

# Critical Review of Capability Approach-Based Frameworks in Information and Communication Technology for Development (ICT4D)

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**ABSTRACT:** Sen's Capability Approach (CA) has emerged as holistic lenses for theorising development within Information and Communication Technology for Development (ICT4D) discourses. There is ongoing research on operationalising CA for ICT, with a number of frameworks having been developed. However, there seems to be minimal usage of these frameworks. This paper explores how the ICT artefact has been conceptualised in these CA-based ICT4D frameworks. This paper gives an overview of CA and then makes a critical review of six CA-based ICT4D frameworks. Research gaps are identified from the review. The paper recommends the development of a framework that holistically conceptualises the ICT artefact in CA. This will be beneficial to ICT4D researchers, practitioners and policy-makers. It will help them to empirically analyse the contribution of existing ICT-enabled interventions towards development outcomes. The providers of the ICT artefacts will be able to consider how the ICT artefact plays out in the development journey of their customers. The framework could also be helpful in formulating policies that will ensure implementation of ICT4D interventions which will expand people's capabilities.

**KEYWORDS:** Capability Approach, ICT Artefact, ICT4D, Frameworks, Interventions, Development

## I. INTRODUCTION

Information and Communication Technology for Development (ICT4D) is an emerging and vibrant field of practice and research, that focuses on the use and design of ICTs in efforts to further (socioeconomic) development [1], [2]. Walsham [3], Kleine[4] and Heeks[5] report that development in this context may be understood to be related to international development co-operation (solving some of the world's most

pressing problems). Hatakka et al. [6] perceive development in this context to be the betterment (improvement in wellbeing, agency and opportunities) of the poor, marginalised and less materially advantaged members of the societies. Qureshi [7] on the other hand looks at the field as: one intended to make the world better with ICTs, by offering improvements in people's lives.

This paper adopt the definition of ICT artefacts as "Bundles of hardware infrastructure, software applications, informational content, and supporting resources that serve specific goals and needs in personal or organizational contexts".[8, p. 631]

It is unlikely that there is consensus on what the most important theories in the field of ICT4D are, given the diverse foundational backgrounds of ICT4D researchers. The diverse number of theories that have been used in ICT4D can be grouped into three streams [9]: Theories about Technology Adoption; Social Processes of ICT4D; and Development. Avgerou[10] also has similar categorisations though with different naming: Technology-Transfer; Social Embeddedness; and Transformative ICT4D. As the field has kept on evolving, some theories have become less relevant and others became so well integrated [11]–[13].

Capability Approach (CA), developed by Amartya Sen, has since emerged as the holistic lenses through which development can be theorised in ICT4D. This is because of its conceptualisation of development not as resource-based, income-based or utility-based, but as expanding people's real opportunities and freedoms to pursue livings (beings and doings) that they have reason to value. Despite the potential that CA has towards theorising ICT4D, it has been criticised as being under-theorised [14]. Sen's deliberate refusal to 'fill in all of the blanks' has led to calls for operationalisation of the CA [15]–[17]. CA has

been used in many ICT4D evaluations as a normative and analytical framework [18]–[23]. However, one challenge is that, there is still no consensus in these frameworks on how ‘technology’ relates to the core concepts of the basic CA (inputs or ‘resources’, capabilities, conversion factors, functionings, structural constraints and agency) [24, p. 99].

## II. OBJECTIVE

The goal of this study was to explore how CA-based frameworks have been used in ICT4D. We aimed to find ways in which the ICT artefact has been conceptualised in the different frameworks, in relation to the core concepts of CA (resources, capabilities, conversion factors, functionings, structural constraints and agency).

## III. METHODOLOGY

For this paper, an exploratory study and analysis was conducted on CA and its evaluative frameworks for ICTs. In a bid to get up to date information about academic research in ICT4D: the current state; the research gaps; and where more research is needed [25], the study explored a number of literature reviews regarding the contribution of ICTs for development in developing countries. A number of scholars have conducted literature reviews (systematic, narrative and meta-analytical), with varying levels of study quality, risk of bias, quality of evidence and timeframes under study[3], [26]–[36].

The study drew heavily from the systematic review of reviews by Lwoga and Sangeda[37]. They had explicitly stated their data sources and research strategy, screening, assessment of study quality, risk of bias, quality of evidence, data extraction procedures and data analysis. The study also went deeper into other reviews that had been excluded due to quality issues, to get a holistic picture of the status of the ICT4D field.

An analysis how CA was combined with other theories to come up with the frameworks was also conducted. The aim was to make recommendations towards the development of a framework that holistically places the ICT artefact in a CA evaluation, which ICT researchers, practitioners and policy-makers find familiar and accessible. One that better communicates the findings of an evaluative exercise. Empirical data was not collected and analysed.

## IV. RESULTS

### 4.1 Capability Approach

The Capability Approach (CA) is a normative (partial) theoretical framework for the evaluation and assessment of individual well-being and social arrangements; the design of policies; and proposals about social change in society. “The Capability Approach purports that freedom to achieve wellbeing is a matter of what people are able to do and to be, and thus the kind of life they are effectively able to lead”. [16, p. 24]

CA has six core concepts (resources, conversion factors, structural constraints, capability set, agency and functionings). In CA, the term ‘resources’ is interpreted in a broader sense than the understanding of the term elsewhere in the Social Sciences. The focus is on material resources: either income and wealth or the consumption that these financial means (or unpaid production) generate. The resources and consumption are conceptualised as capability inputs. They are the means to the opportunities to be the person one wants to be, and to do what one has reason to value doing [16].

