



**HAL**  
open science

## CIPPUA: Towards Coherence and Impact in ICT4D/IS

A. Kayode Adesemowo

► **To cite this version:**

A. Kayode Adesemowo. CIPPUA: Towards Coherence and Impact in ICT4D/IS. International Working Conference on Transfer and Diffusion of IT (TDIT), Dec 2020, Tiruchirappalli, India. pp.329-340, 10.1007/978-3-030-64849-7\_30 . hal-03701781

**HAL Id: hal-03701781**

**<https://inria.hal.science/hal-03701781>**

Submitted on 22 Jun 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# CIPPUA: Towards coherence and impact in ICT4D/IS

A. Kayode Adesemowo<sup>1</sup> [0000-0003-1217-1651]

<sup>1</sup> Nelson Mandela University, Port Elizabeth, South Africa

kadesemowo@soams.co.za | kayode@mandela.ac.za

**Abstract.** Nonetheless, the many developments occasioned by and through information and communication technology (ICT), the plethora of debates on what ‘development’ means persist. Researchers, practitioners, policy makers and stakeholders of ICTs for Development (ICT4D) have a good understanding of ICT4D, yet their views differ when it comes to the ‘development’. The ICT (as an entity), do not get interrogated well enough as a research reality or phenomenon in itself. Differing opinions persist. Without a common understanding, diffusion and adoption of ICT4D will continue fragmented. In continuing the conversation, one area to reimagine is the ICT and digital technologies in ICT4D or information systems. This paper revisits Walsham’s (“ICT4D research: reflections on history and future agenda”) 2017 paper, as a backdrop to elucidate the emancipatory ethos of critical realism and introduce the conceptual CIPPUA model. Through explanatory stratified ontological review of the position, nature and identity of digital technologies/objects, this paper contributes to the ongoing discourse on critical realism in digital development, especially the connection of ICT to development. More so, this paper with the conceptual CIPPUA model, contributes in part to the discourse of operationalizing critical realism in practice.

**Keywords:** coherence; critical realism; emancipatory; digital objects; development, CIPPUA.

## 1 Introduction

The debate of ‘development’ has been well discussed and yet on-going. It is one that keeps diverging at every converging state [1]. In essence, researchers, practitioners, policy makers and stakeholders of Information Systems (IS) and ICT for Development (ICT4D) have a good understanding of ICT4D (or ICTD, subject to the discourse on ICT4D, ICTD or digital development). Ironically, they have varying views of what ‘development’ is [2]. This follows through to common understanding of diffusion and/or adoption not only in ICT4D but also IS, such as in digital transformation [3].

Walsham [4] captures this succinctly, “[I]t may not be possible to agree on a shared definition of development but an alternative approach to coherence for the ICT4D research field, ... may be by *developing a shared conceptual framework for the ICT4D field*”. This indicate a need for further research. What might come to mind is: what further research is required? What type of shared conceptual framework is required? A need for re-interrogation of ICT and development is required, and thus *the potential for*

*enhanced research impact* [4]. A need for common understanding to better appreciate the impact of ICT4D. As a starter, a year on after Walsham's paper, Thapa and Omland [2], outlined three key problems:

- Development outcomes struggle to provide clear attribution of the role played by ICTs in those outcomes;
- Contribution of ICT does not explain the connection of ICT to development;
- Connection between ICTs and development pitched only at the level of juxtaposition rather than causal link;

These contestations resonate with the notion of 'development' in itself [1], as a contested idea with diverse views of what development was, what development is, and what development should be. Whilst De' et al., stated that "[T]he controversies and debates regarding a normative view of development, however, did not deter ICT4D researchers to broadly conclude that ICTs indeed contributed to development", ICT4D researchers and practitioners remain divided on 'ICT' and 'development'. This carries through to the "digital development" paradigm where ICTs are no longer just tools to enable particular aspects of development, but the platform that mediates development [5], just as digital technologies transforms organizations in digital transformation [3].

Part of the challenge of making correlations between 'ICT' and 'D' (Development), it would seem, is grasping the depth and linkage of the nature of ICT (technology) to the sociotechnical nature of ICT4D and IS research [2, 6]. Artefact in design science [6, 7], and objects in activity theory [8, 9], have been used to draw inference, reference and causal relationship. Yet, the underlying questions of how and why ICTs lead to development, remained largely unanswered. Therefore, they are matters requiring further inquiry. Even more so, as Mungai [6] raised a concern about the specific role of technology in mechanisms: the issue that "ICT-based cases involve social and technical entities, which creates the need to identify the elements of socio-technical mechanisms and how such mechanisms interact".

