21. Content category selection towards a maturity matrix for ICT4D knowledge sharing platforms

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Abstract

Research involving the use of information and communication technology for development (ICT4D) inhabits a contested space characterized by varying philosophies, aspirations, realities and priorities. The uncontested fact is that an improved understanding of the different perspectives and increased awareness of the extant research would be beneficial in terms of supporting research collaboration and evaluation. Open knowledge sharing platforms (KSPs) are tools that could be used to support knowledge sharing and collaboration but only if the KSPs are accessible and the content is useful to the target audience. The purpose of this study is to investigate a content category selection towards a maturity matrix for ICT4D KSPs. KSPs are similar to knowledge management systems used in government and private organizations, but important differences also exist. We start out with a content analysis of selected KSPs to identify a set of core functions expected from an ICT4D KSP. These core functions are clustered, prioritized and evaluated against the maturity levels proposed for knowledge management systems. The contribution of this paper is to propose essential content categories for the design of an open, accessible KSP and relate these to maturity levels via a matrix. The maturity matrix is proposed as a step towards developing a maturity model for KSPs in future, which is meant to link existing ICT4D KSPs for supporting research collaboration and knowledge sharing in the field of ICT4D.

Keywords

Maturity model; Knowledge sharing platform, Open knowledge repository, ICT4D.

1. Introduction

The ICT4D research field is characterized by a lack of standardized methodologies and agreement on how research quality can be ensured (Burrell and Toyama 2009); there is little evidence of researchers building on one another's work (Best 2010) with only a few authors contributing to theory building (Heeks 2007; Heeks 2014, Walsham 2013). Steyn (2015) advocates for ICT4D research going beyond the comparison of technicalities and artefacts to address the foundational assumptions and concepts. De Cindio (2015) highlights three main tensions namely the focus on *communities* versus that on *technologies*, the focus on *research* versus that on *action* and the focus on *developed* versus that on *developing* countries. All of these notions imply that an improved awareness of other ICT4D researchers' work is essential in

moving towards a shared understanding of the priorities, theory building foci and collaboration opportunities in the field (Van Biljon and Alexander 2015). Furthermore, the current crisis in funding and political support to the development sector accentuates the urgency of improving internal collaboration and processes (Müller, 2014). One approach to addressing the goal of improved cohesion in ICT4D research would be to investigate the potential of knowledge sharing mechanisms such as KSPs and that is the rationale for this research. More specifically the purpose of this paper is to identify content categories towards a maturity matrix for knowledge sharing platforms. From this matrix, maturity levels for the design of an open, accessible ICT4D KSP can be derived in future research. The research philosophy is positivist as the study aims to identify the essential content categories of ICT4D KSPs towards proposing a maturity matrix for ICT4D KSPs. A set of content categories for ICT4D Knowledge Repositories (KRs) (Platz & van Biljon 2015) was used as the basis for the content analysis of a selection of 16 ICT4D websites. Those websites were chosen by first considering university websites on ICT4D in South Africa and then extended by searching for institutional and individual KSPs containing ICT4D research related content. The content clusters identified from the website analysis were then interrogated against the literature on maturity model frameworks to propose a maturity matrix for KSPs. The contributions of this paper include the maturity matrix for ICT4D websites and the content categories that were abstracted from the analysis of the ICT4D KSPs.

2. Towards a maturity model for ICT4D knowledge sharing platforms

In this section we provide a brief overview of the literature on using KSP's in the field of ICT4D research and that is followed by a discussion on maturity models.

2.1 ICT4D knowledge sharing

ICT4D research broadly involves the consideration of human and societal relations with the technological world and specifically considers the potential for positive socio economic change through this engagement (Burrell & Toyama 2009). Sen (2009) has criticized the emphasis on the economic criteria of advancement as the primary or sole means of measuring human well-being and proposed the capabilities approach as a broader view towards increasing human opportunities, capabilities and freedoms. In a review on ICT4D development Kleine and Unwin (2009) found little change in the way in which development is defined, the failure to learn from previous initiatives, and the fact that top-down and supply led development practice are not advisable. Despite criticism to the contrary and many failed projects, Hamel (2010) supports the use of ICTs to enhance human development on condition that the use of ICTs needs to occur within broader strategies that are tailored to make the most use of these tools and techniques. Considering new opportunities, Kleine and Unwin (2009) contend that the speed and power of new digital technologies provide radical new opportunities for poor-friendly business models on condition that reliable electricity and digital connectivity is available. Another facilitating factor is the networked and decentralized nature of the internet which supports new ways of interaction and knowledge production (Kleine & Unwin 2009). The vast and dynamic nature of the internet means that opportunities for constructive engagement and collaboration can be limited by knowledge management capability