Conversion factors either filter, amplify or modify the input characteristics. They determine the degree to which a person can transform a resource into a functioning. All conversion factors influence (enable or inhibit) how a person can be or is free to convert the characteristics of the resource into a functioning, yet the sources of these factors may differ.

Conversion factors are often categorised into three groups: personal; social; and environmental conversion factors [38, p. 68], [39, p. 99]. The example of a bicycle is often used to illustrate the idea of different conversion factors.

Structural constraints (in Sen’s terminology) can have a great influence on the conversion factors as well as on the capability sets directly. There is a difference between social conversion factors and structural constraints. While structural constraints affect a person’s set of conversion factors including the social conversion factors that s/he faces, conversion factors only help to convert characteristics of resources into capabilities. Structural constraints affect conversion factors but can also affect a person’s capability set without impacting on the conversion of resources into capabilities [16].

Capability refers to a person’s or group’s freedom to promote or achieve valuable functionings. Sen [40, p. 40] posits that capability “represents various combinations of functionings (beings and doings) that the person can achieve. Capability is, thus, a set of vectors of functionings,

reflecting the person’s freedom to lead one type of life or another... to choose from possible livings”.

Capabilities are not automatically converted into functionings. An individual has to choose to act on one or more of the vectors in the capability set in order for achievement. The capability set is in a space of ‘freedom to achieve’ where an individual can make a choice from a variety of capabilities. Upon choosing a capability from the set, the individual achieves the corresponding functioning.

Sen defines an agent as “someone who acts and brings about change, and whose achievements can be judged in terms of her own values and objectives, whether or not we assess them in terms of some external criteria as well” [41, p. 19].

Sen [41, p. 75] defines functionings as “the various things a person may value doing or being”. Functionings are the valuable states (beings) and activities (doings) that make up people’s well-being, such as a healthy body; being safe; being calm; working; resting; having a warm friendship; being nourished; being confident; being able to travel or taking part in political decisions. Functionings are related to resources (goods and income), but they focus on what a person is able to do or be as a result. When a person’s basic need for food (a commodity) is met, they enjoy a functioning of being well-nourished.[42]

#### 4.1.1. Sustainable Livelihoods Framework

The Sustainable Livelihoods Approach (SLA) has a framework, the Sustainable Livelihoods Framework (SLF), which attempts to explore the process the poor go through in their quest to come up with strategies for achieving

livelihood outcomes. Upon close observation of the SLF, it becomes apparent that it has some conceptual parallels with the CA. This is because the requirement for community participation ensures the choices made will incorporate the value of the community, which CA also recommends. Further, the “capitals” of SLF mirror the means (resources) which CA anticipates. For CA, conversion factors facilitate or constrain the conversion of the means to valued capabilities. However, neither conversion factors nor their equivalent are present in SLF.

As for SLF, there are structures and processes that influence people and affect the access to the capitals. These structures and processes can affect whether the people will be able to utilise the capitals to come up with the strategies needed for sustainable livelihoods. The structures include levels of government and private sector, while the processes anticipated include laws, culture, policies, and institutions. It would seem like the influence of these structures and processes could have some parallels to the way conversion factors of CA affect conversion. One limitation of the SLF though, is the fact that the capitals are limited and the development outcomes are pre-determined and not left to the individual to determine. This is a departure from Sen’s CA [15]. Whereas SLF brings out the place of people utilising their resource portfolio (livelihood assets) in their vulnerability context, to come up with livelihood strategies, and the importance of the transforming structures and processes in resource access and accumulation, it does not explicitly bring out agency freedom which is part and parcel of the CA. Figure 1 illustrates the SLF.

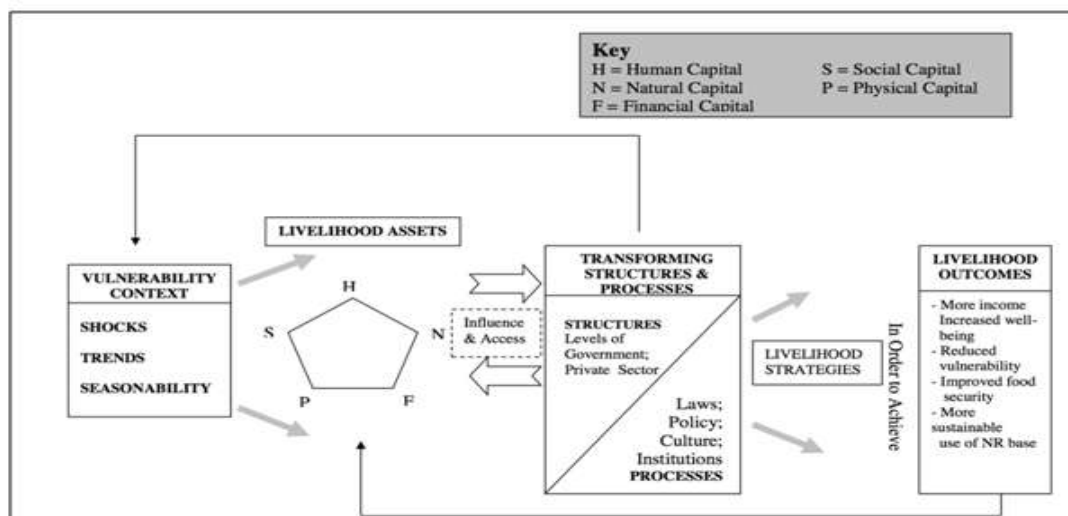


Figure 1: Sustainable Livelihood Framework  
 (Source: Adopted from DFID (1999))