The question is; how are we going to approach the notion of ICT as a (research) reality towards a shared conceptual framework for the ICT4D and IS field? Possibly, through critical realism with its philosophical and ontological nature [1, 2, 10–12]. It is in this regard and context that this paper revisits the nature of digital objects/digital technologies and emancipatory ethos of critical realism as essential fabric towards shared conceptual framework for the 'development' in ICT4D. In this paper, IT, ICT, technology, technological objects, digital technologies and digital objects are used loosely, and where needed, emphasis or distinction are made.

## **1.1 Structure of the paper**

The introduction provides the background to the 'ICT' reality in ICT4D as a building block towards shared conceptual framework for 'development' in ICT4D and IS, introduces the author's view of ICT4D as a precursor to the research approach. Thereafter the paper presents an approach to evaluating critical realism (CR) components and concludes with a way forward.

## 2 Research domain

### 2.1 View on ICT4D

Walsham [4], in his paper “ICT4D research: reflections on history and future agenda” reflected on where we were coming from and possible direction for future engagement in ICT4D. Typical of Walsham philosophical positioning [13], he outlined coherence challenges [4]. At the root of this is the diverging view of what ‘development’ and ‘ICT’ means for practitioners and stakeholders within ICT4D and IS.

It is on this premise that these questions come to mind, namely:

1. How do we view the ‘by’, ‘through’, ‘with’, and ‘of’ ICT ‘for’ development within ICT4D? Put simply, how do we view the ‘ICT’ in/of ICT4D/IS?
2. How do we view and interact with the nature of ICT as digital objects?
3. How do we approach ICT4D geared for micro level and yet (might) have macro or global impact/influence due to the global village nature of the world we live in?

Invariably, must we only look at ICT4D at community, or national or international level before it can be deemed to be ICT4D or can the approaches and principles of ICT4D be applied to projects ‘narrow’ in scope [4]? These questions will assist in the ontological study of ‘ICT’ and ‘development’ in ICT4D. This paper narrows down to offering insight into, *in what way(s) can we achieve coherence and impact in ICT4D and IS?*

This paper’s notion of emancipatory derives from the views of Roy Bhaskar’s critical realism [14–16], as opposed to critical theory/critical realist [16]. CR’s emancipatory values and components though relating, is distinct dialectically from emancipation and emancipation action. The concept of emancipatory is in providing explanatory understanding of how structures and mechanisms interlace toward impactful change [10].

### 2.2 Basis for research and related work

The research philosophy is based on critical realism as opposed to interpretivism. In postulating a critical realism philosophy for identifying mechanisms of ICT4D, Thapa and Omland [2], also revisited Walsham’s [4] fundamental question, “to what extent are ICTs contributing to development”. Bennett, et al. [17], leveraged on critical realism to explore information technology as digital objects from the lens of hylomorphism.

Positivism and interpretivism limit ontological interrogation of ICT research realities in themselves [6, 15], and critically examine underlying structures of ICT as digital objects [18], in order to ‘bring back’ the observation and re-examination thereof. CR provide for this by its ‘retroduction’ process or steps [10, 15, 19].

CR inherently requires pluralism towards validity of insights into events and underlying mechanisms [10]. This paper plural (multi-method) approach, adapted CR’s describe, identify, ‘retroduction’ approach [2], and are as follows:

1. Exploratory scoping: Interrogation of ICT4D research reality vis-à-vis critical realism’s identify and describe [10, 20] vis-à-vis review of the paper: “ICT4D research: reflections on history and future agenda” [4]; and

- Session with author of the reviewed paper: Geoff Walsham in Cambridge;
2. Iteration: further interrogation of ICT4D reality;
    - “Critical realism and ICT4D research” [10];
  3. Explanatory/Argumentative retrodution: critical realism components [21];
    - Extracting the CIPPUA from interrogation of critical realism’s emancipatory components and technological/digital object;
    - Brief discussion of (CIPPUA) evaluation aspects [22].