Knowledge management is the process of capturing, developing, sharing, and effectively using organizational knowledge (Davenport 1994). The success of knowledge management initiatives depends on knowledge sharing (Wang & Noe 2010). In a study on knowledge sharing in virtual

communities of practice and other settings that depend significantly on technological tools for knowledge sharing, Boh (2014) identified the following three key knowledge sources:

- informal network, where the knowledge seeker communicates directly with a single knowledge provider;
- knowledge repository, where the knowledge provider codifies and stores knowledge and publishes them in a repository;
- online discussion forums, where knowledge is exchanged amongst multiple seekers and multiple knowledge providers in an open venue.

A KSP would ideally provide all three sources but resource constraints may limit the capabilities. The scope and audience of knowledge sharing may vary according to the purpose of the website but the aspects of *discoverability* and *knowledge sharing* are critical for organizations and individuals interested in ICT4D research sites. In the context of research publications and research related information *discoverability* is the measure of an item's likelihood of being found by the appropriate user (Naudé 2015). The knowledge management systems are known by different names including e-portals, online knowledge repositories and knowledge sharing platforms. In the context of online knowledge management a community e-portal is used as a technological infrastructure to enable more collaborative communication and interaction on a dynamic level (Parker, Downie, & Manville 2012). Mosweunyane and Carr (2014) describe a knowledge repository as an institutional-scale collection which feeds off individual's document collections. All of these systems are essentially Web based collections of information providing varying degrees of access and interaction but there are differences between what knowledge is made available, the target audience, the access and the interactions facilitated. In organizations, knowledge is a critical resource that is seen to provide a sustainable advantage in a competitive and dynamic economy (Wang & Noe 2010). The success of knowledge management initiatives depends on knowledge sharing (Wang & Noe 2010). However, organizations need to protect their intellectual property and may therefore limit access to their KR so the importance of sharing may vary depending on the raison d'être of the KR. In the context of promoting knowledge production through research it is essential for knowledge to be shared. Platz and van Biljon (2015) advocate for a platform where reputable collections can be aligned and shared for open access in ICT4D and that is used as reference on the characteristics of an open ICT4D knowledge repository as presented in *Table 1*.

	Knowledge Repository (KR) from extant literature	**Open Knowledge Repository (Platz & Biljon 2015).**
Purpose	To capture, manage and leverage an organization's intellectual capital resources utilized by the company's strategies and tactics (Ruppel & Harrington 2001).	To inspire a collaborative effort from *communities* to participate and communicate in a knowledge management initiative.
Strategies	To develop an organization's ability to select, capture, store, disseminate and apply its knowledge resources (Garfield 2014) and to promote collection and sharing among its members (Korvela 2013).	To provide an open KSP to support and promote knowledge sharing in the field of ICT4D research.
Target audience	Mostly employees of an organization, but it may be extended and monitored by external	*Open access to all stakeholders* in ICT4D research.

	contributors.	
Knowledge resources	A collection, which feeds off individuals' document collections (Mosweunyane and Carr 2014).	A *variety of sources*: e.g. web, articles, books, journal and conference papers and individuals.
Structure	A model consisting of three layers namely a technological layer, a social layer and a discursive layer has been proposed by Foth, Gonzalez and Kraemer (2008).	Given the resource and infrastructural constraints of international development KSPs are best served by *smart on- and offline mixtures.*
Governance	Experts or supervisors can be used as referees to review, rate or edit user's contributions and by using community-driven approaches (Kayhan 2009).	ICT4D *community* as represented by interested researchers and practitioners.
Accessibility	Accessible to employees of the company or members of the organization.	*Registered members* as required for governance of contributions but guest users may be given view only access.
Usability	An easy to use technical tool and social incentives to promote use (Dingsoyr and Royrvik 2003).	Effectiveness, efficiency and user satisfaction towards optimal user experience.