#### 4.1.2. Capability Approach Framework

Hatakka & De' [19] are driven by the methodological difficulty in operationalising Sen's Capability Approach [23], and the absence of technology in Sen's writings, then. They aim to develop a framework to be used for evaluation of ICT4D projects by including technology in CA, thereby operationalising the evaluation process. They base their operationalisation on Sen's writings and on operationalisations of the framework by other researchers outside ICT4D, for example Robeyns[39], Alkire[42], [43], Alsop & Heinsohn[44] and Frediani[45]. They also draw from operationalisations of the CA framework in ICT4D by researchers such as Gigler[46], Kleine[21], Madon[47], Madon et al. [48], Zheng [17] and Zheng & Walsham [23].

Hatakka and De' [19] report that their operationalisation has similarities and differences with earlier operationalisations, however, they fall short of pointing out and enumerating those similarities and differences. They then proceed to establish their focus as concentrating between potential and achieved functionings and also the importance of 'context'. They additionally focus on the role of technology in Capability Approach Framework (CAF).

They explicitly conceptualise technology as a commodity. In line with Sen's [41] logic of viewing income not as an end in itself, but as a means to development, the authors adopt the same logic to see technology as a means to achieve freedom. They further argue that it is not the technology in itself that is enabling, but it is the features within the technology and the use of the features that is enabling. In the analysis of the impact of say mobile phones for development, they argue that the focus should not be on the technology but should be on what it enables, and how the different uses of its features have given people the freedom to livings that they value.

Hatakka and De' [19] bundle the intervention as both the technology (artefact and features) and supportive functions (for example, training and support). They conceptualise the combined elements of the intervention as a commodity within the CAF. They argue against an analysis that focusses only on technology, terming it as erroneous in most cases. They propose the inclusion into the analysis, non-technological

functions which support the introduction of technological artefacts and application. An example of supportive functions for computers with educational applications (a means to development), could be training or improving the infrastructure. However, the placement of the supportive functions as a commodity in the framework is inconsistent with this study's reading of Sen's writings on CA. The supportive functions are playing a facilitative role in transforming the artefacts and their features into capabilities. Therefore, this study argues that the supportive functions should be placed within the conversion factors.

Hatakka and De' [19] use the terms context and conversion factors almost synonymously. They claim that "conversion factors will influence both the enablement of potential functioning and the ability of people to utilise the potential functioning, that is, their ability to make choices." They also claim that "an intervention can enable a potential functioning but conversion factors may hinder the choices of the people to utilise it." Their claim on conversion factors influencing people's choices is also inconsistent with this study's reading of Sen's writings on conversion factors.

They validate their framework by applying it to "Bangladesh Virtual Classroom", an interactive distance education using mobile phones and TV. Their framework helps to capture the use of an ICT intervention based on context and the user's appropriation of the system. Using a bottom-up approach, the framework captures the functionings that the system actually enabled and not how the outcome of the intervention maps back against intended consequences.

Hatakka and De' [19] give a comprehensive description of the ICT4D intervention and how the methodology and software for the interaction in the virtual classroom were developed. They subsequently describe how the software (ICT intervention) was re-developed including the aims of the project. However, in line with CA which looks at development from an individual, the authors fall short in providing the methodology and research design which they used, to elicit the capability sets for their case. Figure 2 shows the Capability Approach Framework by Hatakka and De' [19].

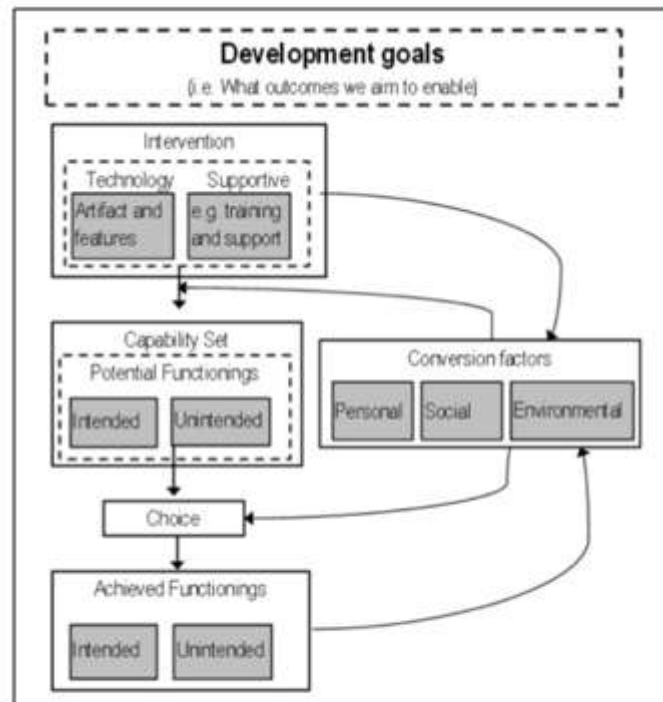


Figure 2: The Capability Approach Framework  
 (Source: Hatakka & De' (2011))