The choice of Walsham’s 2017 paper is at best ‘convenience’ (in sampling parlance) and the augmenting papers follow a spider-crawl (or linking). It is impossible for a paper of this nature to fully cover the spectrum of ICT4D theories, processes and actions, nor under-labour critical realism [23, 24]. CR in ICT4D research and IS are well discussed in literature [10, 25]. Readers are referred to them. For this paper, it is imperative to state that CR unlike (direct) realism, reason-back the experiences and consideration of the ‘reality’ – in what is called ‘retrodution’ [19].

### 2.3 Research realities in ICT4D

This paper has indicated a lack of coherence in ICT4D as it relates to development. It has indicated that the ICT in ICT4D is not just an enabler of “D”, but that it is a research reality in itself. The reality is the understanding (or lack of understanding) of the nature of ‘ICT’ and alongside investigation of identity, functional and societal context. Three research realities in ICT4D are identified: ICT as digital technologies/objects (technological objects), non-coherence, and critical realism emancipatory ethos/components.

#### ICT as digital/technological objects.

Within ICT4D and IS generally, there has been much focus on the human, community, organisational, reference and mid-range theory, societal engagements and consequences of (and/or with) technological entities [2, 4, 9, 11, 26, 27] or as instruments of technical rationality [28]. However, not much has been researched into the ‘technology’ in themselves as research entities of their own [2, 17, 18, 29]. What happens is that technologies are interacted with as part of the research or development process. This neglects the view of intricacies of technologies as technological entities. What if technologies have a life of their own? *A priori*, attempts have been made to theorise technology [27, 30] and to view mechanism of technology as interacting with social space over time domain [See Archer in 31].

Bennett et al, [17] stance is that reality construct of digital technologies/objects is the starting position from ... “where we can ask how can information systems improve our lives”. Faulkner and Runde [18], Bennett et al., and Adesemowo [29] views of IT/ICT, digital technologies/objects, ensembled IT assets can be said to hold true, because as objects, they conform to structured continuants or dynamic structure. This paper therefore adopts their view as those of what ICT means. Explanatory is important

as matters (and any form of dynamic structure) can be complex [21]. Walsham [4] in highlighting the danger of disciplinary stereotyping in ICT4D research projects, pointed out a lack of understanding of the nature of ‘ICT’ and ‘development’ outside researchers’ and practitioners’ discipline. It is essential and healthy to engage in this debate of rediscovering and theorising IT/ICT [26].

### **Non-coherence.**

The other danger that Walsham highlighted is non-coherence in interdisciplinary or transdisciplinary ICT4D research (research projects). That of wanting to bring together varying disciplinary approaches under one methodological or theoretical umbrella. To borrow from physical sciences, it is like achieving coherency with multiple wavelengths in optics [32], or in artificial intelligence, having multiple overlapping nodes or computing agents acting with limited view of the overall task but cooperating coherently in distributed problem-solving [33].

Retrospectively, at the onset of coining ‘information technology’, there were many disciplines. This was perhaps lost along the line and must be revisited. This paper does not provide a bullet-proof answer. It, nonetheless, brings a fresh perspective, of adumbrating the re-interrogation of IT/ICT as technological objects or digital technologies or digital objects and engaging with ICT as such.

### **Critical realism emancipatory values/ethos and components.**

Drawing from the realities of ICT/digital technologies/objects, and non-coherence, this paper explores ‘emancipatory’ in critical realism; derives and provides for in-depth explanatory understanding of how structures and mechanisms interlace toward impactful change of ICT4D projects.

Whilst noting critical realism is emancipatory in a number of ways, the notion of emancipatory examined in this paper emanates and revolves around Bhaskar’s transformational model of social action – TMSA [16, 31]. Without delving into details, emancipatory values/ethos evolve from transformation of structures with commonality of mechanisms [16, 17], and emergent causal powers [17]. Consequentially, it follows that the impact of ICT4D and IS researches must be felt and seen in the broad development they bring, irrespective of narrow micro or broader/global macro views.

### **A view into critical realism TMSA.**

Discussing TMSA comes at the risk of underlabouring or entering the fray of debate on TMSA and Giddens’ structuration theory, or TMSA and Archer’s morphogenetic/morphostatic (M/M). In a nutshell, resolution of the antinomy of structure and agency is at the heart of TMSA with morphogenetic being an approach of development [24]. Archer herself, puts this to rest by advocating M/M as methodological complement to TMSA [21].

