EFD-using businesses; and ensure government political and financial support for the EFD programme.

I now consider the 17 above-listed recommendations extracted from the seven studies, grouped according to the three TOE contexts as set out by Tornatzky and Fleischer (1990):

- technology (T);
- organisation (O); and
- environment (E).

Technology (T)

Usability: According to Maisiba and Atambo (2016), manufacturers of EFDs need to design easy-to-use EFDs, and tax bodies should come up with an application that can make tax registration, filing, and payment easy for the taxpayers.

Compatibility with legacy systems: Many traders complained that the new EFDs did not conform to their existing systems. There is a need for flexible EFDs that are compatible with legacy systems (Omweri et al., 2011)

More robust EFDs: One of the challenges of using EFDs, as pointed out by some VAT-collecting businesses, was that the devices were prone to malfunctions and errors. Omweri et al. (2011) recommend thorough testing of procured EFDs to ensure quality and robustness.

Different EFDs for different types of businesses: Some EFDs may not be appropriate for some businesses, creating a need to introduce different EFD systems for different types of businesses (Omweri et al., 2011).

Organisation (O)

Sustained sensitisation, education and training: Bakar (2014) observes that, for any EFD project to succeed, emphasis should be put on sensitisation, education and training programmes. This helps to inform all stakeholders on how to use EFDs and their benefits to the VAT-collecting business, the taxpayer, and to the government.

Subsidised or free EFDs: There is need to either subsidise the cost of EFDs or make them free. As seen from the challenges affecting the use of EFDs, the high cost of acquiring EFDs was second in importance to lack of training. Mativo et al. (2015)

find that the financial implications of acquisition and maintenance of EFDs is a major hindrance to VAT compliance in Kenya.

Enforcement of the VAT law: Government is advised to be strict in enforcing VAT laws on VAT-collecting businesses. Mativo et al. (2015) find that that the government needs to strongly use the law in order to enforce the use of ETRs machines on every transaction.

Relations between the tax body and VAT-collecting businesses, taxpayers: There is a need for tax bodies to forge a strong relationship with VAT-collecting businesses. Siraji (2015) argues that the tax body should set up a public relations department to regularly visit VAT-collecting entities, talk to them, and get comments or suggestions on different aspects of EFD implementation.

Monitoring EFDs and the businesses using them: Bakar (2014) recommends effective monitoring of areas prone to faults in the system so as to address matters such as substandard EFDs, falsified breakages of EFDs, and collusion between revenue authority officers and traders in tax evasion (e.g., businesses collecting VAT but not paying it over to the authority).

EFD maintenance centres: Siraji (2015) recommends that tax bodies should set up maintenance centres where VAT-collecting businesses with EFDs would go to get the devices maintained and repaired.

Fairness in VAT collection estimations: Kapera (2017) observes that the tax body should have the ability to more accurately estimate VAT-collecting businesses' VAT collection totals. Over-estimating a particular business's collections and obligations will undermine the business.

Involvement of VAT-collecting businesses in EFD programme design and implementation: Involving VAT-collecting businesses in the whole design and implementation process for the EFD programme will enhance compliance (Kira, 2016).

Motivations for potential EFD-using businesses: According to Kira (2016), proving incentives to persuade businesses' adoption of EFDs is one way to influence acceptance. For example, giving out rewards to vendors who use EFDs will motivate other to adopt the devices.

Extension of tax authority hours: Based on VAT-collecting businesses' complaints that the time given to file VAT returns is too limited, Maisiba and Atambo (2016) recommend extension of tax authority working hours to suit the VAT-collecting entities' schedules.

Environment (E)

Government support: There is a need for the government to provide both political and financial support to the EFD implementation process (Bakar, 2017).

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Appropriate legislation and regulation: Fast-changing dynamics in technology-dependent sectors often require legislative amendments or creation of new legislation. Kira (2016) calls for legislation with detailed regulations on use of technology in VAT collection, with the legislation developed with cognizance of the needs of both the VAT-collecting businesses and the tax authority.