#### 4.1.3. ICT4D Evaluation Model

Kivunike et al. [20] propose an ICT4D evaluation model adapted from Robeyns[39]. They aim to contribute to literature in ICT4D evaluation, by proposing a model that enables systematic evaluation of the ICT contribution to development, using an indicator-based approach. They hope that the developed model streamlines data collection and analysis process.

Conceptually, they are guided by ICT4D value chain model, adopted from Heeks and Molla[49], to focus the evaluation in terms of the ICT4D implementation cycle. They then apply CA, to facilitate the definition and understanding of what development is and how it is realised.

They argue for the need to first perform a process analysis from capabilities to achieved functionings. They then proceed to argue for explicit establishment of the conversion factors that affect people's choices. They evaluate ICT contribution to development in relation to the value chain concepts of outputs, outcomes and impacts. Their underlying assumption is that exploiting (choosing to use) available opportunities (outputs) will to a great extent contribute to the development achievements (outcomes). The evaluation can be performed for the contribution the output makes; and the outcome where applicable; which is a

process evaluation of how an initiative has contributed to development.

The constructs of their proposed model include ICT characteristics, conversion factors, opportunities (capabilities), and achievements (choice, personal or community goals, and achieved functionings). Using double pointing arrows between outputs and outcomes, Kivunike et al. [20] show the ability that the achievement of certain functionings enable other opportunities, for example, sensitisation on the benefits of using the internet, empowers individuals to make wise decisions on how to use it.

Based on their earlier studies [50], [51], they use three of the five instrumental freedoms that Sen [41] proposes to enhance people's capabilities namely: social opportunities, economic facilities and political freedoms. They propose a fourth dimension (psychological wellbeing) because it evaluates the substantive freedoms such as choice and self-esteem. They then go ahead to elaborate corresponding achievements (outcomes) and opportunities (outputs) of these dimensions. For example, improved income (and income generation opportunities) is among the achievements (outcomes) that are linked to the dimension of economic opportunities. Similarly, improved access to formal or non-formal education

is an outcome that is linked to the dimension of social opportunities (education and healthcare). Personal and psychological wellbeing dimension is linked to improvement in family relationships and social ties as well as entertainment and fun.

ICTs are mentioned in the model; however, they still remain black boxed. Kivunike et al. [20] place ICT characteristics as resources within the core concepts of CA. They look at the specific characteristics of the ICT and not the ICT in general. It is the different ICT characteristics that a resource enables, which provide opportunities within the constraints of personal, social and environmental factors. Though not explicitly stated, they imply placement of elements of ICTs within conversion factors. Not as a standalone factor, but as a component within the environmental factors. In their operational definitions of environmental factors [20, p. 15], they include internet connection and access time on PC as environmental factors. However, this is inconsistent with Sen's writings on conversion factors which equate environmental factors with physical and built environment in close relation with geographical location.

There is some difference between conversion factors and structural constraints. Structural constraints have a great influence on the conversion factors as well as on the capabilities directly. Conversion factors on the other hand, only influence the transformation of a resource into capabilities (the space of opportunities). The omission of structural constraints in their model makes it miss some explanatory power in the analysis of the transformation from resources to functionings.

Kivunike et al. [20] add the use of indicators into the evaluation of the ICT contribution to development. In this way, they explicitly consider the instrumental and substantive ICT benefits, as well as the context in which the benefits should be obtained. They also stress the need to evaluate psychological wellbeing alongside the other dimensions because this is both a means and an end in ensuring development. They identify that their model does not explicitly address unintended or negative benefits that are prevalent in any development initiative. Figure 3 shows the proposed ICT4D evaluation model by Kivunike et al. [20], adapted from Robeyns[39].