Integral to TMSA are the following:

- *a priori* structures [15];
- social ontology, structures and agency [15, 18, 24];

- ontological and social contexts [15];
- positioning [15];
- mediating concepts/process [15];
- structuring and re-structuring process [15];
- explanatory structure/reasoning/critique [15, 24];
- emergence, change [15, 17];
- Reproduction/transformation [15];

TMSA advocate material effectivity of the emergent properties of structures within a time and context constraint. As ICT4D and IS practitioners, we invariably work within TMSA ourselves. That being the aspects of the social and technical domain: human agency, (social) structures, and the intra and inter-relationship between them [11]. It then implies that social structures of themselves exist to be identified, reproduced and transformed. From TMSA viewpoint, we do not necessarily ‘create them’, even though we might create them as part of the TMSA social action. Loosely speaking, it is just as we use artefact or create or perceive them from our understanding [34]

Within critical realism, structures and mechanisms carry a form of domain, being the overlapping domains of the empirical, the actual, and the real [14]. It is within this interplay of domains that structures, and mechanisms emerge from: hence IT/ICT, digital technologies/objects are structured continuants or dynamic structure that can be interrogated as structures and mechanisms having technical identities and occupying social position(s) and not just artefacts or objects of use.

Thus, *conceptualisation* (of ICT4D/IS) must have a real effect on *applicability* within the (social-technical community) *positioning*. The social-technical dynamics of ICT development points toward ‘real’ domain and reality that is built on *coherence of concepts* and *understanding* [15]. They provide much needed lens to critically, ontologically interrogate coherence and impact in ICT4D and IS. They provide insights into the probing questions of ‘of’, ‘by’, ‘with’, ICT for development. The author is of the strong view that we must engage critically with the technology we are working with or ‘developing’, to ensure they are placed within the social space (as would be seen later in the section on CIPPUA). This will assist researchers working from the concept of IT artefacts, as they will be better placed to locate IT artefacts as embedded in some time, place, discourse, structure and community [27].

### **3 CIPPUA’s lens to critical realisms values and components for ICT4D impact**

Houston [35], alluded to identifying oppressive or restricting agents and then activating enabling or liberating agents. Likewise, Walsham enjoined ‘development’ in ICT4D to impact, as in address or at least reduce inequalities within society. More often than not, in calling for new ICTs-enabled models in transforming the processes and structures of development [4], corresponding calls for engaging the ICTs themselves are limited. More especially those relating to structures, conditions and other mechanisms [2]. It seems implied though! This is partly seen in how Walsham described the Ushahidi

system [4]. The call for further research into the effect of ICTs-enabled model on developments can be met through technical identity. It is by theorising and considering the nature, forms, functions, structure, mechanism and positioning of digital technologies/objects [17, 18, 26, 29]. It is through this intransitive and stratified dimension that knowledge is gained [31] towards impact, diffusion and adoption.

### 3.1 CIPPUA lens

In practical terms, how can this be enabled? In line with the critical realism’s philosophy, this paper through identification, exploratory/explanatory reasoning proposes a conscious and purposeful interrogating at the intersection of two dimensions of ‘*conceptualisation*’, ‘*ICT/IS development*’ and ‘*position*’ vis-à-vis ‘*purpose*’, ‘*usability*’ and ‘*applicability*’ (CIPPUA), as depicted in Table 1. Undoubtedly, the degree of intersection will vary from project to project and the nature of digital technologies/objects at play. For instance, *position* might only be considered for *applicability* and not necessarily *purpose* and *usability*. When digital technologies find *usability* outside of their envisaged *applicability* or *position*, they take on new technical identity, usage/purpose.

**Table 1.** CIPPUA: A conceptual view of enabling and interrogating critical realism’s emancipatory and technological objects.

	<b>Conceptualisation</b> (challenge)	<b>ICTs/IS development</b> (problem solving, enhancement, opportunity)	<b>Position</b> (Local, Society, Nation, Global)
<b>Purpose</b> (initiation)	...	...	...
<b>Usability</b> (experience, learning, skilling)	...	...	...
<b>Applicability</b> (knowledge, impact:)	...	...	...

### 3.2 Deriving the CIPPUA

Without rehashing the many ‘concepts’ that have been engaged and discussed in this paper, the CIPPUA finds its roots in demi-regularities identified in this paper. These identified nuances and demi-regularities on the nature of PhD by publication flowed from the underpinning critical realism research philosophy that this paper hinged on. The emergent generative mechanisms are ICT development, TMSA/emancipatory ethos, digital technologies/object and technical identity.

