AFFORDANCES THEORY IN INFORMATION AND COMMUNICATION TECHNOLOGY FOR DEVELOPMENT (ICT4D) RESEARCH

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ABSTRACT

Information and Communication Technology for Development (ICT4D) is argued to have high potential value across all sectors, both public and private; and at multiple levels, be it fighting poverty; improving healthcare; providing better education; fostering gender equality or extending global partnerships for development. Despite this significance and huge potential, it is still not clear, to what extent ICTs are contributing to development, especially that of the relatively poor members of the society. Affordances Theory which has roots in ecological psychology has in the recent past been used in Information Systems (IS) research. This paper explores how affordances theory has been used in ICT4D research. A review of literature was conducted and recommendations made

Keywords: Affordances Theory, Affordances, ICT4D, Information Systems, Review.

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.

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 [8]: Theories about Technology Adoption; Social Processes of ICT4D; and Development. Avgerou [9] 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 [10]–[12].

The concept of affordances has gained traction in information Systems (IS) literature. It has been used to study the uses and consequences of the ICT artefact [13], [14], describing affordances as possibilities for goal-oriented action, emerging from the relation between IT artefact and organisational systems [15], [16] and afforded to specified groups of actions by technical objects [17].

II.   OBJECTIVE

The goal of this study was to explore how affordances theory has been used in ICT4D research.

III.   METHODOLOGY

For this paper, an exploratory study and analysis was conducted on affordances theory and how it has been used in ICT4D. 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 [18], the study explored a number of literature reviews regarding the contribution of affordances theory on IS. 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[13], [19], [20].

The study also went deeper into other review articles as well as primary articles on affordances theory and IS, in order to get a holistic picture of the status of the discourse. Empirical data was not collected and analysed.

IV.　　RESULTS AND DISCUSSIONS

4.1. Affordances Theory

The theory of affordances has its roots in ecological psychology. Gibson [21] expounds the concept of affordances to be the interaction between an actor with the environment (the surroundings of the actor itself). He intended an affordance to mean an action possibility available in the environment to an actor. An affordance is independent to the actor's ability to perceive the possibility [22]. Affordances are preconditions for an activity, but do not imply that the specific activity will occur.

Affordances are neither the properties of the environment nor the characteristics of the individual [23]. Instead, they are relative to the characteristics of individuals, such as their physical dimensions and abilities, social needs and personal intentions; and the features of the environment [24]. Gibson argued that inherent meaning of things in the environment can be directly perceived, and this information can be linked to action possibilities offered to the animal by the environment.

Therefore, affordances are relational and emerge through interaction between the actor and the artefact [25] and exists relative to the action capabilities of a particular actor [22]. Affordances are neither an outcome of the artefact alone nor the actor alone. People are normally more concerned with the action possibilities enabled by the technology than they are with the properties of the technology itself [26].

The concept of affordances was first applied to technologies, understood as IT artefacts, by Hutchby [27]. It has since gained traction in IS literature. It has been used to study the uses and consequences of the IT artefact [13], [14], describing affordances as possibilities for goal-oriented action, emerging from the relation between IT artefact and organisational systems [15], [16] and afforded to specified groups of actions by technical objects [17]. The concept of affordances has also started appearing in ICT4D studies [28]–[33], with a focus on the use of the concepts to analysing the cases. There are however, various other views of affordances in IS [13]. The views focus on whether affordances exist independent of users or if they only emerge from practice.

As affordances are just potentials for action, several studies recognise that affordances need to be triggered [34] or actualised [35] by a goal-oriented actor to achieve an outcome.

The affordance theory describes action possibilities allowed by material properties, thereby allowing the examination of how individuals explore material properties of IS with the objective of enhancing their capabilities [29].

Thapa and Hatakka [31], propose to use the concept of affordances to unfold the "black boxed" nature of ICT. They argue that the use of social theories in ICT4D research does not explain the mechanisms of ICT use and effect in details, and ICT still remains a "black box". They extend the Gaver's framework of affordances [36], to a societal level, by explaining how different socio-cultural factors affect the perception and actualisation of affordances. They also suggest that the theory of affordances can help bridge the design-reality gap by providing guidelines to designers in explaining how users appropriate the technology in practice.

