ICTD Research by Africans: Origins, Interests, and Impact

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***Abstract*—The ICTs and Development (ICTD) field refers to numerous case studies on the African continent. These stories are, however, often told by Western scholars. This gap between researcher and reality can affect the success of ICT programs in African countries, but also reflects a more serious dependence of Africa on foreign scholarly direction. This paper therefore seeks to better understand what role African researchers have played in the ICTD field, and suggest a way forward that will advance the role of ICTs in the continent's development. We present findings on the participation of African researchers in ICTD through academic publications across four subdisciplines. The findings highlight emerging thematic areas of concern to African researchers and their almost negligible representation in formal academic publications. We therefore suggest that key theories in ICTD are being formed without significant influence by African scholars and identify mechanisms to enhance their contribution.**

***Index Terms*—developing nations, Africa, ICTD, meta-analysis, research output**

I. Introduction

Africa is a captivating story for researchers concerned with socio-economic development issues. We are fascinated by the common condition of many African states, but also the diversity in history, culture, and polity. The maturing ICTs and Development (ICTD) field is no exception and refers to numerous case studies on the continent, from national government policies in South Africa [1] through to micro-enterprises in Rwanda [2]. The emergence of the ICTD field and associated global initiatives such as the World Summit on the Information Society (WSIS) have contributed immensely to a greater awareness around ICTs in Africa and its potential for expanding the freedoms of marginalised groups [3-5]. The story is, however, often told by Western scholars [3, p.14]. This gap between researcher and reality can undermine the success of ICT programs in African countries [4], but also reflects a more serious dependence on foreign scholarly assistance and direction at the cost of African indigenous research.

The authors acknowledge that the history of mainstream journal publications has been dominated by developed countries leaving many emerging or developing nations with little representation in published academic works. Gray [5] finds that Africa delivers a poor record of academic publications under the conventional measure of publication performance which is usually through the Thomson Reuters ISI Web of Knowledge indexed journals. According to her analysis, the ISI index shows that South Africa produces nearly 80% of the region's research outputs and that there has been a drop of research outputs from other Southern African institutions. If we look at the overall ISI journal index King [6] finds that 84% of journal articles are written from four countries: the USA, United Kingdom, Germany and Japan. South Africa contributes only 0.5% of articles in 23 accredited journals.

Abrahams et al. [7] discusses the constraints behind Africa's poor performance in this conventional setting including the lack of awareness of the researcher of the work being produced even in his or her own institution, and the fact that most research work in Africa remains in 'grey area' literature such as working papers and technical papers. In addition, Gray [5] suggests that the publications chosen for the ISI indexes are skewed, with less priority on seeking research which addresses pressing regional developmental needs and locally informed policy. She also points out the political economy of the publishing industry with most journals being based in the North and thus favouring authors from this region of the world. She further notes the potential of Open Access approaches and a re-examination of the values and measures of publishing for the African community.

In the context of these increasingly acknowledged problems with African research, we aim to understand the specific relationship between African researchers and the ICTD field. Given the explicit development objectives of ICTD research and the evolution in development thinking since the 1950s, we may (and should) expect a more appropriate balance between indigenous research and Western knowledge in the ICTD community.

The following sections first outline our research methodology, which is largely based on a meta-analysis of academic publications as a representative indicator of research output in the ICTD field. We then present and discuss our

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findings before making recommendations on how Africans may shape emerging ICTD research to better meet the context and needs of their home countries and other developing countries.

II. METHODOLOGY

The research consisted of a quantitative survey of academic conference and journal publications in the ICTD field, and a more in-depth, qualitative commentary on major themes. Whilst information on other outputs, such as projects and innovations, patents, standards, books, magazines, blogs, policy briefs, and market surveys were relevant to our overarching aims; the selected sources were a relatively self-contained group that simplified analysis but still provided a useful indicator of research performance and topics. We used a combination of predefined categories and a grounded approach to organise research themes, demographic information, and impact measures to describe African research in the ICTD field. Our approach consisted of three main steps:

A. Step 1: Identification of Research Categories and Subdisciplines

First, we conducted an initial, limited sample of research within the field to identify possible categories and subdisciplines that may be relevant to the research aims, summarised in Table I. Whilst a number of relevant categories emerged that may be used to describe the contribution of African research in the ICTD field, we limited this paper's analysis to the number of publications and citations (RC3.1 and RC3.2), host country (RC2.1), and major research subdisciplines or topics (RC1.1 and RC1.2).