Briefly, ICT/IS development are conceptualised for development and use in and at a location (position). The usage (usability) finds applicability in the purpose for which it was intended or conceptualised. The ICT or ICT development project (or ICT4D in itself), can be seen as digital technologies/objects. Their ‘components’ can also be broken down into digital technologies/objects of their own [18]. Technical identity is



shaped not just by the view of developers, but rather by the placement and interaction of the position they are located or placed in. Knowledge is gained through these transitive dimensions and emancipatory ethos come alive in the intersection of the true applicability and purpose.

Bennett's [9], explication of events showed how *purpose*, *usability* and *applicability* of devices and learning management systems mutate across *position* and *ICT development*. Similar explication can be seen in Iannacci [36] causal linkages between legislative and IT artefacts over time in the emancipatory transformation of police–prosecutor routines. Legislative and IT artefacts work across micro and macro levels. This is the tenet of the CIPPUA model represented in Table 1. It reinforces Njihia and Merali [37], view of critical realism causally telling us with good reason from the real domain, “why things are as they are now and where they could be heading”.

### **CIPPUA scenario-play**

To conclude, three ICT4D research projects are placed ‘retrospectively’ within the proposed conceptual CIPPUA model. The scenario-based approach [22] is a foretelling of its potential use and adoption.

#### **Ushahidi.**

Whilst reviewing the Ushahidi project, Walsham [4], called for a need for some solid research as to what exactly are the effects of these ICT-enabled models. An approach would be the CIPPUA matrix. Without doubt, the Ushahidi has mutated and transformed overtime. The *position* keeps evolving, as do the *ICT development* and *applicability*, which expands the *purpose* horizon. This calls for relook of the *conceptualisation* and *usability* experience.

#### **Zenzeleni.**

Zenzeleni started out as a research test bed (in the Eastern Cape province of South Africa), to become a full-fledged, self-sustaining community network [38]. Its *purpose* and *conceptualisation* has moved from testing to practice [39]. Zenzeleni's *applicability* and *ICT development* has transformed from innovation to impact [39, 40]. Zenzeleni's intersection of *applicability* and *ICT development* has seen blending of knowledge transfer, uptake and transferring of skills with indigenous knowledge, as well as, burgeoning growth, community ownership and empowerment.

#### **ICT Network Calculator (codename LVIII).**

ICT Network is and will remain a bedrock of the fourth industrial revolution, knowledge economy and beyond. Skills shortage has been projected in ICT [41], including ICT Networking as a critical skill [42]. The *position* and *usability* of the ICT Network Calculator shifted from windows-based application within a department to web-based globally available and relevant solution [43]. The *ICT Development* has moved on to it being recognised with global award. The *applicability* is no longer just

an ICT calculator tool but becoming a virtual learning environment in use as learning scaffolding. Students are now being empowered with purposeful usage.

The three ICT4D projects appraised above, based on the author's familiarity with them, are just representative of many others for which CIPPUA model can play a role in multi-dimensional evaluation.

## 4 Conclusion

Just as in the discussion between the author and Prof Walsham, and as evidenced in this paper, the intent is not to replace the 'artefact' focus of design science in IS-based ICT4D research projects nor tools in activity theory, neither does it intent to *impose* the digital technologies/objects emancipatory components of CR. The goal is to offer alternative and contribute to coherence, impact, diffusion and adoption.

The problem of coherence in ICT4D would appear to be, not so much of lack of appropriate methodology within each discipline (encompassing ICT4D and IS) but rather reaching-over and bringing other 'ways' into each research discipline, without losing out on common understanding of and theorising on ICT. Whilst it could be argued that existing methodologies exist, we must heed to Walsham [4] warning us, shouldn't we be looking at better approach towards coherence of ICT4D goal and working together across disciplines for better impact? Grover and Lyytinen [26] were clear on the danger of overly focusing on mid-range and referential theories in information systems at the expense of understanding and theorising 'IT' that is at the core of information systems. More so, shouldn't we be taking philosophical emancipatory view, irrespective of whether the ICT4D/IS project is deemed to be micro, macro or global? In any case, by following a digital technologies/objects approach to digital development and IS, a micro can actually be global, and macro can be micro, depending on the CIPPUA views that are at play at a particular time, space and position.