4.1.1.　　Theoretical Framework of Affordances in Information Systems

Researchers engaging with affordances in the IS field are dedicated to studying the relationship and interaction between technical artefacts and organisations, and to explore how the physical properties of a tool or technology provide different modes of interaction [16], [17], [34].

The affordances lens helps to understand the relationship between technology and the human actor. Affordances do not determine how people will use a technology, while at the same time, technology's potential uses are not fully open-ended to the users. The affordances concept has mostly been used in relation to

organisational changes, within IS. There is a dearth of literature on how it plays out at an individual or household level.

With a view of integrating the concept of affordances in IS, [19] formalises the concept of affordances in IS by carrying out a literature review of how it has been used in IS. They adapt a model by Bernhard et al. [14] into a theoretical framework that organises studies under affordance existence, affordance perception, affordance actualisation and affordance effect. In the theoretical framework of affordances in IS, the first step is the cognitive process of affordance existence. It shows that affordances exist from the interaction between the IT artefacts and the goal-oriented actor. The second step is the recognition process which means that the goal-oriented actor needs to perceive or recognise the IT affordances. The third is the action, showing that the goal-oriented actor adopts the potentials for action which they perceive and actualise in support of their goals. Finally, this action will produce immediate concrete outcomes. Figure 1 shows the Theoretical Framework of Affordances in IS
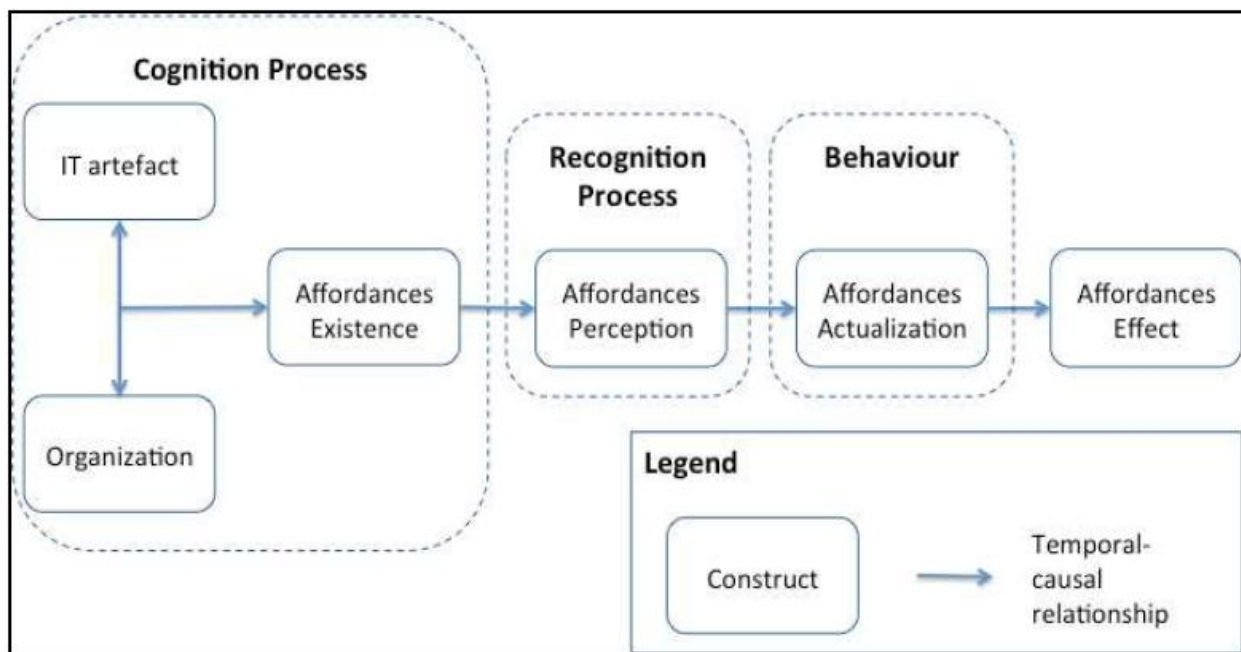

Fig.-1: Theoretical Framework of Affordances in IS1

(Source: Pozzi et al. [19, p. 3])

Despite the affinity of IS research to look at affordances from an organisational perspective, this research study will shift back to Bernhard et al. [14] who indicate that affordances exist from the relation between objects and users. This is a shift of concentration from organisations to individuals.