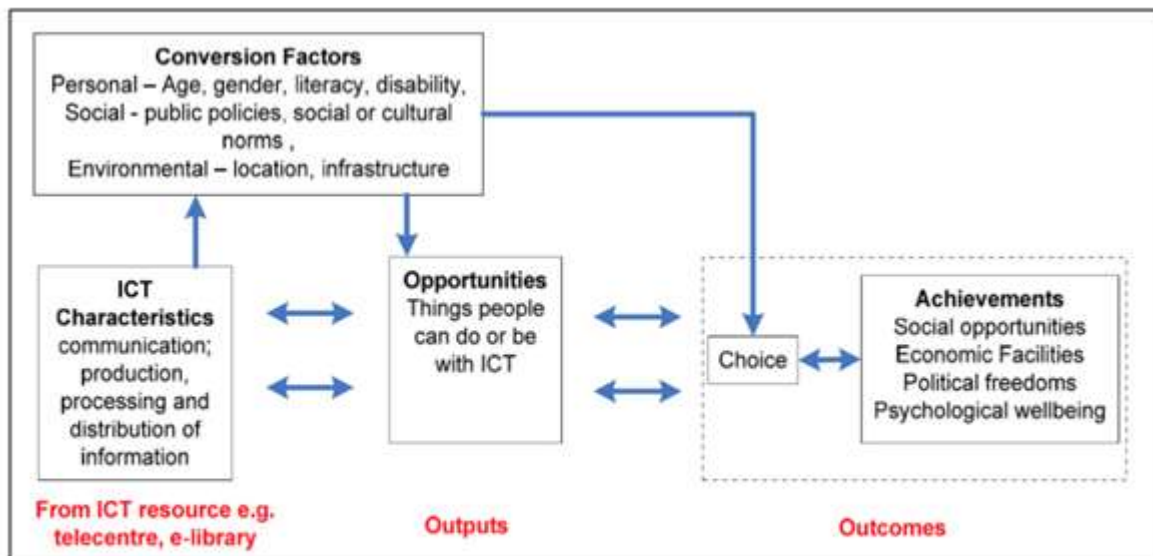


Figure 3: Proposed ICT4D Model Adapted from Robeyns[39]  
 (Source: Kivunike et al. [20, p. 5])

#### 4.1.4. A Framework Using Institutional Analysis and the Capability Approach in ICT4D

Bass et al. [52] offer a first attempt to link Institutional Theory and CA, in the context of ICT4D. They incorporate the complementary strengths of the two approaches. They use Institutional Theory to understand the social drivers that may either enable individuals or inhibit them,

from taking advantage of ICT resources for the furtherance of their own lives. These drivers could be overlooked if any of the theories is used in isolation. They demonstrate the utility of their framework using an empirical case study involving ICT use in Ethiopian higher education.

Their framework identifies how capabilities can lead to institutional change. They

use CA to enable analysis that expands the definition of development goals. They anchor their operationalisation on Robeyns' [39] stylised static representation of the CA. They are interested in the social context which they argue, can be analysed using Institutional Theory. It is the social context which influences an individual's ability to create capabilities (freedom to achieve) from commodities (production, transactions, goods and services).

Bass et al. [52] further acknowledge that social influences affect choices and how to deploy capabilities to create functionings (actual achievement). This is rightly so, based on this study's reading of CA's terminologies. They attempt to fill the gap of linking the role of IT artefacts in institutional change process towards alignment with specific capabilities in the Global South.

In the diagrammatic representation of their novel analytical framework, they use bidirectional arrows to represent influences among ICTs, the CA and Institutional Theory. They use the influences as metaphors to explore the complex interrelationships and influences [53]. They term the positive influences as "exciters" and the negative influences as "inhibitors". They further demonstrate with examples both exciters and inhibitors in each of the three dimensions: Dimension A - institutions and capabilities; Dimension B - capabilities and ICTs; and Dimension C - institutions and ICTs. The dashed lines in their diagrammatic representation of their framework shows the relationships between elements of the framework and the overall goal of ICT4D.

This study is interested in Bass et al.'s [52] conceptualisations of ICTs in two of their dimensions (Dimension B: capabilities and ICTs; and Dimension C: institutions and ICTs). Under dimension B of their framework, they conceptualise ICTs as an exciter for capabilities. This study's translation of this conceptualisation

into CA's terminologies places it within commodities (means to achieve). They also argue that "establishment of local area network access to server-based storage requires specialised skills" [52, p. 24]. They further give an example of how complex ICTs that lack user-friendly features and rely on technical jargon undermine the capabilities of user groups. Lack of awareness of the benefits of ICTs excludes individuals or communities from opportunities to enhance capabilities. These are elements to do with the personal conversion factors of the individual users of the ICTs (educational resources, informational resources or psychological resources).

By looking at the link between CA and ICTs (Dimension B) as a black box, the analysis misses out on the actual relationships and mechanisms between the different elements in CA. The conceptualisation of ICTs as an exciter to institutions also translates to the use of ICTs as a commodity (means to achieve) in CA's terminologies. Bass et al. [52] give examples of ICTs use in increasing transparency through provision of information about service provision.

Bass et al. [52] used a case study approach and conducted interviews with 27 respondents from four universities and one NGO in Ethiopia. They also supplemented the data with information from documents and field notes. They adequately report their methods, data collection strategy, analysis and findings.

Their analytical framework successfully demonstrates exciters and inhibitors in each dimension of the framework. The framework has potential to successfully analyse ICT4D interventions geared towards institutions. However, it misses out on the nuances in ICT4D interventions targeting individuals and households. It black boxes the interactions within CA. Figure 4 illustrates the framework linking Institutional Theory, CA and ICT.

