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Developing criteria for the evaluation of the ICT contribution to social and economic development

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ABSTRACT

Practitioners in Information and Communication Technology (ICT) for development have repeatedly relied on evaluations of past or present initiatives to advise and facilitate the design and implementation of other development initiatives. However, current quests for measures that demonstrate the developmental contribution of ICT call for new approaches to ICT4D evaluation. In response to this, the study presented in this paper provides a starting point in the development and evaluation of the appropriateness of a set of criteria – dimensions and indicators that can be applied to the appraisal of the ICT contribution to development. Development is defined as a multidimensional concept based on Sen’s capability approach, particularly focusing on the outputs (opportunities) and outcomes (benefits) ICT can enable within a given context. Indicators are proposed for education and research, healthcare, economic opportunities and political freedom dimensions. Findings obtained through exploratory survey research show that the proposed indicators are appropriate for the evaluation of the contribution of ICT to social and economic development, especially in a developing country context. Additional indicators were also proposed for some of the dimensions. Participants further reiterated the need to combine both qualitative and quantitative indicators to supplement and balance each other in the appraisal of development initiatives. Subsequent studies will seek to devise means of how this can be addressed, as well as a process through which a combined analysis can be obtained. Such studies should seek to extensively evaluate the indicators as well as apply them for the evaluation of ICT4D initiatives.

Keywords: ICT4D evaluation, ICT contribution to Development, Indicators, Sen’s Capability approach

INTRODUCTION AND MOTIVATION

Practitioners in Information and Communication Technology (ICT) for development have repeatedly relied on evaluations of past or present initiatives to advise and facilitate the design and implementation of development initiatives (Heeks, 2009). However, as interest in the ICT

field shifts from readiness, through access and use, and now to impact, new challenges have come up relating to how to best appraise the ICT impact on social and economic development. This challenge is an even greater concern in developing countries where the uptake, use and subsequent impact of ICT are more dependent on contextual factors than the development initiatives in question. Furthermore the evaluation is exacerbated by: the ambiguous and multi-dimensional nature of development as the ultimate goal of all ICT4D initiatives, which can be variedly defined depending on the context; and the constraints related to data (availability, collection, validity).

Consequently, there has been an increase in studies into how ICT contribution to development can be evaluated. However, despite this increase, there is a lack of structured approaches to facilitate this evaluation process (Gomez and Pather, 2012). A majority of the existing approaches are in-depth descriptive exercises, which provide a rich understanding of the benefits of the initiative(s) at a micro level and within a given context. However such in-depth assessments are difficult to replicate in another context and produce a lot of data that is not easy to aggregate and report in instances involving multiple individuals and projects. Hatakka and Lagsten (2012) point out that aggregation of such in-depth evaluations is susceptible to the loss of information which may affect the understanding of the development process.

These aspects therefore motivated the development of an approach that lies between the evaluation of infrastructure readiness in terms of quantitative measures e.g. computers per household at the macro (national) level, and the in-depth story telling approaches at the micro (individual) level. The approach proposed here employs indicators but differs from the usual quantitative methods in that the indicators are mostly qualitative, do not present precise data requirements, and are not limited to readiness assessment. The qualitative assessment facilitates a structured approach which provides sufficient information to report the ICT contribution to development at various levels of assessment. For instance a selection of the proposed criteria may be used to evaluate the ICT contribution in specific sectors such as health or education. On the other hand a structured evaluation may also be performed at a micro-level of a specific initiative, for example the contribution a community ICT facility makes on individuals' overall wellbeing.

The indicators used are based on a model developed in an ongoing research that proposes an approach for the evaluation of the ICT contribution to social and economic development (Kivunike et al., forthcoming): the model referenced is based on development theories to ascertain the multi-dimensional interactions as well as the role various contextual factors play in realizing a development contribution from ICT. This paper on the other hand is focused on the development and evaluation of the proposed indicators to ascertain their appropriateness for the evaluation of ICT4D initiatives.

The rest of the paper is organised as follows. Section 2 reviews literature on the current state of ICT4D evaluation approaches which rely on development theories. In section three the methodology applied in the assessment of appropriate ICT4D evaluation indicators is discussed. This is followed by the results and discussion in section four; and finally the conclusion and future work in section five.

ICT4D EVALUATION APPROACHES

The progress of activities in ICT4D can be investigated using the ICT4D value chain model (Adamali and Lanvin, 2005, Heeks, 2009). The value chain is based on the standard input-process-output model linking resources and processes to systematically analyze the stages an ICT initiative traverses over time. An ICT4D intervention which is the input results in deliverables (e.g. a telecentre, e-library platform etc), which once exploited by the target beneficiaries produce outputs; leading to outcomes and ultimately impacts. The realization of outcomes from outputs as well as impact from outcomes is affected by various contextual factors. ICT4D outputs are the behavioural changes associated with technology use that consist of new information and decisions, new communication patterns, and new actions and transactions. Outcomes, on the other hand, are the direct benefits in terms of measurable (both quantitative and qualitative) benefits as well as costs associated with the outputs; while development impacts refer to the ICT contribution to the broader development goals. Development impact is less tangible (Gomez, 2012, Leimbach et al., 2012).