Table 1 Difference between KRs and open KRs

From this table it can be observed that the main difference lies in the open access and thus a KSP can be described as an open KR. For this study the term *knowledge sharing platform* is used, since that encompasses the characteristics of both a community e-portal and a KR but reflects the intrinsic purpose of sharing knowledge through open access and designing for discovery and accessibility.

2.2 Challenges to knowledge sharing

One major challenge regarding knowledge sharing in the field of ICT4D is the variety of terms used to describe ICT4D. *ICT for Development (ICT4D)* also refers to the use of ICT for sustainable development. Heeks suggests the term *Development Informatics* (DI) rather than ICT4D, since the latter is deemed too technocratic (Heeks 2007). However, given the widespread use of ICT4D, he agrees that the terms can be used interchangeably. Another similar term is *ICT and Development (ICTD*). The term is also largely synonymous with ICT4D and is used by a series of conferences whose aim is exploring the role of ICT in social, political, and economic development (ICTD 2014). The 2016 World Bank report (2016) used the term digital development and that could indicate a new tendency to abstract ICT and development to a higher level.

A related field is *Community Informatics* (CI), which is concerned with the application of ICT to facilitate and empower community processes (Gurstein 2007). Stillman and Linger (2009) maintain that CI has a dual focus: firstly, the conduction of research about the relationship between the design of ICTs and local communities and secondly, the implementation of ICT projects in local communities. It can be concluded that all the terms ICTD, DI, ICT4D and CI are

all essentially about the use of technology for developing towards improving the human condition in a sustainable way with varying foci on the technology, sociology and community aspects. The problem with using divergent terminology is that it negatively impacts the discoverability of knowledge sources when researching the use of technology for development.

Another challenge regarding knowledge sharing in the field of ICT4D is the variety of stakeholders among the information consumers. The information consumers include a diverse number of role players at various levels of society involved in ICT4D, with divergent goals, agendas and points of departure (Van Biljon & Alexander 2015). In terms of funding models these include government organizations, semi-government organizations and private institutions all with different priorities. In terms of research approaches these range from the highly theoretical research done at universities to practical involvement in rural communities. Most role players are in agreement that the complex multi-dimensional problems in ICT4D need a variety of role-players to engage in collaborative multi-, inter- and trans-disciplinary research to make substantive progress. The divides in the landscape do, however, become a challenge in terms of conceptualising roles, contributions and foci, as well as establishing research priorities (De Cindio 2015).

2.3 Maturity models as point of departure in the development of KSP's

The concept of maturity is fundamental to the evaluation of systems and maturity models are used in different fields such as business, education and information systems to evaluate and monitor progress (Paulk, Weber, Curtis & Chrissis 1993). Maturity model frameworks consist of three key attributes: a knowledge element; an assessment element (methods, processes and procedure that can be used to self-assess); and an improvement element (Rhoads 2008). As maturity models for an ICT4D KSPs do not exist yet, a new maturity model has to be derived from existing maturity models in other fields. Given the many different maturity models it is necessary to find the most appropriate as point of departure.

Socio-economic development activated by information and ICTs require an effectively operating government and specifically an effective electronic government (e-government) system presented as e-portals (Karokola and Yngström 2009; Ziemba and Papaj 2013). ICT4D research involves more than the use of ICTs for socio-economic development but sustainable socio-economic development towards improving the human condition is mostly an objective. Therefore, maturity models for e-government provide a feasible foundation for launching the development of a maturity model for ICT4D. E-government portals also have other similarities with ICT4D KSPs as they are designed to allow open access to a diverse group of users (Karokola and Yngström 2009).

The e-portal services are rendered at different levels of maturity, which represent different levels of technological sophistication, stakeholders' orientation and an administrative change (Ziemba & Papaj 2013). Therefore several maturity models have been developed to guide and benchmark e-government portals in developing countries (Karokola & Yngström 2009).

The e-government maturity models are designed to guide the implementation and development of applications in a stage-wise manner – from immature (one-way communication) to the mature (digital democracy) stage (Ziemba & Papaj 2013). For example, an e-government e-portal's ma-

turity model defines a set of stages (from basic to advanced) that offer a way to rank e-government portals (Fath-allah et al. 2014).