The identified subdisciplines (RC1.1) of the ICTD field are summarised in Fig. 1, and largely based on an adaptation of the model used by Heeks [8, 9]. A certain degree of triangulation was achieved in identifying the subdisciplines by drawing on the perspectives of the authors who work in different areas of ICTD, and through subject categories used in the journal ranking databases. The four main "ICT" subdisciplines (Group B) form the information and communication basis for the ICTD field. These include Computer Science (CS) (including Human Computer Interaction (HCI)), Telecommunications and Networking, Information Systems (IS), and Communication and Media Studies. These subdisciplines also roughly represent the main layers [10-12] or value chain components in the broader ICT system: Terminals, Network Infrastructure, Applications, and Content respectively.

TABLE I
CLASSIFICATIONS USED FOR ANALYSIS

Ref#	Description
RC1	*Research description*
RC1.1	**Subdiscipline**
RC1.2	**Research question, topic or theme**
RC1.3	Country or region of interest in Africa
RC1.4	Language of publication
RC1.5	Theoretical basis
RC1.6	Methodology
RC1.7	Unit of analysis
RC2	*Demographic information*
RC2.1	**Host country of Africa-based researcher**
RC2.2	Co-authorship with foreign or African researchers
RC2.3	Host country of diaspora researcher
RC2.4	Highest qualification of African researcher
RC3	*Research impact*
RC3.1	**Publication number**
RC3.2	**Citation count**
RC3.3	Source impact factor
RC3.4	Source type
RC4	*Research resources*
RC4.1	Support organisation location

The research classifications (RC) used in this paper's analysis are highlighted in **bold**.

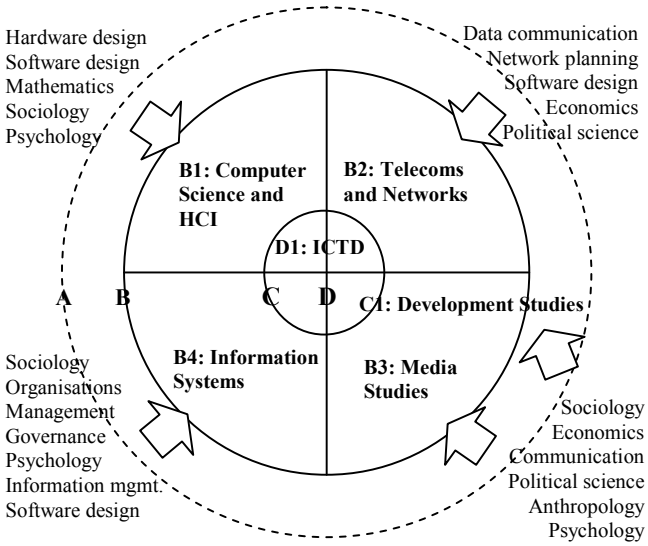

Fig. 1. ICTD subdisciplines

The ICT subdisciplines are based on a number of technological and social science "foundation" disciplines such as Sociology and Economics (Group A). The Development Studies field (Group C) cuts across the four ICT subdisciplines to form the core ICTD field (Group D). Importantly, as highlighted by Heeks, Walsham and Sahay [3, 9], the unit of analysis within each subdiscipline varies from the macro (e.g., link between national GDP and telephony penetration) to the individual level (e.g., individual perceptions of mobile phone benefits).

B. Step 2: Macro Analysis

The above categories and subdisciplines were then used to conduct a broad quantitative survey of African academic publications in the ICTD field over a twenty year period between 1990 and 2009 in Thomson Reuters ISI Web of Science (WoS). Whilst research in ICTD has only recently emerged as a generally accepted inter or multi-disciplinary field, there have been contributions at the intersection of ICTs and development issues throughout history. Nonetheless, we focus on a period characterised by substantial growth in the accessibility and pervasiveness of modern computing and national and international communication networks in both

developed and developing countries. At the same time, research by Africans in this field, as recorded by WoS, prior to 1990 is negligible.