4.1.1.1. Affordance Existence

Affordance existence is a cognitive process [37] where users realise that there may be some potential for actions when they interact with objects. Affordances exist where ICT artefacts interact with goal-oriented actors, but are independent of people's perceptions. Affordances are relational [16], [27]. They are neither exclusive properties of the goal-oriented actor nor of the ICT artefact, but the relationship and the result of the dynamic interaction between the two.

Markus and Silver [17] define functional affordances as "the possibilities for goal-oriented action afforded to specified user groups by technical objects". This demonstrates the bi-directional relationship between the two. Affordances which are consistent to our goals are of great significance to us and more likely to work, while those opposite to our goals are meaningless to us and may be ignored [23]. This analysis helps to better understand how actors behave based on specific affordances.

4.1.1.2. Affordance Perception

It is a process of recognition [38] of the affordance existence which is influenced by the information that actors perceive about affordances. Affordance perception is influenced by features of IT artefacts, which originate from intentions by designers, and by actor's goals and capacities.

Perceived affordances are different from affordance existence. When users perceive a part of existing affordances, the perceived affordances are a subset of existing affordances. They can also be completely different sets when actors perceive wrong affordances because of lack of capacities or wrong understanding of the characteristics of objects.

Gaver [36] brought out the difference between affordances and perceptual information. Affordances are possibilities for real actions whereas perceptual information are the messages of actions perceived by people. Gaver [36] identified four categories of affordances based on existence of perceptual information: **Perceptible affordance**: where the affordance and its information exist together. There is information of an existing affordance. **False Affordance**: information that users perceive belongs to an affordance that does not exist. Where information suggests a non-existent affordance and people mistakenly try to act. **Hidden Affordance**: information of affordance does not exist and users need to recognise affordance by other means or inferred from other evidence. **Correctly Rejected**: both the affordance and its information do not exist, so the users cannot perceive. People will not think of a given action if there is no affordance or perceptual information. Figure 2 shows the Types of Affordances Matrix by Gaver.
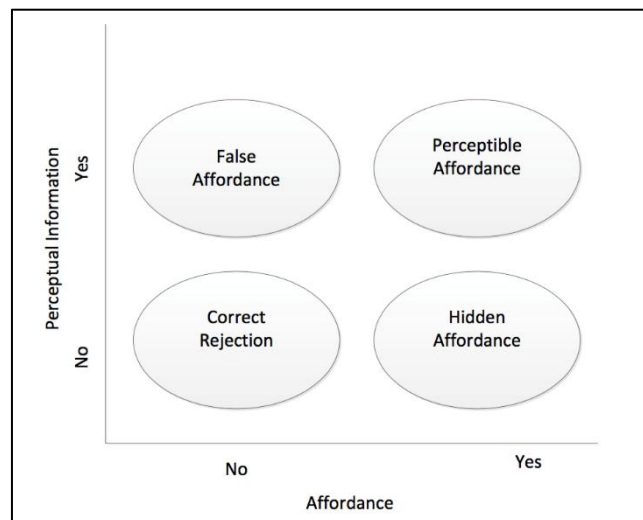

Fig.-2: Types of Affordances

(Source: Gaver [36, p. 80])

4.1.1.3. Affordance Actualisation

Many individuals may encounter difficulties in the way to actualise affordances. It is critical to identify and thus solve the difficulties. Strong et al. [35] defines the concept of actualisation as "the actions taken by actors as they take advantage of one or more affordances through their use of technology to achieve immediate concrete outcomes in support of organisational goals". Goal-oriented actors interact with IT artefacts and take actions to actualise affordances to achieve immediate concrete outcomes in support of their goals. The affordance actualisation concept can be equated to the agency and choice section within CA.

4.1.1.4. Affordance Effect

Through the process of affordance actualisation, actors can achieve multiple effects called 'immediate concrete outcomes'[35]. The affordance effect concept can be equated to functionings in CA terminology, only that it will just be a subset of functionings because functionings are achieved beings and doings whereas the affordance effect will only be an action by the goal-oriented actor, and thus a doing.