A limitation of this paper overly focusing on Walsham's paper [4], has been compensated with a cursory glance at other relevant literatures: Bennett et al. [17], Faulker and Runde [11], Faulkner and Runde [18], Fletcher [12], Heeks and Wall [10], Iannacci [36], Minger et al. [31], Mungai [6], Njihia [44], Orlikowski and Iacono [27], and Pourreau [45], and Vandenberghe [16].

I close with Bhaskar's adumbration of CR as agent of emancipatory change [24]: *"If this is so, an underlabouring philosophy such as critical realism, seriously committed to the project of universal human flourishing, can aspire to be more than a nuisance, a Nietzschean gadfly on the neck of the powers that be; it can become a spark, a liberation, lifting the weight of the (Lockean) rubbish that mires us. This is philosophy as enlightened common sense and as midwife, an agent of emancipatory change."*

### Acknowledgements.

The author acknowledges Profs Geoff Walsham, Khaled Abou El-Hossein for their feedback on earlier draft of the manuscript. The invaluable feedback of the anonymous reviewers is duly acknowledged. Many thanks to Desiree dos Santos for the linguistic four eyes review.

## References.

1. De', R., Pal, A., Sethi, R., Reddy, S.K., Chitre, C.: ICT4D research: a call for a strong critical approach. *Inf. Technol. Dev.* 24, 63–94 (2018). <https://doi.org/10.1080/02681102.2017.1286284>.
2. Thapa, D., Omland, H.O.: Four steps to identify mechanisms of ICT4D: A critical realism-based methodology. *Electron. J. Inf. Syst. Dev. Ctries.* 84, e12054 (2018). <https://doi.org/10.1002/isd2.12054>.
3. Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., Jensen, T.B.: Unpacking the Difference between Digital Transformation and IT-enabled Organizational Transformation. *J. Assoc. Inf. Syst. Forthcomin.* (2020).
4. Walsham, G.: ICT4D research: reflections on history and future agenda. *Inf. Technol. Dev.* 23, 18–41 (2017). <https://doi.org/10.1080/02681102.2016.1246406>.
5. Heeks, R.: ICT4D 3.0? Part 2—The patterns of an emerging “digital-for-development” paradigm. *Electron. J. Inf. Syst. Dev. Ctries.* e12123, (2020). <https://doi.org/10.1002/isd2.12123>.
6. Mungai, P.W.: Causal mechanisms and institutionalisation of open government data in Kenya. *Electron. J. Inf. Syst. Dev. Ctries.* 84, e12056 (2018). <https://doi.org/10.1002/isd2.12056>.
7. Kuechler, W., Vaishnavi, V.: A Framework for Theory Development in Design Science Research: Multiple Perspectives. *J. Assoc. Inf. Syst.* 13, 395–423 (2012). <https://doi.org/10.17705/1jais.00300>.
8. Ladel, S., Kortenkamp, U.: Artifact-Centric Activity Theory—A Framework for the Analysis of the Design and Use of Virtual Manipulatives. In: Moyer-Packenham, P.S. (ed.) *International Perspectives on Teaching and Learning Mathematics with Virtual Manipulatives. Mathematics Education in the Digital Era.* pp. 25–40. Springer, Cham, Switzerland (2016). [https://doi.org/10.1007/978-3-319-32718-1\\_2](https://doi.org/10.1007/978-3-319-32718-1_2).
9. Bennett, L.A.: Capturing information technology use by senior secondary school students in New Zealand. In: *Proceedings of the 28th Australasian Conference on Information Systems (ACIS2017)*. AAIS: Australasian Association for Information Systems, Hobart, Australia (2017).
10. Heeks, R., Wall, P.J.: Critical realism and ICT4D research. *Electron. J. Inf. Syst. Dev. Ctries.* 84, e12051 (2018). <https://doi.org/10.1002/isd2.12051>.
11. Faulkner, P., Runde, J.: Technological Objects, Social Positions, and the Transformational Model of Social Activity. *MIS Q.* 37, 803–818 (2013).
12. Fletcher, A.J.: Applying critical realism in qualitative research: methodology meets method. *Int. J. Soc. Res. Methodol.* 20, 181–194 (2017). <https://doi.org/10.1080/13645579.2016.1144401>.
13. Walsham, G.: Interpretive case studies in IS research: Nature and method. *Eur. J. Inf. Syst.* 4, 74–81 (1995). <https://doi.org/10.1057/ejis.1995.9>.
14. Bhaskar, R.: *A Realist Theory of Science*. Routledge, Oxon, Oxford (2013).
15. Archer, M.S., Bhaskar, Roy, Collier, Andrew, Lawson, T., Norrie, A. eds: *Critical Realism: Essential Readings*. Routledge (2013). <https://doi.org/10.4324/9781315008592>.
16. Vandenberghe, F. ed: *What's Critical About Critical Realism?: Essays in Reconstructive Social Theory*. Routledge, Oxon OX14 4RN (2013). <https://doi.org/10.4324/9780203798508>.