In this step of the research, we executed a search for various "ICT" and "development"-related terms in WoS over the specified period, then filtered the results to only show those articles authored or co-authored by scholars based at African institutions. Whilst it may be argued that all publications by African authors are inherently development related, the focus of this paper is on research that refers specifically to enabling socio-economic development in more marginalised contexts through ICTs. We also acknowledge that the WoS does not include all publication languages, journals and conferences that may be relevant to the ICTD field, including local journals, and tends to under represent citation scores, but we consider this database a suitable tool to provide an *indication* of *relative* academic research output by African researchers over this period. In addition, whilst we recognise the substantial contribution of the African diaspora, we limit ourselves to research produced by African scholars based at African universities as an indicator of the research contribution emerging from the continent's research institutions.

C. Step 3: Meso Analysis

To gain a more in-depth understanding of research output and themes over a more recent period (between 2007 and 2009), we then augmented the list of journals identified in the WoS search with a selection of emerging international and African journals relevant to ICTD. These additional sources were identified through consultation with co-authors, colleagues, and through key commentaries and articles in the ICTD field [13]. A combination of quantitative and qualitative techniques was used to analyse the contribution of African authors and key research themes relevant to the continent.

III. Macro-perspective: 1990 to 2009

From the quantitative search in WoS it was possible to gain an overview of the African contribution to the ICTD field over the past twenty years. The search identified 150 articles authored by African scholars, of which 30 articles were co-authored with non-African scholars. The 150 articles by African authors represent 9% of the total of 1,633 articles on ICTD in the WoS search[1]. As highlighted in Table II, South Africa ranks seventh globally in terms of publications output with 56 publications, then Nigeria with 26 publications. However, for institutions, the University of Botswana is ranked first in terms of publication count (18 items, with 24 citations), ahead of other prominent institutions in the field such as the University of Manchester (13 items, with 101 citations). The total number of citations for the 150 African-authored ICTD articles is 220, with average citations per item at 1.47; in comparison to the global average of 1.89 citations per item. In addition, African authors tend to publish less in conference proceedings (50%) than non-African authors (60%), possibly due to the limitation of travel costs.

TABLE II
PER COUNTRY DISTRIBUTION OF PUBLICATIONS IN ICTD FROM WOS

Country	Global Rank	Total Pubs. (n>5)	% of African Pubs.
South Africa	7	56	37%
Nigeria	12	26	17%
Botswana	16	21	14%
Egypt	35	10	7%
Kenya	35	10	7%
Ghana	45	6	4%

TABLE III
MAIN JOURNALS FOR AFRICAN AUTHORS IN ICTD FROM WOS

Publication Name	Publications	Citations	Citations to Pubs. Ratio
Electronic Library	13 (9%)	21	1.6
Methods of Information in Medicine	8 (5%)	12	1.5
Telecommunications Policy	7 (5%)	21	3
International Journal of Medical Informatics	4 (3%)	54	13.5
Journal of Information Science	4 (3%)	13	3.25

According to Table III, the main sources of African publications in the field were the journals: Electronic Library, Methods of Information in Medicine, and Telecommunications Policy. The highest impact articles were in the International Journal of Medical Informatics, suggesting that African authors have had greatest global influence in the e-Health area, although medical articles tend to get cited more often than other fields [6]. The popularity of library information sciences is explained somewhat by the relatively high output of the University of Botswana's Department of Information and Library Sciences, whilst the high number of Telecommunications Policy publications studies may reflect the pressure on developing countries to implement reforms of their telecommunications regulation systems.

IV. Meso-perspective: 2007 to 2009

The macro-perspective provided by the WoS analysis gives an indication of the relatively low level of formal research output by African authors over the past two decades, and a suggestion of thematic focus on library sciences, e-health and telecommunications policy. However, to gain a more in-depth understanding of key themes and impact over a recent period, we narrowed the time-frame to three years, between 2007 and 2009, and expanded our analysis to include a selection of journals and conferences that are relevant to the ICTD field but not included in WoS. We use the subdisciplines in Fig. 1 to guide the discussion.

[1] Where there are multiple authors from the same country in one article WoS only records this as one contribution from the country

A. Inter/multi-disciplinary (Group D1)

Certain newer journals and conferences address the ICTD field directly, from a more inter or multi-disciplinary perspective. These publications, such as Information Technologies and International Development (ITID), seek to cover a broader range of topics in the converged ICT sector, including policy issues, "engineering innovations", and socio-technical aspects[2]. Similarly, whilst the ICTD conference series is supported by IEEE/ACM it still aims to cover both the "social and technical sciences"[3] and thereby cover a cross-section of sub-disciplines. The ICTD conference has been held three times between 2006 and 2009.