Fath-Allah, Cheikhi, Al-Qutaish and Idri (2014) compared 25 e-government maturity models and identified *presence*, *interaction*, *transaction* and *integration* as the criteria that differentiated the first four maturity levels in most of e-government websites. The levels of service and complexity are similar to those described for the European Union (EU) e-government model (Ziemba & Papaj 2013) as depicted in Table 2.

Level	**Focus and description of the maturity level in different E-government models**	
1	Summary of models (Fath-allah et al. 2014).	European Union model (Ziemba & Papaj 2013).
2	Presence: provides basic introductory information about the institution.	Information: corresponds to the online availability of general information.
3	Interaction: text or information about the organization, graphics, contact details and a feedback mechanism.	One-way interaction: involves the possibility of obtaining paper application forms from the publicly available government website in an electronic way.
4	Transactional: if it has a search engine and more detailed information on what is offered by the institution (e.g. courses, training programmes, catalogues).	Two-way interaction: represents the possibility of getting forms electronically to obtain government services and to check, advise and deliver the forms to government agencies electronically.
5	Integration: if it contains systems such as content and distribution management, customer relationship management strategies, and credit card processing functionalities.	Transaction: a full electronic delivery of government services. However, government documents as well as the payment of fees or dues can also be arranged electronically.
6	Personalization: offers portal and personalized capabilities and contains multi-media content such as videos and multiple language choices.	N/A

Table 2: Maturity levels of E-government models

Considering the level descriptions (as provided next to the name of the level) the stages have some overlaps although the EU model expands the interaction into two levels and goes only up to level 4. Note that *integration* and *personalization* could be used to extend the EU model so that it has six stages but the context and the purpose of a certain e-government website will determine if that would be useful. Therefore we will consider the content categories identified from the ICT4D websites for proposing a maturity matrix. This is the first step towards the development of an ICT4D KSP maturity model as suggested for future research.

3. Research design

The research philosophy is positivist as the study aims to identify the essential content categories of KSPs towards proposing a maturity matrix for ICT4D KSPs. The research design involves content analysis of a selection of websites as described in section 3.1. The results are used to inform the maturity matrix where e-government maturity models were used as reference for mapping the content categories to maturity levels for the ICT4D context.

3.1 Sample selection

The first priority was to get a representative sample of ICT4D websites; we started with South African websites since our goal is to develop an African KSP and then added other websites as those arose from the searches. ICT4D research is conducted by a wide spectrum of stakeholders from the formal and informal knowledge society, many of those by organizations and individuals not associated with universities. However, university websites were selected since this provides a verifiable list of universities to work from (South Africa Universities, 2015). According to this list there are 11 Traditional universities, six Comprehensive universities and eight Universities of Technology. Only five ICT4D websites were found for the total number of 25 institutions. We are aware of more universities (e.g. University of Fort Hare, North-West University and the University of the Free State) that produce ICT4D research. This means their ICT4D KR either does not exist or could not be found using Google as search engine when entering the keywords "ICT4D" or "Development Informatics".

South African University websites		
University	Website	ICT4D website
Nelson Mandela Metropolitan University	https://www.nmmu.ac.za/	*http://news.nmmu.ac.za/News/ICT-solutions-for-developing-countries*
Rhodes University	https://www.ru.ac.za/	*http://www.ru.ac.za/informationsystems/research/researchgroups/*ictfordevelopment/
	https://www.ru.ac.za/	http://www.ru.ac.za/computerscience/researchgroups/ict4d/
University of Cape Town	http://www.uct.ac.za/	http://ict4d.cs.uct.ac.za
	http://www.uct.ac.za/	http://www.citanda.uct.ac.za/

Table 3: South African Universities with ICT4D websites

The list of 5 university ICT4D sites (note that Rhodes University and the University of Cape Town have two sites each) was too small for meaningful analysis so it was extended by adding other national and international ICT4D KSPs provided by research organizations which emerged from a Google search as depicted in Table 4. This list is proposed as a starting point for investigating ICT4D KSPs in South Africa, but it is by no means presented as a complete list. The selection and addition process was terminated when two consecutive new sites did not add any new features or functionality. The three categories analysed are thus universities, organizations and individual researchers' sites. The results are presented in summarised format to avoid comparison between the sites.