17. Bennett, L.A., Toland, J., Howell, B., Tate, M.: Revisiting hylomorphism: What can it contribute to our understanding of information systems? In: 30th Australasian Conference on Information Systems 2019 (ACIS2019). pp. 173–179. Australasian Association for Information Systems, Fremantle, Perth, Western Australia, Australia (2019).
18. Faulkner, P., Runde, J.: Theorizing the Digital Object. *Manag. Inf. Syst. Q.* 43, 1279–1302 (2019). <https://doi.org/10.25300/MISQ/2019/13136>.
19. Saunders, M.N.K., Lewis, P., Thornhill, A.: Chapter 4: Understanding research philosophy and approaches to theory development. In: *Research Methods for Business Students*. pp. 128–170. Pearson, Harlow, England (2019).
20. Arksey, H., O'Malley, L.: Scoping studies: towards a methodological framework. *Int. J. Soc. Res. Methodol.* 8, 19–32 (2005). <https://doi.org/10.1080/1364557032000119616>.
21. Archer, M.S.: The Morphogenetic Approach; Critical Realism's Explanatory Framework Approach. In: Róna, P. and Zsolnai, L. (eds.) *Agency and Causal Explanation in Economics*. pp. 137–150. Springer, Cham (2020). [https://doi.org/10.1007/978-3-030-26114-6\\_9](https://doi.org/10.1007/978-3-030-26114-6_9).
22. Wright, G., Cairns, G., Bradfield, R.: Scenario methodology: New developments in theory and practice. *Technol. Forecast. Soc. Change.* 80, 561–565 (2013). <https://doi.org/10.1016/j.techfore.2012.11.011>.
23. Price, L., Martin, L.: Introduction to the special issue: applied critical realism in the social sciences. *J. Crit. Realis.* 17, 89–96 (2018). <https://doi.org/10.1080/14767430.2018.1468148>.
24. Bhaskar, R.: *Enlightened Common Sense: The Philosophy of Critical Realism*. Routledge, New York: Routledge, 2016. | Series: *Ontological* (2016). <https://doi.org/10.4324/9781315542942>.
25. Heeks, R., Thapa, D., Wall, P.J.: Critical realism and ICT4D: editorial introduction to the special issue of EIJSDC. *Electron. J. Inf. Syst. Dev. Ctries.* 84, e12050 (2018). <https://doi.org/10.1002/isd2.12050>.
26. Grover, V., Lyytinen, K.: New State of Play in Information Systems Research: The Push to the Edges. *MIS Q.* 39, 271–296 (2015). <https://doi.org/10.25300/MISQ/2015/39.2.01>.
27. Orlikowski, W.J., Iacono, C.S.: Research Commentary: Desperately Seeking the “IT” in IT Research—A Call to Theorizing the IT Artifact. *Inf. Syst. Res.* 12, 121–134 (2001). <https://doi.org/10.1287/isre.12.2.121.9700>.
28. Noir, C., Walsham, G.: The great legitimizer: ICT as myth and ceremony in the Indian healthcare sector. *Inf. Technol. People.* 20, 313–333 (2007). <https://doi.org/10.1108/09593840710839770>.
29. Adesemowo, A.K.: A Rethink of the Nature and Value of IT Assets – Critical Realism Approach. In: Dwivedi, Y., Ayaburi, E., Boateng, R., and Effah, J. (eds.) *IFIP AICT: ICT unbounded, Social Impact of Bright ICT Adoption*. pp. 402–414. Springer, Cham (2019). [https://doi.org/10.1007/978-3-030-20671-0\\_27](https://doi.org/10.1007/978-3-030-20671-0_27).
30. Faulkner, P., Lawson, C., Runde, J.: Theorising technology. *Cambridge J. Econ.* 34, 1–16 (2010). <https://doi.org/10.1093/cje/bep084>.
31. Mingers, J., Mutch, A., Willcocks, L.: Critical Realism in Information Systems Research. *MIS Q.* 37, 795–802 (2013).
32. Hobbs, J.R.: Coherence and Coreference. *Cogn. Sci.* 3, 67–90 (1979). [https://doi.org/10.1207/s15516709cog0301\\_4](https://doi.org/10.1207/s15516709cog0301_4).
33. Durfee, E.H., Lesser, V.R., Corkill, D.D.: Coherent Cooperation Among Communicating Problem Solvers. *IEEE Trans. Comput.* C-36, 1275–1291 (1987).