ICT4D assessment has advanced over the years from readiness, through uptake and usage, and now impact. Assessing readiness in addition to uptake and usage mostly focused on the inputs and deliverables including infrastructure as well as other enabling factors such as affordability, capability, and the regulatory environment. These were mostly performed at the macro level

employing such measures as phones per capita or computers per household etc. This has since evolved to address impact assessment. For instance the World Economic Forum Network readiness index first introduced in 2001 to measure the degree to which countries leverage ICT for enhanced competitiveness initially focused on readiness and usage. It has since been modified to cater for measures of social and economic impact so as to ensure relevance to the current ICT trends (Bilbao-Osorio et al., 2013). Similarly Heeks and Molla (2009) provide an extensive study of the existing ICT4D impact assessment approaches in general.

A Development approach to the evaluation of ICT4D Initiatives

The evolution to impact measures arose from the need for ICT4D initiatives to demonstrate that they actually contribute to social and economic development. One of the major concerns for sound ICT4D impact evaluations has been the need for an increase in reliance on relevant theoretical or conceptual foundations to guide the evaluation process (Gomez and Pather, 2012, Heeks, 2010). In the current study this gap is being addressed in part through the application of development theories in the development of evaluation approaches. This is based on the notion that perception of benefits drives ICT use which determines the nature of impact. Therefore, focus shifts from the ICT to the benefits (i.e. the development) it enables within a given context. However, development is a vague concept which lacks a clear definition. It has also evolved over the years from the one-dimensional economic growth metrics, to the increasingly accepted notion of human development which defines development as a multidimensional aspect involving several dimensions as well as actors.

Consequently the multidimensional development definition is the major current guide to ICT4D impact evaluation. There is a growing body of research that is applying development theories or concepts for purposes of ICT4D evaluation. Principal among these is Amartya Sen's (2000) capability approach. Development according to Sen is the expansion of freedoms (capabilities or opportunities) to enable people lead the lives they value (Sen, 2000). Development is more than the provision or access to a resource like ICT, but rather what ICT can enable people to do or be given their contextual aspects. Another approach is the sustainable livelihoods approach - SLA (Chambers and Conway, 1992) which pays attention to capabilities, assets, and activities that pertain to sustainable livelihoods within a given context (Parkinson and Ramirez, 2007, Gigler, 2011). The livelihoods framework also partly draws from the capability approach.

These development concepts have either been adapted within a context for the formulation of relevant conceptual models or are adopted as is to guide the evaluation process for various applications (De', 2006, Hatakka and Lagsten, 2012, Ibrahim-Dasuki et al., 2012, Madon et al., 2007). For example, Gigler (2011) combines both the capability approach and sustainable livelihoods models to propose a framework for the evaluation of development initiatives. Kleine's (2009) choice framework for a holistic in-depth analysis of ICT4D initiatives is also based on the capability approach. It draws on the principles of the empowerment framework as well as on elements of the SLA. On the other hand Hatakka and Lagsten (2012) apply the capability approach to assess how students use internet resources to facilitate their learning. Ibrahim-Dasuki et al (2012) also use the freedoms concept of the capability approach as an evaluative space of the developmental impact the electricity pre-paid billing system has had in Nigeria. De'(2006) and Madon (2007) demonstrate how various components of the capability approach may be applied for the development appraisal of e-government projects. Parkinson and Ramirez (2007) applied the SLA for the impact assessment of a telecentre in Colombia on the livelihoods of people within the community.

Clearly there is a growth in research relying on development theories to propose approaches for the evaluation of ICT4D initiatives. Most of these evaluations are in-depth narrative reports that facilitate the understanding of the development process and how it is enabled or restricted through ICT given various contextual factors. These approaches are characterized with lots of data which are well-suited for a micro level appraisal of how specific ICT4D projects contribute to the (social and economic) development of individuals or communities. However, similar approaches are not well-suited for appraisals involving multiple projects since multiple instances of data would be produced presenting a challenge at aggregation and reporting. Hatakka and Lagsten (2012) point out that aggregation of such in-depth evaluations run the risk of losing information which may affect the understanding of the development process. This calls for structured approaches to facilitate an objective impact evaluation process of the ICT contribution to development (Garnham, 1997, Gomez and Pather, 2012). It is envisaged that the structured approach streamlines the data collection and analysis process to ensure that the method is not too simplistic to overlook essential details and neither is too elaborate to inhibit proper reporting.

Consequently the model applied for the development of the evaluation criteria is also based on the capability approach (see details in Kivunike et al., forthcoming). The model proposes a

holistic, multidimensional and hierarchical approach to the evaluation of ICT4D initiatives. It particularly focuses on evaluating impact i.e. output and outcome components of the value chain. However impacts cannot be confidently attributed to the initiative since there are normally other factors that could have affected the resultant outcome. To address this challenge, it is argued that rather than aim at proving attribution (identifying the cause of an effect and determining how much of the effect results from the intervention), emphasis should be placed on the contribution an initiative has had on social and economic development (Mayne, 2012 pp 273). This seeks to systematically establish the role played by the initiative towards the achievement of the result in cognisance of the multiple factors involved. This is achieved through establishing causal linkages of how outputs led to the achievement of the outcomes, and the factors that facilitate or inhibit this process.