Added National and International Websites	
Institution	University ICT4D Website
Centre for Development Informatics (Manchester University)	*http://www.cdi.manchester.ac.uk/*
Organizational sites	
IST-Africa (European Commission - African Union)	*https://www.ist-africa.org*
Research Africa (Open Society Institute)	*www.researchictafrica.net*
IICD	*www.iicd.org*
IFIP 9.4 (Social implications of computers in Developing Countries)	*http://www.ifipwg94.org/*

ICT4D Jamaica	*http://ict4djamaica.org/html/*
IDIA (International Development Informatics Association)	*http://www.developmentinformatics.org/index.html*
Individual sites	
Ismael-Pena-Lopez	*http://ictlogy.net/*
Mario Marais	*http://www.ict4dc.org/users/mario-marais*
Kentaro Toyama	*http://blog.ict4djester.org/*
Richard Heeks	*https://ict4dblog.wordpress.com/author/richardheeks/*

Table 4: Added National and International sites

4. Results and Findings

This analysis covered 16 websites, six from universities, six from organizations and four from individuals. The content elements are clustered semantically towards investigating the possibility of mapping the content categories onto maturity levels for ICT4D sites.

4.1 Content categories results and findings

The content categories that ICT4D KSPs should cover evolved from the results derived from an initial questionnaire on KSPs presented by Platz and Biljon (2015) and were augmented by the analyses of the 16 existing ICT4D websites. The initial results were updated by adding relevant new items from the analysis and then capturing the data for those items on all the sites. After the data was captured the relevance of the items was reconsidered based on both frequency of occurrence and the value it could add for promoting ICT4D research. The final set of 38 category items delivered from the content analysis of the websites combined with the ICT4D questionnaire results presented by Platz and Biljon (2015) are provided in *Appendix A*. The availability of the category items presented in Appendix A was assessed for the 16 websites. Each item was rated for each site with “1” for “available” and “0” for “not available”. The values were summed for the items belonging to a certain category and the arithmetic mean was calculated to determine the degree to which a certain category is covered by the investigated sites. Figure 1 shows the relative results of this investigation, the covering-degree of the categories represents the percentage of the websites that provide that feature or functionality. The categories include the following components:

- Purpose of the site is described comprehensibly.
- Member Management includes a login option and membership requirements.
- Knowledge Sharing includes the availability of downloadable or linked information like publications, software and career related information.
- Social Networking includes blogs, discussion forums, polls, and the availability of Facebook or Twitter as networking platforms.
- Thematic areas & Events include thematic areas like e-government, e-health, e-learning, e-infrastructure, e-agriculture or other areas and the advertisement of ICT4D-events.

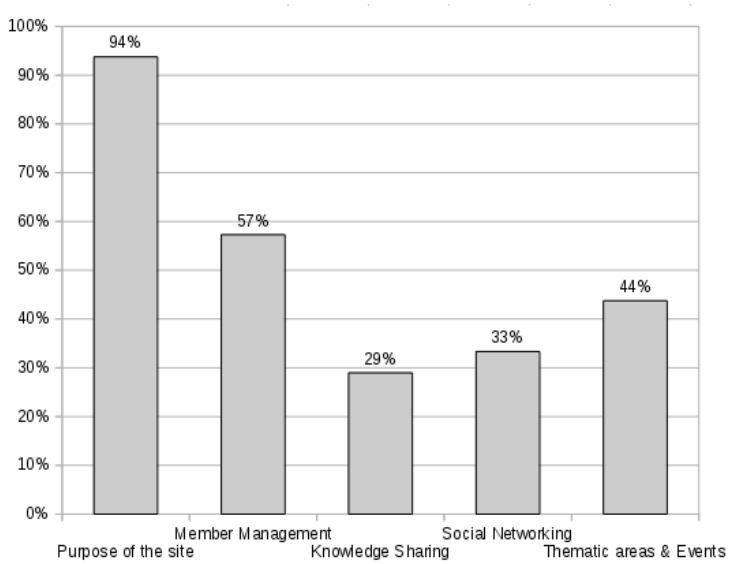

Figure 1*: KSP content category coverage in the ICT4D-websites investigated*

The next step was to align the categories with the maturity levels in the field of e-government (see Table 2). A maturity level that is seen as optimum to reach for an ICT4D KSP is assigned to the different categories. The maturity levels in Table 5 are based on a selection of the levels in Table 2. It is assumed the higher levels include all the functionality of lower levels.