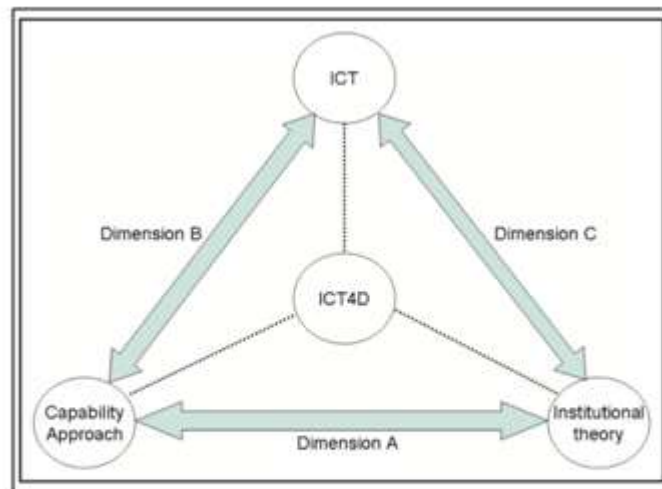


Figure 4: Institutional Theory, Capability Approach and ICT  
 (Source: Bass et al. (2013, p. 23))

#### 4.1.5. Choice Framework

With the difficulty in identifying the specific contribution of the use of ICTs to specific development goals, Kleine[21] argues that ICT4D should be used as an example of development process which has to be analysed in a systematic way. While agreeing that CA offers a more holistic view of development, Kleine[21] appreciates the difficulty in finding a balance between CA's

conceptual richness and its potential to be operationalised.

Informed by an in-depth research project with micro entrepreneurs' use of ICTs in Chile [21], [22], she draws elements from literature on Empowerment [44] and on Sustainable Livelihoods [54], to enhance the application of Sen's approach, by developing Choice Framework (CF). Figure 5 shows the CF.

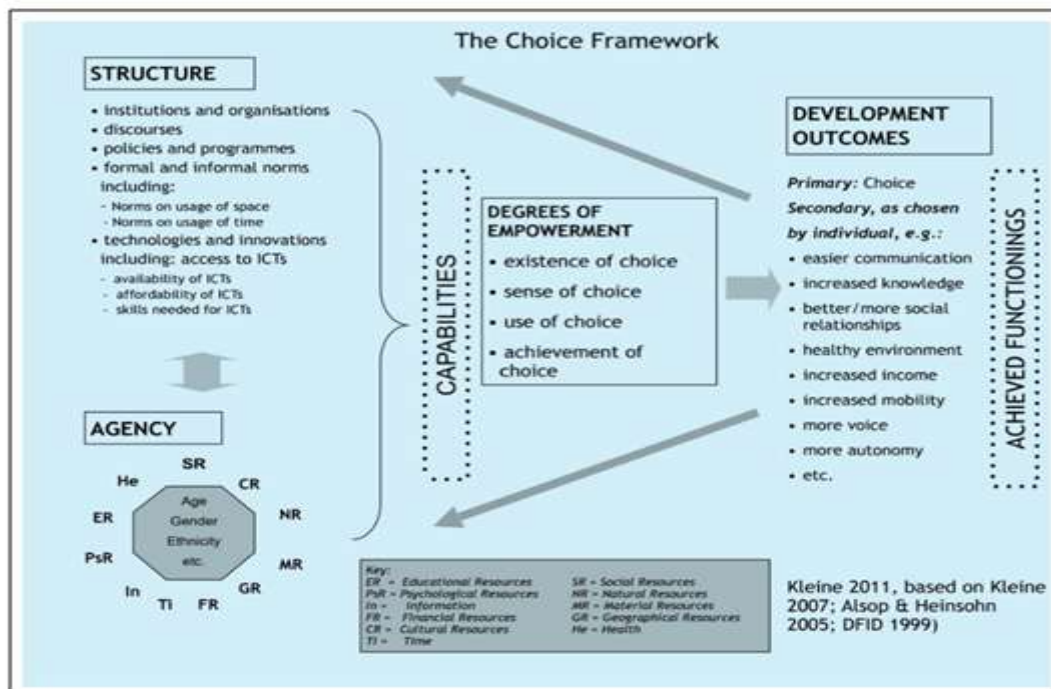


Figure 5: Choice Framework  
 (Source: Kleine[22, p. 122] Based on Alsop & Heinsohn[44]; DFID [54])



The CF does not measure capabilities directly. The outcome component will measure the achieved functionings resulting from an individual's choices as a proxy to the capabilities. The CF is read from right to left. Analysis starting from outcomes, then working backwards into the systematic relationships between agency, structure and choice, thereby analysing how the outcomes came to be. CF places choice as the primary development outcome, while other secondary outcomes depend on the individual's choice as to what livings they value. The CF also has dimensions of choice, including: existence of choice; sense of choice; use of choice and achievement of choice.

Kleine[21] uses the CA terminology of resources as opposed to capitals and assets or capital portfolios, as used in SLF. She interprets development as individual agency-based capability inputs which, together with structure-based capability inputs, can be converted into capabilities.

CF [21] lists and defines 10 types of resources: material; financial; natural; geographical; psychological; cultural; social and educational (education and skills) resources; health; and information. She later added time as another resource [22]. CF also includes elements of structure which frame people's lives: institutions and organisations; discourses; policies and programmes; formal and informal laws; technologies and innovations, including availability, affordability and necessary skills for ICTs. These components form the context in which human development occurs.