Over the sample period, African contributions to ITID were low at approximately 4%, whilst the participation at ICTD in 2006 was close to 10% but then less than 5% in subsequent years. The African contribution to ITID is limited to South African authors only, but does reflect the multi-disciplinary nature of the journal in covering both CS (e.g., low-cost computing device) and IS (e.g., diffusion of shared ICT access), as well as individual level analysis and macro-trends (e.g., adoption of ICTs by SMMEs in 14 African countries). Whilst publications such as ITID and ICTD attempt to adopt a more multi-disciplinary approach to publications in the field, older ICTD journals such as Information Technology for Development (ITD) and Information Development (ID) have a distinct leaning into a certain subdiscipline, specifically IS, and are discussed below.

The following sections highlight the contribution of African authors in more specific subdisciplines of the ICTD field. Whilst we do acknowledge the significant overlap between subdisciplines and their associated publications, they still provide a useful analytical distinction.

B. Computer Science and HCI (Group B1)

In computer science, the majority of published papers appear in conference proceedings [14, 15], and are not often covered by the Thomson Reuters ISI database. The top-cited conferences and workshops in the field are as significant as journals in other fields, accounting for over 78% of all research outputs [ibid.]. Conferences are generally considered to have a greater impact, with a larger readership and shorter time to publish novel ideas [16].

Conferences hosted by either the ACM or IEEE – the key USA-based organisations for engineering and computing – are considered of highest quality in the CS field, as demonstrated by various conference ranking websites. In main stream computer science, ICTD is yet to be recognised as a subfield due to an ongoing debate about its validity as an applied science. To this end it is yet to have its own "technical" conference or similar publication avenue [17].

As a result we sought out all Computer Science conference publications in both the ACM and IEEE digital libraries in an effort to identify ICTD related publications from Africa. Using keywords related to Africa, ICTs and development we identified conferences with the most number of ICTD related publications. Africa-based publications comprised less than 1% of the total number of publications in the CS field. Even in the more rounded Springer publisher, which includes conferences held in Asia, Africa-based researchers do not feature in a majority of the computing fields, making up less than 10% of the total search results. Chetty et al. [18] suggest that the lack of Africa-based computer scientists could be explained by the low entrance and retention of students in CS programs within sub-Saharan institutions. From interviews with sub-Saharan faculty members in CS departments she found that, although undergraduate CS has practical components, very little of the research translates into publications either by the students or their supervisors. Although it is claimed that most CS programs in Africa are ICTD oriented, a sample of leading computer science conferences in the region seems to point to the contrary. For instance, in the last three series of the annual conference by the South African Institute of Computer Scientists and Information Technologists (SAICSIT) that attracts research from both South African universities and industry, with a range of interests, there has been a less than 10% contribution in ICTD-related topics.

We then narrowed our analysis further by searching within various subfields of computer science designated by the Computer Science Accreditation Board (CSAB). The Human Computer Interaction (HCI) subfield had the highest amount of ICTD literature within the CS arena. This may be explained by the fact that HCI is the face of computing that deals with the design and evaluation of technology to make it both useful and useable by a large variety of people. The mismatch between technologies developed for the West, and the information and communication needs and nuances of developing country citizens, drives many researchers to the design of more appropriate human-computer interfaces.

In HCI, the ACM Conference on Human Factors in Computing Systems (CHI) is the premier international conference for the field, attracting over 2000 participants. In the period 2007 to 2009, CHI had an average of two hundred papers and extended abstracts accepted in its main proceedings. Of the total submissions in the three years only four were from an African institution, amounting to less than 1% of the total number of papers presented. In 2007 and 2009, there were no papers from Africa accepted into the main proceedings. Of the four papers accepted in 2008, three came from one institution, whilst in the fourth paper the African contributor was placed as a fifth author. Only three of the four papers would be considered relevant to the ICTD field. Apart from the main proceedings, a special workshop on HCI and Development was run each year between 2007 and 2009. In 2007 the African participation in the workshop was at 20%, but this seems to have declined in subsequent years with 11% in 2008 and 9% in 2009.