- Level 1: *Presence* (Fath-allah et al. 2014) corresponds with the lowest level of simply having an online presence. Content categories would include the purpose of the site in terms of presenting a person or organization and limited knowledge sharing.
- Level 2: *Information* (Ziemba and Papaj 2013) concurs with the one-way interaction (Fath-allah et al. 2014) where users can access information via links or downloads but not contribute anything. Content categories would include knowledge sharing but only in terms of knowledge provision to the users without any feedback opportunity.
- Level 3: *Interaction (*Fath-allah et al. 2014; Ziemba and Papaj 2013) refers to two-way interaction with users. Content categories would include knowledge sharing, social and business networking, news and search functionality.
- Level 4: *Integration* was chosen to represent level 4 since transactions are less common on ICT4D KSPs. Member management and knowledge sharing include content and distribution management and user relationship management strategies. Content categories would include knowledge sharing, social and business networking and news.
- Level 5: *Personalization* represents portal and personalized capabilities and multi-media content such as videos and multiple language choices. Content categories would include knowledge sharing, social and business networking and news with personalisation options.

In Table 5, maturity levels are matched to the content categories presented in Figure 1. Characteristics assigned (marked with an X) represents the minimum level of functioning that the KSP should provide on that level. The maturity levels do not correspond exactly to the coverage as presented in Figure 1 since frequency has to be mediated by importance in ICT4D KSPs. It is assumed that the higher level will include lower level functionality. The thematic areas are not included since the scope of the ICT4D research does not impact the maturity level of the KSP, i.e. a maturity level 5 KSP may focus only on e-health.

	Level 1	Level 2	Level 3	Level 4	Level 5
Characteristics	Presence	Information	Interaction	Integration	Personalization
Social				X	X
Member Management			X	X	X
Knowledge Sharing		X	X	X	X
Purpose of the site	X	X	X	X	X

Table *5*: Component maturity matrix for ICT4D websites

5. Conclusions

The study investigated knowledge sharing support in the field of ICT4D through the provision of KSPs. The paper analysed and presented findings from 16 ICT4D websites and cross-examined the findings against the levels suggested for e-government maturity models. The main contribution is the proposal of a maturity matrix for ICT4D KSPs. The fact that no online presence could be found for some of the universities which are known to deliver ICT4D research is an important issue for further investigation into the discoverability of research information for collaboration and knowledge sharing. The findings are limited by the relatively small number of websites evaluated so further research is required to validate the findings, optimize the matrix and develop a maturity model appropriate for ICT4D KSPs. That can be useful in informing researchers and practitioners on designing or updating ICT4D KSPs with the intention of linking to the existing ICT4D KSPs. The content categories identified and the matrix proposed are based on the analysis of ICT4D websites but could inform the design of any open knowledge repository.

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Appendix A

Purpose of the site	***P***	***Social Networking***	***S***	***Thematic area***	***T***
Description of what the site is about	**P1**	Discussion forum	**S1**	E-Government	**T1**
		Blog site	**S2**	E-health	**T2**
Member Management	***M***	Twitter	**S3**	E-Learning	**T3**
Login option	**M1**	Face Book	**S4**	E-Agriculture	**T4**
Membership based on personal information	**M2**	Poll site	**S5**	E-Business	**T5**
Membership based on personal information and payment	**M3**				
User groups	**M4**	***Events***	***E***	***Contact***	***C***
Individual Profiles	**M5**	Internal events	**E1**	Email - link only	**C1**
		External events	**E2**	Content manager to collect information about the visitor	**C2**

Knowledge Sharing	***K***				
Downloadable information	**K1**				
Publications	**K2**				
Software downloads	**K3**				
Career opportunities	**K4**				
Funding opportunities	**K5**				
Skills development opportunities	**K6**				
Existing projects	**K7**				
News	**K8**				
Awards	**K9**				
Note: Contact was captured under member management but can also be seen as a separate item.					