In conclusion of the theoretical framework of affordances in IS, there are calls for more attention to be paid to the enhancers or inhibitors of the affordance actualisation phase [20].

4.1.2. Frameworks that Incorporate Capability Approach and Affordances Theory

4.1.2.1. Extended Choice Framework Including Gaver's Four Categories of Affordances

Choice Framework (CF) is the most used operationalisation of CA [11], [29]. Hatakka et al. [29] argue that by combining the CF with affordances, the two can better explain the role of ICT in the development process, and explain how individual's agency and social structures influence their ability to perceive affordances in their interaction with the ICT.

They adopt Gaver's [36] four categories of affordances (perceptible affordance, hidden affordance, false affordance and correct rejection) because of its multi-fold explanation of affordances. They argue that CF lacks the details on how the conversion takes place from material properties to a capability. They further argue that to better understand the impact ICT can have for development, there is need to look at the material properties and how they, in interaction with actors in a specific context, affect individuals. They therefore place the concept of affordances between structure and agency in CF. Their extension of CF is depicted in Figure 3.

In the CF, ICT is mainly analysed for its affordability, accessibility and availability [39]. Through the affordance's lens, the ICT-enabled capabilities can only be converted into a functioning if the perceptible affordances are actualised.

Though their research was still in progress, Hatakka et al. [29] discuss four scenarios, demonstrating the utility of their framework. They discuss perceived and actualised affordance, hidden affordance due to limited agency; false affordance due to limited structural conditions and correct rejection due to lack of relevant capability.

The extended framework by Hatakka et al. [29] however uses the CF in the same format that this study critics. The CF is inconsistent with CA's terminologies. 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" [40, 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.

Hatakka et al.'s [29] extension of CF uses Gaver's [36] categories of affordances. By this, the framework handles the concepts of affordance existence and affordance perception, but it does not analyse the affordance actualisation and affordance effect.
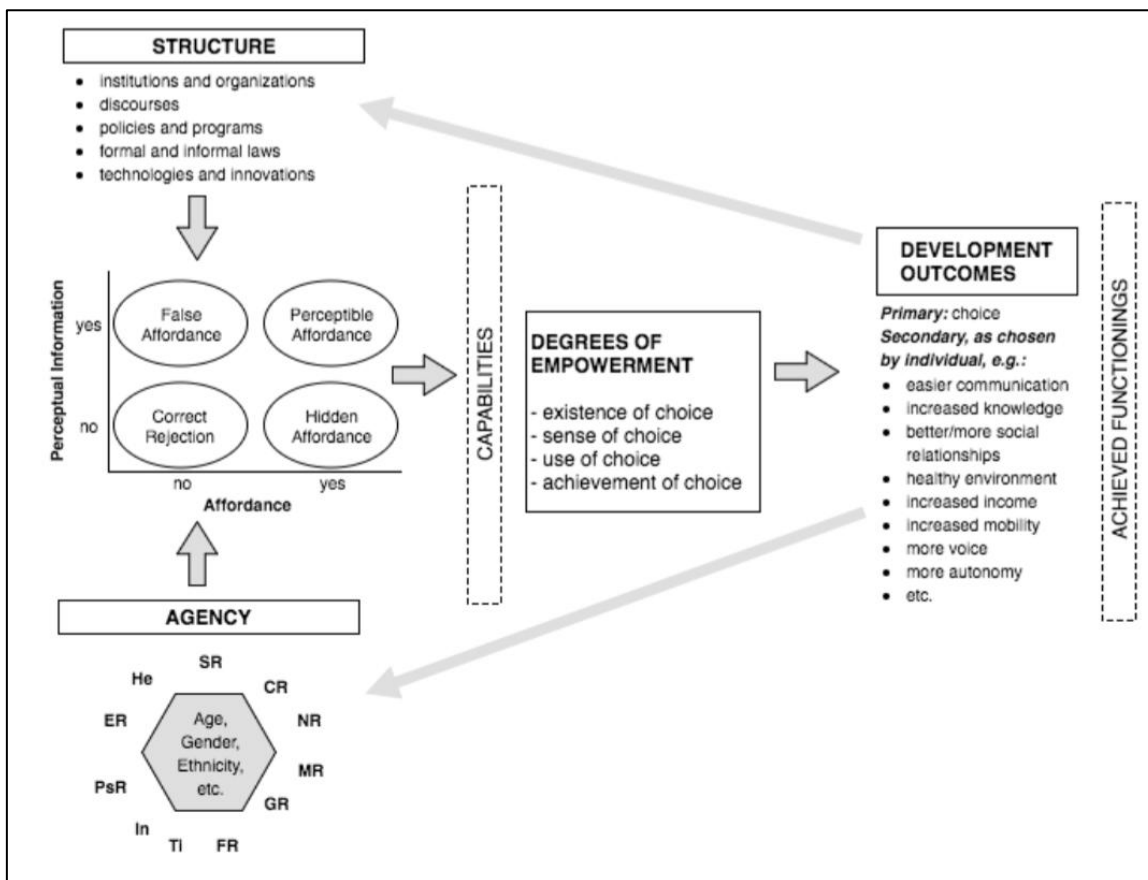
Fig.-3: Extended Choice Framework Including Gaver's 4 Categories of Affordances
(Source: Hatakka et al. [29])