A consistent theme in all African contributions was the use

[2] http://itidjournal.org/itid/about/editorialPolicies
[3] http://www.ictd2010.org/?page_id=93

of designs and design approaches that are appropriate for varying African contexts. Bidwell and Winschiers-Theophilus [19] explain that this interest was most likely to have been forged by the need for more localised design to improve the usability and user experience. This, they say, can only be achieved by contextualising accountability in the production of technological intervention which means a design by Africans in Africa for African situations.

There was also a substantial interest in the appropriation of mobile phones as a platform for development-oriented applications and its design implications for future interventions in specific areas such as education, health care, democracy, commerce, and agriculture.

C. *Telecommunications and Networks (Group B2)*

The CS subdiscipline overlaps significantly with work in communication network research. The special interest group on communication (SIGCOMM) hosts an annual conference covering a broad range of networking topics, whilst MOBICOMM is a major conference on Mobile Computing and Networking. In both conferences, African researcher participation was negligible, making up less than 1% of the proceedings between 2007 and 2009. These conferences have played host to parallel workshops that are aimed at ICTD research. The special Workshop on Networked Systems for Developing Regions (NSDR) focuses on the technical networking and systems research challenges that arise in the design of Internet and communication technologies for developing regions. Key research topics include, among others, rural wireless technologies, low-cost networking, and power-efficient systems. Whilst these topics are relevant to African contexts, a survey of participation from the continent in the workshop over the sample period did not produce any results. A review of the main technical communications journals (such as the IEEE Transactions on Communication and Mobile Networks and Applications) shows negligible (less than 5% in WoS) coverage of ICTD issues by African authors. Key telecommunications conferences on the continent, including the South African Telecommunication Networks and Applications Conference (SATNAC) and IEEE AFRICON, are largely technical in nature with limited focus on the application of networks to development. Other than a handful of papers (less than 5%) addressing rural telecommunications, very few address the design of telecommunications systems to meet the specific requirements of developing contexts or to facilitate the development of marginalised groups or regions.

The telecommunications and networks subdiscipline extends from the low level engineering of physical artifacts to higher level service and application layer systems and macro-level economic and policy issues and impact analyses. Much of the prominent early research in the Telecoms4D policy area, and ICTD in general, was concerned with achieving universal service (access and affordability), initially in fixed-line but later in mobile, as well as in assessing the impact of access to telecommunications networks on developing countries' GDP growth [e.g., 20]. However, African research in this subdiscipline was largely tied to the urgent demand for post-colonial reform of national governance institutions to attract international investment in basic infrastructure, and therefore tended to focus on establishing and assessing national regulatory frameworks, with the more implicit goal of improving access to telecommunications. This focus is reflected in the majority of articles contained in the emerging, but influential African Journal of Communication (AJIC).

The general importance of the telecoms policy subdiscipline to African authors is reflected in the high proportion of Telecommunications Policy articles in ICTD (see Section III), with African authors contributing close to 12% of all articles in the journal up to the mid-2000s. Of concern, however, is that there were no African publications in the journal during the sample period between 2007 and 2009.

The major telecommunications policy research conferences, TPRC and EuroCPR, held in the USA and Europe respectively, have naturally focused on Western policy issues. Significantly, a complementary policy research conference, CPRafrica, was established in 2010 with a focus on African policy research, and grant funding to support African scholar attendance.

D. *Communication and Media Studies (Group B3)*

Communication conferences such as the conferences of the International Association for Media and Communication Research (IAMCR) and International Communication Association (ICA) are held annually and typically include tracks that address development issues. Example tracks at recent IAMCR conferences included "Participatory Communication Research" (IAMCR 2008/2009) and "Digital Divides (IAMCR 2008/2009). African participation is less than 5% in the IAMCR 2008 Digital Divide working group and about 8% in the IAMCR 2008 Participatory Communication Research Working Group. The most consistent interest of African authors is in communication to address health care and HIV-AIDS issues, but also in facilitating democratic governance processes. Meanwhile, at least three African media studies journals (African Media Studies, Communicare, and African Media Review) have published research between 2007 and 2009 that addresses a range of ICTD topics. As may be expected from media studies publications the three main themes relevant to the ICTD field are the preservation of identity, culture and community; the promotion of more effective democratic participation through media such as radio and music; and improving communication around health issues, particularly around HIV-AIDS. The importance of health informatics was suggested by the relatively large number of publications in this area during the macro-analysis. However, health communication is a key issue in the broader communication and media studies field, reflected by the second-place ranking of the Journal of Health Communication (JoHC) in the ISI Web of Knowledge communication subject category, so this emphasis is probably not specific to Africa. The only two articles by African authors in JoHC consider the importance of multi-lingual