Electricity supply to power EFDs: The government must ensure that all VAT-collecting businesses have access to affordable, stable electricity to run their EFDs and EFD-related systems (Maisiba & Atambo, 2016).

6. Conclusion: A TOE-based model for EFD adoption in East Africa

The concluding output made possible by this systematic review is a proposed model for EFD adoption in East Africa—generated by mapping the 17 recommendations (as just discussed, from the seven studies) in terms of the TOE framework. We saw in the previous sub-section that the 17 recommendations can be ordered against the three TOE contexts—technology (T), organisation (O), environment (E)—as follows:

Technology (T)

In the technology context, we saw above that for EFDs and their related systems to be widely adopted, they must be: user-friendly; robust; compatible with legacy systems; and differentiated according to types of businesses.

Organisation (O)

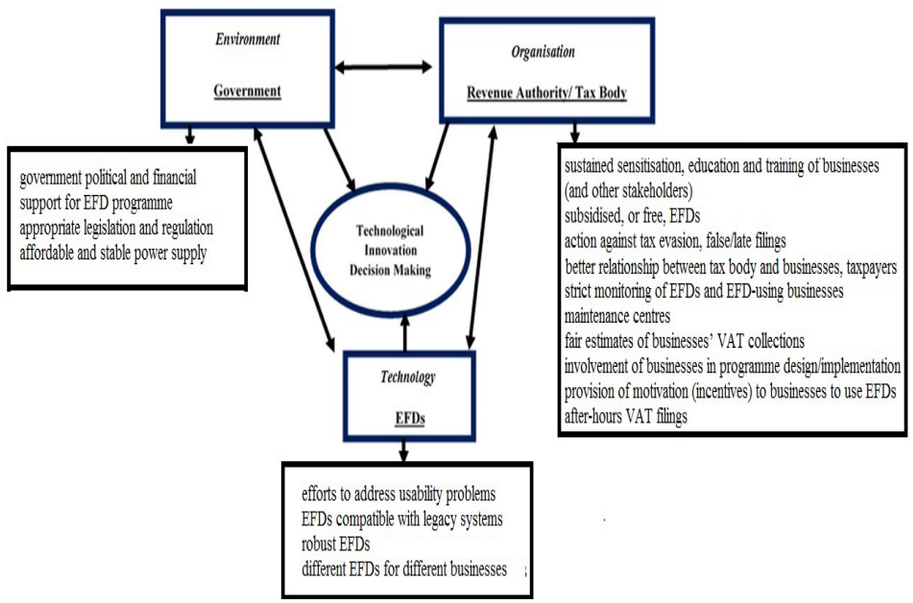
In the organisation context, we saw above that wide adoption of EFDs and their related systems requires: sensitisation, education and training of businesses and other stakeholders; subsidised or free EFDs; enforcement of VAT law; good relations between the tax authority and businesses/taxpayers; monitoring of EFDs and their users; maintenance centres; fairness in VAT collection estimates; business involvement in EFD programme design and implementation; incentives for business EFD take-up; and provision for after-hours VAT filings.

Environment (E)

In the environment context, we saw that adoption of EFDs and EFD systems requires: government political and financial support; appropriate legislation and regulation; and affordable and stable electricity supply.

Accordingly, Figure 5 provides a graphical illustration of the TOE-based model just outlined for effective adoption of EFDs to leverage VAT compliance in East Africa.

Figure 5: TOE-based model for EFD adoption in East Africa



The TOE framework thus provides a suitable taxonomy for mapping the recommendations that emerge from the seven studies of EFD adoption in East Africa. It is hoped that this model may be of use to policymakers and ICT implementers seeking to deploy EFDs in support of VAT collection in East Africa, and potentially elsewhere on the African continent and the developing world.

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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)

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