4.1.2.2. A Framework to Explain the Relation between ICT and Development: Combining Affordances and the Capability Approach

Hatakka et al. [30] aim to suggest a framework to better explain the relation between ICT and development, by combining affordances and CA. On one hand, they select CA to define development as freedom of choice, and on the other, they select affordances to explain the relational aspects of people and technology. They argue that the concept of conversion factors in CA is underspecified and only provides a limited understanding of the conversion process. They proceed to argue for the inclusion of resource portfolios, agency and social structures from CF [39].

Affordances can exist without user's perceptions, while capabilities depend on making affordances perceptible and providing conducive social structure and resource portfolio. For a capability to be available for individuals to act on, they first need to be able to perceive the affordance based on their goals. This provides a nuanced explanation of the process of moving from an ICT artefact to a capability.

Hatakka et al.'s [30] framework shows the process and relation between ICT and development, depending on the actor's goal, the actor's ability to perceive affordances of ICT; and the context of the actor such as resource portfolio and social structure. The actor may perceive an affordance and actualise it leading to functionings, or may be unaware of the affordance, if it is hidden. Figure 4 shows their integrated framework.

They apply the framework to a case study of a study-circle project that took place in Kwale district at the Kenyan coast. They describe the case and the data collection procedures. They carried out twelve focus group discussions with 109 participants, two focus group discussions with six government officers and one focus