In the initial depiction of the CF [21], there are inconsistencies with the terminologies of CA. Capabilities and conversion factors are not explicitly included but implied. In the newer version [22], capabilities are explicitly added, however, the conversion factors and their relation to structure elements are only implied and remain black boxed. The combining of agency and structural resources as capability inputs, while omitting an explicit placement of conversion factors, CF neglects some analytical interpretations of the interactions especially for an ICT artefact that can be conceptualised in different ways. By missing out on conversion factors, CF lacks the details on how the conversion takes place from material properties of an ICT artefact to a capability.

Within CF, agency is placed before capabilities. It is conceptualised as agency-based capability inputs. In relation to agency, Sen defines an agent as "someone who acts and brings about

change, and whose achievements can be judged in terms of her own values and objectives, whether or not we assess them in terms of some external criteria as well" [41, p. 19]. This study however argues that agency should be placed between capabilities and functionings because it entails the action of selecting one vector of freedom from the capability set.

The ICT artefact still remains black boxed in the CF. ICTs are mentioned within structure as technologies and innovations including access to ICTs, it is also conceptualised as information among the agency-based resources.

This study argues for a re-configuration of the CF's elements, so that they can be consistent with CA's terminologies, in order to expand the analytical usefulness by not missing out on some interactions.

Methodologically, Kleine[21, p. 113] prescribes that a focus on the individual's own development outcomes means that the research needs to start from these wished for outcomes, measure the degree to which they have been attained and work systematically backwards through structure, agency and choice to understand how these outcomes have come about.

#### 4.1.6. Technology-Augmented Capability Approach

Driven by lack of a harmonised underlying notion of how technology should be conceptualised in CA, Haenssger & Ariana [24] aim to provide a justification for the explicit inclusion of technology in CA. They use the term technology to include any form of technology of which ICTs are a subset. They endeavour to review the prevailing notions of technology in the CA literature and try to reconcile the various perspectives present, drawing on the disciplines of cultural anthropology and sociology.

They argue that technical objects have '**generative dimensions**' that qualify them to be inputs just like other objects in CA. They further argue that technical objects also have a '**transformative dimension**' through which other inputs are influenced in the attainment of valued capabilities. In such a conceptualisation, the technical objects behave like other conversion factors.

Since the technical objects acquire their transformative properties from the broader social-technological context, Haenssger & Ariana [24] propose a new class of conversion factors, in addition to the traditional conversion factors like individual, social and environmental factors. Within their conceptualisation, the technological

context, and by extension, the technical objects interact with the conversion factors, introducing additional interpersonal and intergroup variations in the conversion of inputs into valued capabilities.

They acknowledge that they are not trying to add another operationalisation of CA framework, but instead they aim to harmonise existing

approaches through a discussion of the notions of technology at a fundamental and abstract level, within the language of CA. They however go ahead and diagrammatically depict their conceptualisation of the technology-augmented capability approach. Figure 6 shows this depiction.

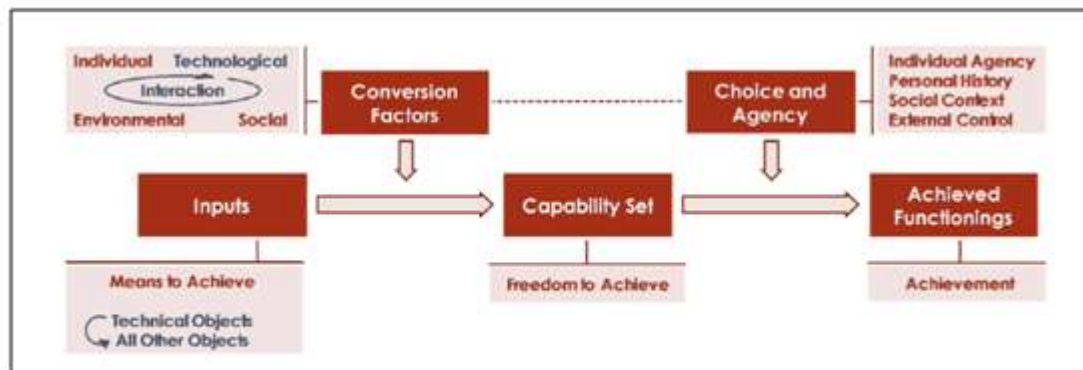


Figure 6: A Technology-Augmented Capability Approach  
 (Source: Haenssge & Ariana [24, p. 104])

Haenssge & Ariana [24] reconcile the different perspectives of technology presented in previous studies [17], [49], [55]–[59]. They explicitly place technical objects as inputs and technological conversion factors because they can have characteristics required for attaining valued capabilities and at the same time, possess transformative abilities of modifying the characteristics of other inputs in the same way that conversion factors do. Figure 6 illustrates the Technology-Augmented Capability Approach by Haenssge and Ariana.

Haenssge & Ariana [24, p. 105] contend that “the technological environment defines technical objects (and the structures that shape their use) and comprises the complete set of technological knowledge in a society”. They however fall short of explicitly placing the technological object as a component of the context in their conceptualisation. Such an analysis may neglect important interactions of how the technological object as a contextual element affect other constructs such as how it influences other conversion factors or choice and agency.

They demonstrate the utility of their framework in a qualitative case study where they analyse the use of mobile phones in healthcare in rural India and China. They use data collected from interviews and focus group discussions with 89 villagers and interviews with 53 health and communication experts.