The work reported in this paper focuses on the development of indicators for the evaluation of ICT contributions to social and economic development at various levels of analysis in the developing country context. This is in contrast to the reviewed literature which mostly consists of descriptive methods to evaluate ICT contributions to development at micro level; or the initial approaches that evaluated readiness and usage in terms of quantitative measures at macro level.

METHODOLOGY

This study consists of two parts: the first involved the development of criteria, while the second evaluated the appropriateness of proposed criteria. As a starting point in developing criteria for the evaluation of ICT contributions to social and economic development, this study specifically sought to explore how the most appropriate criteria (i.e. indicators which were adequate and usable for the measurement of ICT contributions to development) could be identified. It further sought to discover new ICT4D assessment aspects as suggested by respondents. Accordingly the survey research approach was employed more so in an exploratory manner. Pinsonneault and Kraemer (1993) point out that exploratory survey research is appropriate when the aim is to “refine the measurement of concepts” as well as “discover and raise new possibilities and dimensions of the population of interest”. The application of survey research in this study aimed at facilitating a loosely structured process of eliciting respondents’ viewpoints regarding the proposed criteria as well as suggesting others. Survey research is further appropriate if the study involves quantitative descriptions of phenomena, asking structured and pre-defined questions as

well as data collection about only a fraction of the study population; which were all important features of this study.

Data collection

The development of ICT4D criteria was informed by prior empirical research (Kivunike et al., 2011) as well as additional literature studies (Ndiwalana et al., 2010, Grunfeld et al., 2011, Gigler, 2011). The criteria draws from aspects of the ICT4D value chain model specifically focusing on the impact component (outputs, outcome and impact) of the value chain(Heeks, 2009). The details of this are discussed in the results section.

A questionnaire-based survey was employed for the evaluation of the appropriateness of the proposed criteria. The questionnaire was divided into two main sections. The first focused on the respondents' demographic details, i.e. names, contacts, and institution. To ensure that respondents were competent, they were also requested to identify some of the ICT4D projects they had been involved in. In the second section the questionnaire was divided into modules based on the different social and economic sectors or dimensions, i.e. education, healthcare, economic opportunities, and governance (see results for a detailed discussion of how these were developed). Each of these sectors represented corresponding development dimensions. To guarantee meaningful participation in the survey, respondents were only required to fill out one or two modules depending on their area of expertise. The decision to divide the questionnaire into modules resulted from initial questionnaire tests in which potential respondents were concerned about its length and number of indicators. Furthermore one of the dimensions, the psychological well-being dimension, was eliminated from the final survey mainly because aspects of this component were common to all dimensions as outcomes. The questionnaire asked respondents to specify on an ordinal scale of 1 to 5 how appropriate each of the indicators was for assessing ICT contribution to social and economic development within the different dimensions. On the likert scale this translated as follows: 1=strongly inappropriate, 5=strongly appropriate, while 3 represented undecided (average). Besides the suggested indicators respondents were also requested to suggest any other indicators they thought would be relevant for the evaluation of ICT4D initiatives in the different dimensions. Prior to the evaluation of indicators, respondents were requested to identify the opportunities/benefits ICTs can enable in the different dimensions through an open-ended question. Doing this before respondents gave

their opinion on the suggested indicators aimed at avoiding biases, establishing whether what was suggested was meaningful as well as identifying any additional opportunities.

Since the study upon which the current one builds sought perceptions of ICT beneficiaries of the potential ICT benefits, the current study sought responses from ICT4D practitioners involved in the design and implementation of ICT4D initiatives in developing countries. As influential decision makers who rely on evidence based approaches to advise ICT4D practice, the opinion of these practitioners serves to add value and ensure appropriate and widely acceptable measures. The questionnaire was hosted online and distributed via email to around 300 respondents purposively selected. The survey yielded 54 responses; of which 30 were usable responses despite several email reminders as one of the ways of improving response rates for postal or email surveys. The survey was conducted in July and August 2013.

Data Analysis

The SPSS software package was used to perform data analysis. According to Bazeley (2002) non-parametric descriptive statistical techniques like frequencies and medians are sufficient for the analysis and reporting of ordinal data sets for which statistical distributions can not be realised. Consequently the median sufficed as a measure of central tendencies in establishing the indicators agreed upon as most appropriate in the different dimensions.

RESULTS AND DISCUSSION

Developing ICT4D evaluation Criteria

The proposed ICT4D evaluation criteria consist of three levels (dimensions, outcomes, and outputs) and indicators are proposed for the outcomes and outputs levels.