group discussion with six members of staff of the implementing organisation. They further conducted interviews with nine people and made observations of the group activities.
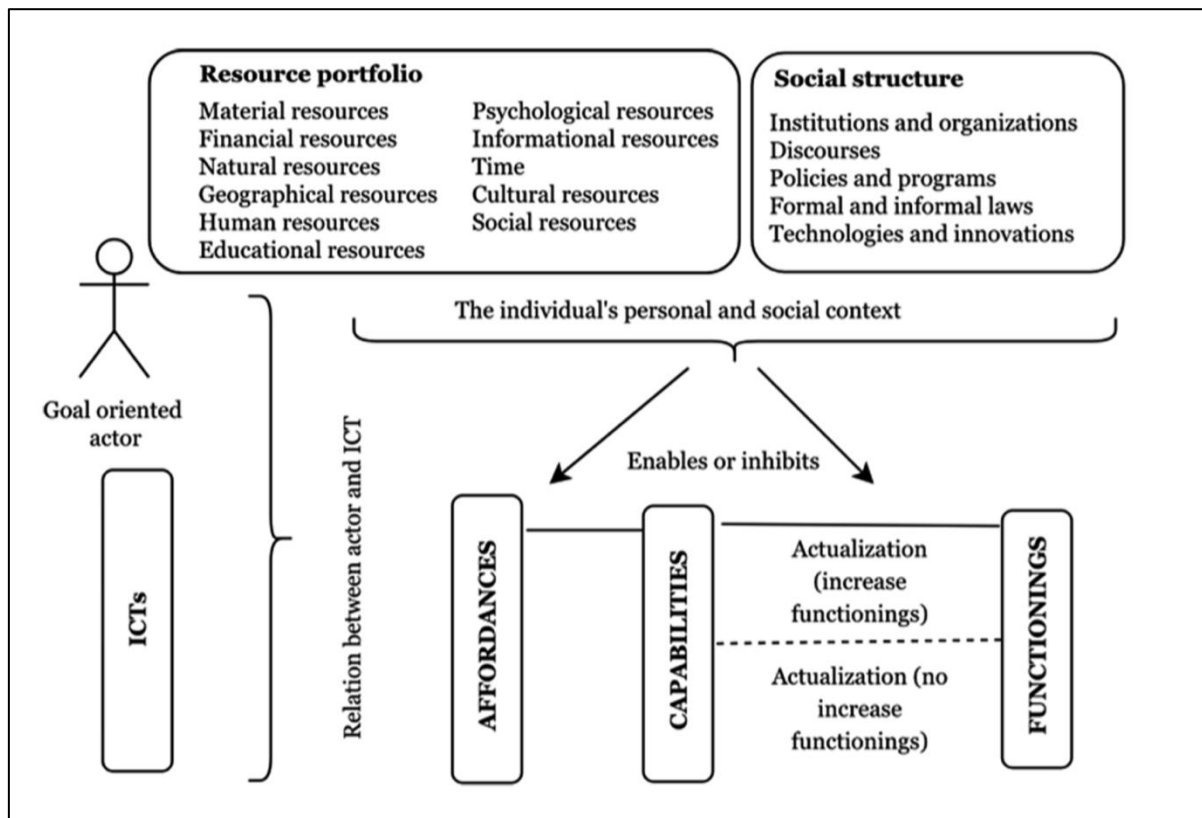

Fig.-4: A Framework to Explain the Relation between ICT and Development: Combining Affordances and the Capability Approach

(Source: Hatakka et al. [30, p. 64])

Their use of terminologies of CF without the conversion factors is inconsistent with Sen's terminologies. By failing to engage with the different explicit conceptualisations of the ICT artefact within the CA, the framework misses out on some explanatory power in the analysis. The framework also engages less with the concept of affordance effect.

V.   CONCLUSION

The concept of affordances has been applied to understand the IT-associated change processes in organisational setup [35], [41] and lately on a societal level [31]. There is a theoretical and empirical gap in the affordances literature in ICT4D, since studies on affordances have not been carried out at the individual or household level. This study recommends the empirical and theoretical exploration of the concept of affordances at the individual and household, so as to bridge the dearth of knowledge identified.

VI.   REFERENCES

[1]   D. Kleine and T. Unwin, "Technological revolution, evolution and new dependencies: what's new about ICT4D?," Third World Quarterly, vol. 30, no. 5, pp. 1045–1067, Jul. 2009, doi: 10.1080/01436590902959339.

[2]   L. Stillman and H. Linger, "Community informatics and information systems: Can they be better connected?," The Information Society, vol. 25, no. 4, pp. 255–264, Jul. 2009, doi: 10.1080/01972240903028706.

[3]   G. Walsham, "ICT4D research: reflections on history and future agenda," Information Technology for Development, vol. 23, no. 1, pp. 18–41, 2017, doi: 10.1080/02681102.2016.1246406.

[4]   D. Kleine, "ICT4D," in The International Encyclopedia of Digital Communication and Society, American Cancer Society, 2015, pp. 1–9.

[5]   R. Heeks, "The ICT4D 2.0 manifesto: Where next for ICTs and international development?," University of Manchester - Institute for Development Policy and Management, Working Paper 42, 2009. Accessed: Oct. 03, 2019. [Online]. Available: http://hummedia.manchester.ac.uk/institutes/gdi/publications/workingpapers/di/di_wp42.pdf.

[6]   M. Hatakka, D. Thapa, and J. Zhang, "Introduction to the minitrack on information and communication technology for development (ICT4D): ICT and sustainable development," Hawaii International Conference on System Sciences 2018 (HICSS-51), Jan. 2018, [Online]. Available: https://aisel.aisnet.org/hicss-51/eg/ict4d/1.