communication around health issues in Zambia, and assess the effectiveness of an HIV-AIDS awareness campaign in Kenya. Other high ranking journals (such as Media, Culture and Society) have a similarly low contribution by African authors. An additional overarching discussion common to African journals concerns structural reform of the media industry and its regulation to ensure media independence whilst maintaining accountability to citizens. An interesting, emerging aspect of this structural debate is the growing role of Chinese media as part of their "cultural reproduction" agenda in Africa, and what this means for African identity and power.

E. Information Systems (Group B4)

Within the IS subdiscipline, the nature and impact of information systems in developing contexts has gained recognition through the publication of special issues in leading IS journals and established tracks at major IS conferences [3]. However, the contribution of African scholars in these forums appears to be marginal. Major IS conferences such as the International Conference on Information Systems (ICIS) and Hawaii International Conference on System Sciences (HICSS) typically run two or three ICTD tracks addressing topics such as "The Role of ICT in Capacity Building in the Developing World" (ICIS2008), "Information Technology for Development" (HICSS2008/2009) and "Digital Divide/s and Inclusion/s" (HICSS 2009) with between four and five papers per track. From our sample of IS conferences, African participation in IS4D topics is less than one out of twenty-five papers presented, although there are additional, but also very occasional contributions in other tracks addressing ICTD topics indirectly. In the MIS Quarterly (MISQ) special issue of 2007 there was only one contribution from an African co-author [21]. In this case the researchers conducted a longitudinal, action-research study that sought to reduce fragmentation of health information systems (HIS) in various developing countries, including South Africa. Within lower ranking IS journals that specifically address developing country issues the proportion of African authors is higher. In the Information Technology for Development (ITD) and Information Development (ID) journals, African authors constituted 13% and 37% respectively over the three year period. African publications in the ID journal favoured knowledge management in university libraries, whilst e-health, e-agriculture and e-governance were also consistent themes. Meanwhile, the integration of IT in developing country organisations was the main theme of ITD. We would have expected that a significant proportion of African IS research would be targeted at health issues. However, in a review of 15 publications by African scholars in the Electronic Journal of Information Systems in Developing Countries (EJISDC) only one paper addressed HIS. Meanwhile, the highest proportion of papers (five) was concerned with e-commerce issues. E-commerce is prominent in other African publications such as the African Journal of Information Systems (AJIS). However, e-governance is consistently popular with three papers in the EJISDC, two out of the eight papers in the AJIS, and a more recent paper in the high-ranking Government Information Quarterly (GIQ) [22]. Most of these papers are concerned with the success or failure of e-government implementations in African countries due to the lack of "contextualization" [23, p.1], but there is also a concern over the potential exploitation of e-government systems by a central political elite that may contribute to further "social exclusion from governance" [22, p.96]. The problems associated with transferring "Western" systems to developing contexts is well recognised in the IS literature [4, 24]. As a result prominent African commentators argue for more African research in the IS4D field to ensure that emerging ICTs match the context and needs of African societies [25].

V. Discussion and Way Forward for African ICTD Research

A key observation from the above investigation is that the African contribution to international academic research in ICTD is very low, typically between 1% and 9% percent of publications across subdisciplines. It appears that the percentage has remained fixed in this range during the study period, and even decreased in some cases. There are however exceptions, especially in certain lower ranked and electronic journals, that are more oriented to publishing research by developing country scholars. The low output of African authors in the ICTD field suggests that theories around the appropriate design, mechanisms of adoption, and impact of ICTs in developing countries are being formed without significant influence by African scholars. As highlighted by Mbarika [25], "*...the fact remains that theory-driven ICT articles on Africa are rare. Hence, many business owners and policy makers in Africa have fallen to the grave error of acquiring new "high-tech" technologies for the sake of keeping up with the "West" without addressing the questions: "Which specific technologies do we need?" and "What do we need these technologies for?".* The lack of Africa-generated theory also points to a potential ethical and practical weakness in the wider ICTD field: "local" participation is recognised as essential to the success of ICT implementations in developing countries [26, 27], but the lack of African scholarly influence undermines the participatory nature of ICTD research and practice over the long-term. This reinforces the passive role of Africans as consumers, rather than producers and innovators [8, 28, 29].