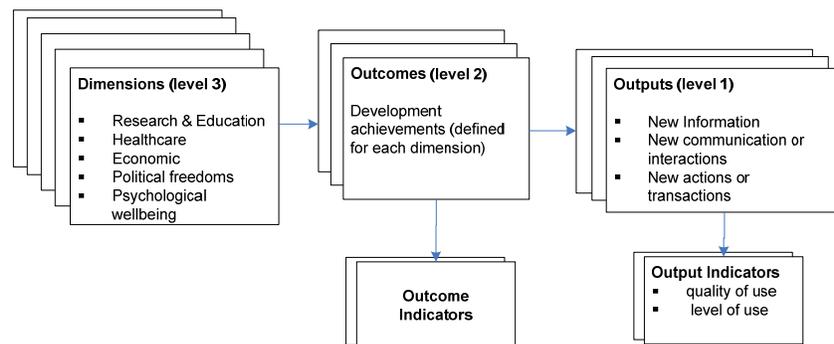


Figure 1: ICT4D evaluation criteria model

The dimensions consist of the major aspects which collectively make up social and economic development. These are motivated by Amartya Sen's (Sen, 2000) composition of instrumental and intrinsic freedoms including: social (education and healthcare) opportunities, economic opportunities, political freedom, and psychological wellbeing. In this respect, development consists of two aspects (Prakash and De', 2007, Qureshi, 2013): from an instrumental perspective there are improvements (social, economic and political) in peoples' lives; while the intrinsic aspect is what constitutes the lives people value (psychological wellbeing). This provides a holistic evaluation of development which considers both the means and the ends of development (of course not ignoring context which is a vital component but beyond the scope of this paper).

- **Social opportunities** are the arrangements society makes available to enable an individual to live a better life; this focuses on the **education** and **healthcare** which are essential aspects of social development.
- **Economic opportunities** refer to the opportunities that individuals enjoy to utilize resources for the purpose of consumption, production or exchange. They include aspects such as productivity, employment, etc.
- **Political freedoms** are the opportunities available for people to exercise their political rights, e.g. being able to participate in local election, community development programmes, etc.
- **Psychological wellbeing** refers to the emotional and personal development opportunities. These are mostly a result of using ICT or participating in ICT4D projects. Examples include gaining respect from peers or increase in self-esteem. Psychological wellbeing is a common achievement to all dimensions above, consisting of mostly subjective measures of people's quality of life. It was not explicitly evaluated in this study to avoid tiring respondents and ensure that data obtained on the other dimensions was meaningful. However a few psychological wellbeing evaluation metrics were captured as part of the outcome in the rest of the dimensions.

These dimensions supplement and reinforce each other. For example, gains in psychological wellbeing (e.g. self-esteem) boost people's abilities to exploit opportunities in other dimensions (e.g. political participation). These dimensions represent individual or collective social and economic development and have been applied in various evaluation contexts e.g. (Ibrahim-Dasuki et al., 2012, Grunfeld et al., 2011).

Outcomes are the achievements (costs or benefits) associated with the development initiative and for which outputs are a prerequisite. Outcomes are defined for each dimension and focus on the effectiveness of a development initiative. Similarly, outcome indicators that measure the proposed outcome are proposed to measure the initiative effectiveness towards the achievement of certain goals.

Outputs, on the other hand, are the behavioural changes resulting from the initiative. These may generally be defined as the opportunities an initiative can enable. For instance, the ICT artefact enables communication, production, processing, and sharing of information as well as the performance of transactions. Consequently three main output categories are proposed to be assessed for each outcome (Heeks, 2010):

- **New information** is the information that an initiative immediately supports or offers. For instance, a project aimed at supporting university library functions will improve research innovations (the outcome) through the provision of access to online research journals (the output). Other such outputs include e-learning platforms, online health platforms
- **New communication or interactions** refer to the new modes of communication or interaction an initiative supports; for example online collaborations through video conferencing – remote diagnostics, access to social media like face book, twitter; interactions through blogs or discussion forums etc.
- **New actions or transactions** refer to the transactions an initiative enables or supports. For example money transfers, paying bills online, etc.

In this research context development is more than just the provision of opportunities. It is also concerned with whether these opportunities are of value to the target end-users (Sen, 2000). This value attachment determines whether or not an end-user will exploit a provided opportunity. Additionally, information system studies have shown that quality generally influences people's

perception of value or benefits; which in turn affects the actual use or exploitation of an opportunity (Nelson et al., 2005). Consequently the evaluation of outputs in terms of user perceptions of quality and usage provide insight into how instrumental the output is towards the achievement of the outcome. The proposed indicators are mostly qualitative which accommodates and maintains the vagueness in the definition of development which respondents can easily relate with, and for which data can easily be obtained. As a result the following generic operational definitions of output indicators are proposed:

Quality in this context adopts a user-centric approach defined in terms of conformance to end-user expectations related to excellence and value in relation to customer perceptions (Akter et al., 2013, Bovee et al., 2003, Nelson et al., 2005). This facilitates an evaluation of a broad range of quality attributes that reflect the importance of service/information to the beneficiaries. There have been several studies into evaluating and validating user perceptions of quality depending on whether it is the information systems/services or information obtained (see e.g. Tufail and Ehsan, 2012, Nelson et al., 2005, Bovee et al., 2003, Akter et al., 2013). Based on these studies, generic definitions for each output are proposed as follows. If the output is access to new information evaluation is performed for perception of quality of content/information in terms of relevance – degree by which information service serves its purpose, usefulness – degree of usefulness of content/information to beneficiaries’ needs (Alalwany and Alshawi, 2008) sufficiency – degree by which content sufficiently satisfies beneficiaries’ goals/needs. Similarly quality of new communications or interactions such as blogs, discussion forums or remote diagnostics focus is evaluated in terms of relevance/care – degree by which interaction service serves its purpose, cooperation – degree of beneficiary’s willingness to interact or collaborate and ease of use – level of simplicity of using the service (Alalwany and Alshawi, 2008, Alshawi and Alalwany, 2009, Akter et al., 2013) Finally the quality of transactions is evaluated in terms of relevance - degree by which a transaction service serves its purpose, usefulness - degree of usefulness of transaction to beneficiaries’ needs ease of use – level of simplicity of using the service. Assessing quality seeks to establish whether end users actually value the opportunity, which determines the nature of use and development outcome.

Usage evaluates stakeholder perceptions of the extent by which they use or exploit the ICT opportunity. In reference to Internet usage, van Dijk (2006) points out that usage can be measured in various ways including usage time, range of applications used, or active and creative

usage. Given the potential lack of data, and the generic nature of evaluation which will involve projects from different sectors, it is proposed that evaluation is performed in terms of active use, which is the level of use of the initiative; a qualitative measure of the frequency of use of new information, participation in an interaction or performance of a transaction. This may be supplemented by an open-ended question to establish what exactly the service is used for. It is important to note that these definitions provide a general guidance for the measured attributes but might slightly vary depending on the initiatives being evaluated.

Empirical evaluation of ICT4D indicators

For purposes of simplification and to obtain more specific data, the social opportunities dimension was split into research and education, and healthcare in the empirical study. The responses obtained from the survey were divided as follows; research and education – 18 (60%); healthcare – 11 (36.7%); Economic opportunities – 6 (20%) and political freedoms – 7 (23.3%). Majority of the respondents were from academic institutions – 15 (50%), 5 (17%) were from relevant government institutions, 9 (30%) from civil society organizations and 1 (3.3%) from a private company. Majority of the respondents i.e. 28(93%) were from developing countries (i.e. Uganda and Mozambique) that had some point been involved in the design, development or implementation of an ICT4D initiative. Only 2 (6.6%) were from developed economies and had been involved in the development and implementation of ICT4D initiatives.

Research and Education

From the study, the research and education dimension consisted of two major outcomes; 1) improvement in research quality and innovations and 2) improved access to formal and/or non-formal education. Output and outcome indicators were proposed for each of these outcomes.

Outcomes	Indicators	Median	Other suggested Indicators
Improvement in research quality and innovations	Output indicators		
	Quality of online resources e.g. research journals, online libraries, super/grid computing	5.00	• Level of participation at international and local forum to present findings
	Level of use of online resources e.g. research journals, online libraries, super/grid computing	5.00	
	Quality of research collaborations in terms of commitment to collaboration	4.00	

Outcomes	Indicators	Median	Other suggested Indicators
	Level of participation in research collaborations	4.00	
	Quality of research outputs -i.e. frequency of citation	5.00	
	Level of production of research outputs	5.00	
	Outcome Indicators		
	Existence of innovations (patents, research standards)	4.00	<ul style="list-style-type: none"> • Quantity & quality of new innovations, products or processes • Reduction in duration of solving problems/challenges facing society • Market requirements for research results • Increased institutional research and technology capacities
	Level of use of innovations, research standards, patents (requested and issued)	4.00	
	Level of dissemination of research publications in both local and international journal	5.00	
	Reduction in research completion life-span	3.00	
	Start-ups resulting from initiative e.g. community outreach	4.00	
	Expanded chances for (better) employment	4.00	
	Output indicators		
Improved access to formal and/or non-formal education	Level of use of relevant online resources e.g. online courses, e-learning platform	5.00	
	Quality of relevant online resources	4.00	
	Quality of IT-enabled forum in terms of degree of activity e.g. discussion forums	4.00	
	Level of participation in ICT-enabled learning forums	4.00	
	Quality of research outputs -i.e. frequency of citation	4.00	
	Level of production & publication of research outputs	4.00	
	Outcome Indicators		
	Level of students performance	5.00	<ul style="list-style-type: none"> • ability for trainees to demonstrate the productive utilization of the acquired skills/education • Being able to study from anywhere at anytime
	Efficient and timely feedback	5.00	
	Level of student(s) participation in their own learning	5.00	
Expanded chances for (better) employment	4.00		
Attainment of new/advanced skills or academic credentials	4.00		