## V. DISCUSSION

Within the Sustainable Livelihoods Framework, conversion factors are missing. Additionally, the capitals/ resources are limited to only five and the development outcomes are pre-determined and not left to the individual to determine. This is a departure from Sen’s CA which gives freedom to the individual to choose and pursue doings and beings that they value and have reason to value.

The Capability Approach Framework by Hatakka & De’ [19], bundles together the technology (artefact and features) and supportive functions (training and support), into a construct they term as ‘intervention’. The intervention is conceptualised as a commodity in Sen’s terminology. However, their placement of the supportive functions within a commodity is inconsistent with this study’s reading of Sen’s writings on CA. The supportive functions are playing a facilitative role in their framework, by transforming the artefacts and their features into the space of capabilities. The supportive functions should therefore be in the space of conversion factors. This misplacement presents a gap.

Hatakka and De’ [19] use the terms context and conversion factors almost synonymously. They claim that “conversion factors will influence both the enablement of potential functioning and the ability of people to utilise the

potential functioning, that is, their ability to make choices.” They also claim that “an intervention can enable a potential functioning but conversion factors may hinder the choices of the people to utilise it.” Their claim on conversion factors influencing people’s choices is also inconsistent with this study’s reading of Sen’s writings on conversion factors, since it is the structural constraints that influence choice formation. Conversion factors either filter, amplify or modify the input characteristics of material resources in their transformation into functionings. Therefore, these inconsistent conceptualisations present a further research gap in literature.

Kivunike et al. [20] omit structural constraints in their ICT4D Evaluation Model. There is some difference between conversion factors and structural constraints. Structural constraints have a great influence on the conversion factors as well as on the capabilities directly. Conversion factors on the other hand, only influence the transformation of a resource into capabilities (the space of opportunities). The omission of structural constraints in their model makes it miss some explanatory power in the analysis of the transformation from resources to functionings.

Though not explicitly stated, Kivunike et al. [20] imply placement of elements of ICTs within conversion factors. Not as a standalone factor, but as a component within the environmental factors. In their operational definitions of environmental factors [20, p. 15], they include internet connection and access time on PC as environmental factors. However, this is inconsistent with Sen’s writings on conversion factors which equate environmental factors with physical and built environment in close relation with geographical location.

Bass et al. [52] developed a framework using Institutional Analysis and the Capability Approach in ICT4D. By looking at the link between CA and ICTs (Dimension B in their framework) as a black box, their analysis misses out on the actual relationships and mechanisms between the different concepts in CA. The framework has the potential to successfully analyse ICT4D interventions geared towards institutions. However, it misses out on the nuances of ICT4D interventions targeting individuals and households. It also black boxes the interactions between the different concepts within CA.

Dorothea Kleine [21], [22] developed the Choice Framework. It is arguably the most used operationalisation of CA in ICT4D [12], [60]. In the initial depiction of the CF [21], there are

inconsistencies with the terminologies of CA. Capabilities and conversion factors are not explicitly included but implied. In the newer version [22], capabilities are explicitly added, however, the conversion factors and their relation to structure elements are only implied and remain black boxed. The combining of agency and structural resources as capability inputs, while omitting an explicit placement of conversion factors, CF neglects some analytical interpretations of the interactions especially for an ICT artefact that can be conceptualised in different ways. By missing out on conversion factors, CF lacks the details on how the conversion takes place from material properties of an ICT artefact to the space of capabilities.

Within CF, agency is placed as a precursor for capabilities. It is conceptualised as agency-based capability inputs. In relation to agency, Sen defines an agent as “someone who acts and brings about change, and whose achievements can be judged in terms of her own values and objectives, whether or not we assess them in terms of some external criteria as well” [41, p. 19]. This study however argues that agency should be placed between capabilities and functionings because it entails the action of choosing one vector of freedom from the capability set.

The ICT artefact still remains black boxed in the CF. ICTs are mentioned within structure as technologies and innovations including access to ICTs. ICTs are also conceptualised as information among the agency-based resources.

In the Technology-Augmented Capability Approach, Haenssger & Ariana [24] fail to explicitly place the technological object as a component of the context in their conceptualisation. They only contend that “the technological environment defines technical objects (and the structures that shape their use) and comprises the complete set of technological knowledge in a society” [24, p. 105]. Such an analysis may neglect important interactions of how the technological object as a contextual element affect other constructs such as how it influences other conversion factors or choice and agency.

## VI. CONCLUSION

From the results and discussion sections, research gaps have been identified on the six CA-based ICT4D frameworks. The gaps need to be addressed so as to make the frameworks to be consistent with this study’s reading of Sen’s terminologies. We recommend the development of a framework that holistically conceptualises the ICT artefact in CA. This will be beneficial to

ICT4D researchers, practitioners and policy-makers. It will help them to empirically analyse the contribution of existing ICT-enabled interventions towards development outcomes. The providers of the ICT artefacts will consider how the artefact plays out in the development journey of their customers. This could enable them to put in place mechanisms that will enhance the related resources to help achieve the valued development outcomes. The framework could be helpful in formulating policies that will ensure implementation of ICT innovations which will expand people's capabilities.

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