Meanwhile, the thematic focus of African research in ICTD varies depending on the subdiscipline, but in all cases is concerned with adapting or contextualising "Western" systems to various African environments. The most common areas of interest appear to be e-health, library science, e-governance (incl. media and democracy), and national ICT policies and institutions. African research in ICTD therefore appears to be quite diverse in addressing a range of development issues. Future research will need to provide a more comprehensive description of the thematic foci, preferred methodologies, theoretical bases, and units of analysis as envisaged in Table I;

and to what degree these areas represent the interests of African researchers versus their national or international funding partners. More controversially, a valid inquiry as to whether journal editors are swayed in their choice of articles according to their readership or subscriber demographic, or improving their readership if editors choose "Ivy League" university authors can also be contested.

We look to explain a number of these observations, particularly around research output and impact, by drawing on existing research and commentaries regarding the status of African research. A number of related and overlapping issues are identified in the literature that provide some insight into the situation, and suggest approaches for addressing the challenges:

1.) Publishing culture: In most Western universities a "publish or perish" culture drives academics to publish in accredited journals and conferences to sustain their careers [30], although with a potentially negative effect on the quality of research [31]. However, this traditional phenomenon and measure of success does not always apply to African institutions. Tenureship or academic promotions are often not based on the number of publications but rather on educational qualifications and experience, determined by number of years spent in academia. There is also a critical demand for, and emphasis on, teaching in African institutions. As a result, career progression is largely determined by success in teaching rather than publication output.

In addition, research and innovation in Africa is not always published via formal academic channels. The innovations which are flourishing in the mobile sector in Africa only reflect a small sample of scholarship which was able to shape their research into globally acceptable articulations. The rest remains invisible from formal venues whether it be due to the current political economy of today's publishing schema or due to the targeted "grey literature" policy papers or working documents used more to affect change in government and reach its more interested audience in Africa.

2.) Institutional factors: As highlighted above the main incentives for African academics are in a long teaching career. In addition, the high demand and salaries for ICT graduates in developing countries means that the incentives for postgraduate study are low, leading to a small base of researchers and research supervisors.

Given the issues raised on the measures of African academic success and the indigenous demands of research from higher education bodies, a way forward can include an African re-think of demand-driven indicators which are more realistic measures to the African context. One group at the University of Cape Town, South Africa has begun to investigate ways for increasing the scholarly outputs in Africa[4]. South Africa has also initiated the South Africa Research Chairs Initiative through the National Research Foundation with hopes to retain high caliber researchers in their institutions as well as develop strategic research which has a high level of relevance and excellence in the national and international domain[5]. An important part of this work is to understand why current government and industry incentives have not lead to a substantial increase in publication. In addition, the excellence in research outputs by African researchers needs to be a noted indicator in and used to help inform decisions on science and technology policy and investments. This would raise the profile and incentives for research activity.

3.) Information access: The dissemination of research stimulates further research as scholars look to build up or critique the work of other researchers. Exposure to research through various outlets is one way to ensure that researchers get involved in research activities including publication. However, many research outlets are subscription based. The annual subscription cost is far beyond what many African researchers and institutions can afford. For example, from Houghton's Australian report, unit costs of journals saw a rise by 474% between 1986 and 1998 [5].

Despite the recent efforts of regional university blocs to negotiate fibre access in their regions, infrastructure issues continue to influence the cost and quality of access to research material. This means that higher education institutions in Africa have limited access to digital research tools. Further, institutions lack other facilities such as properly equipped and updated libraries.

Concerns over the limited access to knowledge resources are reflected in the high number of publications in the library and information sciences field by African scholars, as well as more recent publications discussing open-access to knowledge [7]. Given the importance of physical infrastructure for research as well as academic resources such as online journals, the continuous advocacy for African nations to support their National Research and Education Networks (NRENs) in the collective negotiation for high capacity fibre optic internet connectivity is essential. Secondly, the continuous pressure on academic publishing firms to open access to their publication databases, particularly to Africa, would help contribute to evening out the playing field of research access.