Table 1: Summary of indicators proposed for evaluating research and education

1. *Improvement in research quality and innovations* seeks to measure whether an education ICT initiative has had effect on the quality of research and innovations. This can be applied to the assessment of e-infrastructure, e-library, e-research/science or e-learning initiatives aimed at enhancing research quality. From the empirical study (see

Table 1) experts found the output indicators i.e. quality and level of use of relevant online resources, quality and level of participation in collaborations as well as the quality and level of production of research outputs either strongly or somewhat appropriate for the assessment of the ICT contribution to improved research quality and innovations. Some of these are in agreement with various studies; for example Ochsner et al (2012) establish that collaborations and quality of research outputs in terms of citations are extensively applied in research quality evaluations. Chandra and Chaturvedi (2013) further corroborate these findings by suggesting the use of citations more so in a developing country context, and in combination with other indicators. In agreement with Tufail and Ehsan (2012), respondents also regard outcome indicators including existence and use of innovations in terms of e.g. patents or research standards, as well as start-ups resulting from the initiative e.g. community outreach as relevant measures of improved research quality and innovation.

Respondents also made suggestions of additional indicators as summarized in the Table 1. While the majority of the proposed indicators are qualitative, some of the suggested indicators highlight the need for incorporating quantitative measures as well, e.g. quantity of new innovations or publications. This may be attributed to the historical approaches of ICT evaluation which is an added value except in instances where access to such data is a challenge. Interestingly, while experts are undecided on whether reduction in research completion life-span was appropriate or not, “Reduction in duration of solving problems/challenges facing society” which demonstrates the impact of research on industry is one of the suggested indicators. Indicators suggested for demonstrating such interactions include “Start-ups resulting from initiative” and “market requirements for research results”. This may be attributed to the need for indicators which demonstrate the relevance of research to industry/society to feed into research and development policy formulation in the developing country context (Bhutto et al., 2012).

2. ***Improved access to formal and/or non-formal education*** is vital in the assessment of whether ICT initiatives facilitate the learning process. It is without doubt that ICT facilitates teaching and learning in developing countries notwithstanding failures in some

instances arising from contextual differences. The proposed output indicators evaluate students' perceptions of how important initiatives such as e-learning are towards student learning. This evaluates the quality and usage of opportunities like online or mobile access to educational material and participation in online collaboration forums, which respondents generally find appropriate. On the other hand the outcome indicators evaluate whether the initiative has actually contributed to people's learning. Respondents also found the proposed outcome indicators appropriate for the appraisal of improved access to education (see Table 1). Other indicators were proposed including "ability for trainees to demonstrate the productive utilization of the acquired skills/education", and the ability to study from anywhere at anytime. Similarly while evaluating m-learning initiatives, Valk et al. (2010) establish that the ability to provide immediate feedback, acquisition of new skills and ubiquitous access to learning are essential outcome measures of improved access to education.

Healthcare

In this study, appraisal in healthcare considered two main aspects; access to and delivery of healthcare services.

Outcomes	Indicators	Median	Other suggested Indicators	
Improved access to healthcare services	Output indicators			
	Quality of the health-related information e.g. websites/sms to share information on good health practice, or pandemics etc	4.00	• Reliability of e-health services	
	Level of use of health-related information	4.00		
	Quality of feedback from remote consultation and diagnosis e.g. through phone calls, video calls etc	4.00		
	Level of use of remote consultation and diagnosis	4.00		
		Outcome Indicators		
	Timely access to health services	4.00	• Quality of patient care received	
	Savings on access to health services	4.00		
	Reduction in certain health conditions (increased) Level of awareness of various health conditions or pandemics	4.00		
		5.00		
Improved delivery of healthcare services	Output indicators			

Outcomes	Indicators	Median	Other suggested Indicators
	Quality of health management information systems in terms of ease of use	5.00	
	Level of use of health management information systems	4.00	
	Quality of collaborations among health workers in terms of degree of activity	4.00	
	Level of participation in collaborations and co operations among health workers	4.00	
	Outcome Indicators		
	Better reporting and planning for the health sector	4.00	<ul style="list-style-type: none"> • reduction in patient waiting times
	Level of distribution of health supplies	4.00	<ul style="list-style-type: none"> • reduction in health care cost
	Proper accountability for health supplies	5.00	<ul style="list-style-type: none"> • timely reporting of disease outbreaks • timely delivery of medical interventions • improved sharing and dissemination of up-to-date information • Improved coordination and monitoring of health activities

Table 2: Summary of indicators proposed for evaluating healthcare

1. **Improved access to healthcare services** seeks to establish how effective health related ICT initiatives have been in facilitating access to health services. This appraises the patients' perception of the opportunities (i.e. access to information and remote diagnostics & treatment) that ICT enabled health initiatives offer. Focus is not on the initiative itself but on the opportunities the initiative enabled. Examples include websites/SMS that share information on good health practice, pandemics, etc. Experts thought all proposed indicators were appropriate which may be attributed to the increased dependence on information and communication systems to facilitate healthcare access and delivery (see Table 2). Respondents suggest other quality metrics including reliability of e-health services and quality of patient care received (as perceived by beneficiaries). This points to the fact that perception of quality has had significant impact on user satisfaction and the use of health services as reported by (Akter et al., 2013).
2. **Improved delivery of healthcare services** focuses on evaluating whether automation in health service delivery improves the operational efficiency in healthcare service delivery.