<https://doi.org/10.1109/TC.1987.5009468>.

34. Fjeld, M., Lauche, K., Bichsel, M., Voorhorst, F., Krueger, H., Rauterberg, M.: Physical and Virtual Tools: Activity Theory Applied to the Design of Groupware. *Comput. Support. Coop. Work.* 11, 153–180 (2002). <https://doi.org/10.1023/A:1015269228596>.
35. Houston, S.: Prising Open the Black Box. *Qual. Soc. Work Res. Pract.* 9, 73–91 (2010). <https://doi.org/10.1177/1473325009355622>.
36. Iannacci, F.: Routines, Artefacts and Technological Change: Investigating the Transformation of Criminal Justice in England and Wales. *J. Inf. Technol.* 29, 294–311 (2014). <https://doi.org/10.1057/jit.2014.10>.
37. Njihia, J.M., Merali, Y.: The Broader Context for ICT4D Projects: A Morphogenetic Analysis. *MIS Q.* 37, 881–905 (2013). <https://doi.org/10.25300/MISQ/2013/37.3.10>.
38. Rey-Moreno, C., Roro, Z., Tucker, W.D., Siya, M.J., Bidwell, N.J., Simo-Reigadas, J.: Experiences, challenges and lessons from rolling out a rural WiFi mesh network. In: *Proceedings of the 3rd ACM Symposium on Computing for Development - ACM DEV '13*. p. 1. ACM Press, New York, New York, USA (2013). <https://doi.org/10.1145/2442882.2442897>.
39. Rey-Moreno, C., Blignaut, R., Tucker, W.D., May, J.: An in-depth study of the ICT ecosystem in a South African rural community: unveiling expenditure and communication patterns. *Inf. Technol. Dev.* 22, 101–120 (2016). <https://doi.org/10.1080/02681102.2016.1155145>.
40. Takavarasha Jr., S., Adams, C., Cilliers, L.: Community Networks for Addressing Affordability of ICT Access in African Rural Areas. In: Takavarasha Jr, S. and Adams, C. (eds.) *Affordability Issues Surrounding the Use of ICT for Development and Poverty Reduction*. pp. 1–27. IGI Global (2018). <https://doi.org/10.4018/978-1-5225-3179-1.ch001>.
41. Mikroyannidis, A., Gómez-Goiri, A., Smith, A., Domingue, J.: PT Anywhere: a mobile environment for practical learning of network engineering. *Interact. Learn. Environ.* 1–15 (2018). <https://doi.org/10.1080/10494820.2018.1541911>.
42. Adesemowo, A.K., Oyedele, Y., Oyedele, O.: Text-based sustainable assessment: A case of first-year information and communication technology networking students. *Stud. Educ. Eval.* 55, 1–8 (2017). <https://doi.org/10.1016/j.stueduc.2017.04.005>.
43. Adesemowo, A.K., Msikinya, D., Nikitha, M., Darier, J., Tekeni, L.: L8 NetCalc: ICT Network Calculator. In: Remenyi, D. (ed.) *The e-Learning Excellence Awards 2017: An Anthology of Case Histories*. pp. 1–10. ACPIL: Academic Conferences and Publishing International, Porto, Portugal (2017).
44. Njihia, J.M.: Critical realism and its prospects for African development research and policy. *Thought Pract. A J. Philos. Assoc. Kenya.* 3, 61–85 (2011). <https://doi.org/10.4314/tp.v3i1.70985>.
45. Pourreau, L.: Technology, Power, and Leadership: Recommendations for Preserving Faculty Autonomy in the 21st Century. *Siegel Inst. J. Appl. Ethics.* 5, 1–23 (2017).