4.) Political and language bias: The publication process is inherently peer-driven, meaning that marginal groups will find it difficult to break into existing networks who have a set standard as to what is regarded as quality research. Language and style are to some degree second to content in as far as determining the standard and quality of publication. These are both key obstacles for many African academics, whose potentially innovative work is rejected due to poor presentation in English which to a majority is a second or third language. The English bias in publication presents a challenge for a large proportion of the Francophone population in Africa, who are assumed to carry the cost of translation. These biases discourage many African researchers from exploring international publication for fear of rejection [32]. In addition, it could be argued that there is a capacity gap in the ICTD publishing system, due to its relatively young age and in not

[4] http://www.researchoffice.uct.ac.za/socialinnovation/sca/

[5] http://www.nrf.ac.za/projects.php?pid=61

being able to process the range of languages that characterise the field.

5.) Lack of conference attendance: Conference attendance is an important element of the publication process. Conferences are used to introduce research to potential publishers and peer networks, but also to shape emerging themes in the field. African scholars have limited opportunities to attend international conferences, or to join conference committees and thereby advocate topics most relevant to the continent or push for greater acceptance of African submissions. As highlighted in the CS analysis above, conferences are becoming more prominent as a publishing channel in a number of fields due to the rapid change in the ICT sector and the slow turn-around time in journals. African researchers therefore risk further marginalisation due to limited access to international conferences. An awareness of these limitations has meant that many conferences are now supporting developing country academics with travel grants.

6.) Research community: Given these related and overlapping issues which can help to explain the lack of African research output in ICTD, one factor which may bring these observations together could be the lack of an ICTD community in Africa. While several African ICTD networks exist such as Research ICT Africa (RIA) or the Education Research Network for West and Central Africa (ERNWCA), the development of similar networks of ICTD researchers would greatly enhance the cross filtration of ideas, informal gatherings, brainstorming, and confidence building around producing high quality research and publications. This could include frequent regional workshops where scholars can present their research to a wider community than the relatively small university faculty groups.

Africa has many factors which work to the detriment of the continent's researchers and academic excellence. The importance of moving ahead is to concentrate realistically on Africa's niche research areas in ICTD but under criteria for academic excellence which fit the given circumstances of Africa's emerging research base, and match and support the values and goals of indigenous production in the networked knowledge society. More broadly, facilitating support for initiatives which help enable researchers and institutions in resource-poor environments to gain equal opportunities and capabilities as their more well-endowed counterparts in the West can help to level the playing field on the publication of academic research. Some strategies which can help enable this equality include supporting tertiary institution policy on cheaper bandwidth negotiation with internet service providers, sponsoring in depth studies on the scholarly writing in Africa, and reviewing the impact of national policies on research and incentives provided to institutions. Further partnerships or funding, whether they are from private or public entities, may also have an effect on the research publication rates of universities. However caution must be placed on the ethical practice of academic freedom and transparency when agreements are taken up with sponsors.

Finally, the relatively high proportion of African publications in emerging, online journals suggests that these platforms should be supported and referenced as a way to give a voice to the issues and methods that African authors perceive as critical in the ICTD field, rather than what is determined by top Western researchers. This may involve a leaning towards a more normative or consensus building approach [33] to guide the ICTD field, rather than a technocratic emphasis on accepted measures of research objectivity and rigour. We suggest that the ICTD field has a responsibility to explore alternative academic and publishing practices to ensure that the thematic, epistemological and methodological direction of research best serves the development of marginalised groups. Similarly, by identifying, nurturing and integrating existing research and innovation systems that are not necessarily publishing in formal academic channels, African researchers may ensure that research outputs incorporate knowledge from both developed and developing contexts [34], effecting change where it is most needed.

Whilst broad geographic realignment is important for the ICTD field, this does not mean that many formal African academics based in different countries and, very often, in relatively developed, urban enclaves have been able to bridge local socio-economic and cultural divides. Therefore, as much as this paper is a call for reflection by the global ICTD research community on where research is produced, it should also be seen as a call for African researchers to reassess their approach to ICTD.

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