This information should be elicited from health workers as well as service recipients (more so the outcomes) to establish whether in realizing organizational efficiency, the service recipients also realize a development benefit. Respondents generally perceive the proposed indicators as either somewhat (4) or strongly appropriate (5) (see Table 2). Other outcome indicators that articulate the efficiency in health services delivery were proposed including reduction in patient waiting times, reduction in health care cost, timely reporting of disease outbreaks, and timely delivery of medical interventions. Furthermore, based on suggestions made by respondents it is proposed that “better reporting and planning for the health sector” could be broken down into improved sharing and dissemination of up-to-date information (e.g. patient records, health supplies and improved coordination) and monitoring of health activities. These indicators elicit whether the available health data/information benefits decision making. Latifov and Sahay (2013) point out that health information systems in developing countries have a lot of data which has not been used for decision making. These appraisals will provide some insight into how health information benefits the delivery of services to achieve quality patient healthcare.

Economic opportunities

The results focused on two outcomes, improved productivity and improved income (including income generation opportunities)

Improved Productivity	Output indicators	
	Quality of content of relevant information	4.50
	Level of use of information from relevant resources	4.00
	Quality of online communities in terms of degree of activity	3.00
	Level of participation in relevant online communities e.g. farming blogs, content production	4.00
	Outcome Indicators	
	Existence of new goods/services produced (type and value)	4.50
	Levels of production	4.50
	Timely delivery of products	4.50
	Reductions in production and transport costs	4.50
	Increased timeliness of sales	5.00

Improved income including income generation opportunities)	Output indicators		
	Quality of content of relevant information	4.00	
	Level of use of relevant information	3.50	
	Quality of ICT-related training & skills development activities	3.50	
	Level of participation in relevant (ICT-related) training & skills development activities	3.50	
	Quality of platforms that support online transactions in terms of ease of use	3.50	
	Level of performing ICT-related transactions	3.00	
	Outcome Indicators		
	Existence of new job opportunities created	4.00	reduction in unemployment
	Reduction in transaction and transport costs	4.00	
	Attainment of new skills	3.50	
	Acquisition of better paying job opportunities	4.00	

Table 3: Summary of indicators proposed for evaluating economic opportunities

1. **Improved productivity** seeks to appraise the effect of ICT enabled information and communication services on economic productivity. It specifically aims to establish the correlation between the increase in ICT capital investment and firm productivity and growth. Examples of initiatives that can be evaluated in this dimension are those concerned with economic production include the effect of online farming blogs or SMS services on better yields, the promotion of entrepreneurship ideas/training, or the effect of ICT in the efficiency of small and medium enterprises (SMEs) etc. In corroboration with other studies (Baro et al., 2013, Braun, 2010), respondents agreed that the outcomes of ICT on improved productivity included increased and timely production and delivery, reduction in production and transportation costs, production of new goods or services among others (see Table 3). Additionally the quality and level of use of relevant information, as well as participation in relevant communities were agreed upon as appropriate output indicators in establishing improved productivity.
2. **Improved income (including income generation opportunities)** is another vital outcome of ICT enabled information, communication and transactions activities. Examples include information on available employment or investment opportunities, better pricing

information, training in content development or ICT literacy, and transactions such as e-tax, money transfers, remittances, etc. Respondents generally thought that the proposed indicators were somewhat appropriate (3.5-4 - see Table 3). This non-committal state may be attributed to the mixed perceptions of ICT benefits on employment. For instance, Sey and Fellows (2009) report that researchers have had mixed results regarding employment-related benefits of ICT. While some studies found it beneficial (see e.g. Braun, 2010), others found little such evidence. Respondents in this study also proposed reduction in unemployment as another indicator in this dimension.

Political freedoms

The study focused on three outcomes that result from governance issues as presented below:

Outcomes	Indicators	Median	Other suggested Indicators
Improved participation in local/community or national politics	Output indicators		
	Quality of content of e-voting, community/national websites	5.00	
	Level of use of relevant online resources e.g. e-voting, community/national websites	4.00	
	Quality of local/community or national activities in terms of relevance	4.00	
	Level of participation in local/community or national political activities e.g. elections, debates, radio talk shows etc	5.00	
	Outcome Indicators		
	Level of participation in local/community or national politics or activities	5.00	
	Ability for individuals to demand for better services without fear	5.00	
	Increase in local production and dissemination of relevant information	4.00	
	Improved national/institutional/community transparency	Output indicators	
Quality of relevant online resources e.g. budgets on community/national websites in terms of relevance		4.00	
Level of use of relevant online resources e.g. budgets on community/national websites, citizen online database etc		4.00	

Outcomes	Indicators	Median	Other suggested Indicators
	Quality of national/community policing forums in terms of relevance	4.00	
	Level of participation in national/community policing e.g. freely reporting fraud	4.00	
	Outcome Indicators		
	Ability for individuals to report fraud without fear	4.00	• reduction of middlemen in the acquisition of services
	Ability for individuals to engage local leaders on how public resources are managed	5.00	
	Increase in reported incidents of corruption	4.00	
	Reduced levels of fraudulent activities (corruption)	4.00	
Improved institutional/organizational efficiency	Output indicators		
	Quality of platforms in terms of ease of use	4.00	
	Level of use of relevant platforms e.g. education management systems	4.00	
	Quality of participation in inter-organizational networking in terms of degree of activity	4.00	
	Level of participation in inter-organizational networking	4.00	
	Quality of performed transactions in terms of ease of use	4.00	
	Level of performance of transactions e.g. salary remittances	5.00	
	Outcome Indicators		
	Timely handling and closure of client issues.	5.00	
	Better reporting and planning activities	5.00	

Table 4: Summary of indicators proposed for evaluating political opportunities

1. *Improved participation in community or national politics* seeks to establish the effectiveness of services such as e-voting services and community/national websites on citizen participation. Both output and outcome indicators were either somewhat (4) or strongly (5) appropriate for the evaluation of citizens' political participation (see Table 4). This is in agreement with the notion that improved political participation results from empowering citizens through the provision of relevant services and making conditions favourable for their consumption (Madon et al., 2007, Alsop et al., 2006).

1. **Improved national/institutional/community transparency** assesses the positive correlation between the availability of e-government services, e.g. citizen online databases (birth certificates, computerized land registration, pension application etc.), and their contribution to transparent governance and service delivery. It enables people to hold decision-makers accountable. Experts rate the proposed indicators as somewhat and strongly appropriate based on the median values, 4 and 5 respectively (see Table 4). The challenge in developing countries has always been that while services are streamlined through computerization, their sustainability is hampered by fraudulent administrators who no longer find loopholes to exploit target beneficiaries. Another important indicator in this respect is the reduction of middlemen in the acquisition of services.
2. **Improved institutional or organizational efficiency** seeks to appraise the effect of ICTs on strengthening institutional capacities. It is, however, important that attempts to achieve an efficient institution or organization eventually or directly benefit the end-users. For instance, Prakash and De (2007) report that while the computerization of land records in Bhoomi India brought about transaction efficiency for obtaining land ownership certificates (RTC - record of rights, tenancy and crops) it benefitted only the land-owning farmers and overlooked the landless. Additionally, farmers had to travel long distances to obtain these documents. Consequently, it is proposed that improved efficiency is evaluated as perceived by the service providers as well as the beneficiaries. This assists in ensuring that the improved institutional efficiency is relevant to the needs of the recipients of the services that the institution offers (i.e. development that target beneficiaries' value). Experts in the survey rated the proposed indicators as somewhat and strongly appropriate for the evaluation of organizational efficiency.

CONCLUSION AND FUTURE WORKS

This paper reports an exploratory research study aimed at developing and evaluating the appropriateness of criteria (dimensions and indicators) for the evaluation of the ICT contribution to development. Development was defined as a multidimensional concept based on Sen's (2000) capability approach, particularly focusing on the outputs (opportunities) and outcomes (benefits). Indicators were proposed for education and research, healthcare, economic opportunities, and political freedom dimensions. Rather than proving attribution, the proposed criteria seek to

establish the ICT contribution to development by considering the process of realizing outcomes given certain outputs (which directly result from the initiative), within the limitation of various contextual factors.

Findings show that the proposed indicators were appropriate for the evaluation of ICT contributions to social and economic development within a developing country context. Additional indicators were also proposed for the various dimensions. However while these results cannot be generalized based on the exploratory nature of study, they provide insight into the kinds of indicators required for the appraisal of the ICT contribution to social and economic development in developing countries. Unlike preceding approaches that focused on ICT in terms of readiness, the proposed set of criteria is people-centred, facilitating a structured appraisal of how people benefit from various ICT4D initiatives. This provides a sufficient starting point in efforts seeking such metrics for the evaluation of development initiatives. It is envisaged that such metrics will benefit ICT4D practitioners to advise future investments; it enables the prioritization and forecast of potential impacts; as well as facilitating accountability and establishing performance of ICT4D initiatives.

Findings in this study are limited to a single method; a survey questionnaire. It is recommended that these findings could be corroborated with further research that employs other methods and extended surveys. Respondents also reiterate the need to combine both qualitative and quantitative indicators to supplement and balance each other in the appraisal of development initiatives. As earlier highlighted, a main challenge in conducting quantitative assessments in the developing country context is normally the lack of data. Subsequent studies could also seek to devise means of how this can be addressed, as well as a process by which a combined analysis of both qualitative and quantitative assessments can be obtained. Subsequent studies should further apply and test the proposed criteria for the evaluation of ICT4D initiatives.

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