[7]   S. Qureshi, "Creating a better world with information and communication technologies: Health equity," Information Technology for Development, vol. 22, no. 1, pp. 1–14, Jan. 2016, doi: 10.1080/02681102.2015.1121585.

[8]   Y. Zheng, "ICT4D, overview of theories in," in The International Encyclopedia of Digital Communication and Society, American Cancer Society, 2015, pp. 1–10.

[9]   C. Avgerou, "Information systems in developing countries: A critical research review," Journal of Information Technology, vol. 23, no. 3, pp. 133–146, Sep. 2008, doi: 10.1057/palgrave.jit.2000136.

[10]   C. Avgerou, "Theoretical Framing of ICT4D Research," in Information and Communication Technologies for Development, 2017, pp. 10–23, doi: 10.1007/978-3-319-59111-7_2.

[11]   M. K. Sein, D. Thapa, M. Hatakka, and Ø. Sæbø, "A holistic perspective on the theoretical foundations for ICT4D research," Information Technology for Development, vol. 25, no. 1, pp. 7–25, Jan. 2019, doi: 10.1080/02681102.2018.1503589.

[12]   Y. Zheng, M. Hatakka, S. Sahay, and A. Andersson, "Conceptualizing development in information and communication technology for development (ICT4D)," Information Technology for Development, vol. 24, no. 1, pp. 1–14, Jan. 2018, doi: 10.1080/02681102.2017.1396020.

[13]   K. Stendal, D. Thapa, and A. Lanamäki, "Analyzing the concept of affordances in information systems," in 2016 49th Hawaii International Conference on System Sciences (HICSS), Jan. 2016, pp. 5270–5277, doi: 10.1109/HICSS.2016.651.

[14]   E. Bernhard, J. C. Recker, and A. Burton-Jones, "Understanding the actualization of affordances: A study in the process modeling context," presented at the International Conference on Information Systems (ICIS 2013), Università Bocconi, Milan, 2013, Accessed: Oct. 15, 2019. [Online]. Available: http://aisel.aisnet.org/icis2013/proceedings/ResearchInProgress/41/.

[15]   P. M. Leonardi, "When flexible routines meet flexible technologies: Affordance, constraint, and the imbrication of human and material agencies," MIS Quarterly, vol. 35, no. 1, pp. 147–167, 2011, doi: 10.2307/23043493.

[16]   R. F. Zammuto, T. L. Griffith, A. Majchrzak, D. J. Dougherty, and S. Faraj, "Information technology and the changing fabric of organization," Organization Science, vol. 18, no. 5, pp. 749–762, Oct. 2007, doi: 10.1287/orsc.1070.0307.

[17]   M. L. Markus and M. Silver, "A foundation for the study of IT effects: A new look at DeSanctis and Poole's concepts of structural features and spirit," Journal of the Association for Information Systems, vol. 9, no. 10, pp. 609–632, Oct. 2008, doi: 10.17705/1jais.00176.

[18]   J. Webster and R. T. Watson, "Analyzing the past to prepare for the future: writing a literature review," MIS Quarterly, vol. 26, no. 2, pp. xiii–xxiii, 2002.

[19]   G. Pozzi, F. Pigni, and C. Vitari, "Affordance theory in the IS discipline: A review and synthesis of the literature," presented at the Twentieth Americas Conference on Information Systems, Savannah, US, 2014, Accessed: Oct. 15, 2019. [Online].

[20]   H. Wang, J. Wang, and Q. Tang, "A review of application of affordance theory in information systems," Journal of Service Science and Management, vol. 11, no. 1, pp. 56–70, Jan. 2018, doi: 10.4236/jssm.2018.111006.

[21]   J. J. Gibson, The ecological approach to visual perception. Hillsdale, NJ: Lawrence Erlbaum Associates, 1986.

[22]   J. McGrenere and W. Ho, "Affordances: Clarifying and evolving a concept," presented at the Graphics Interface 2000, Montreal, 2000.

[23]   T. A. Stoffregen, "Affordances as properties of the animal-environment system," Ecological Psychology, vol. 15, no. 2, pp. 115–134, Apr. 2003, doi: 10.1207/S15326969ECO1502_2.

[24]   A. Chemero, "An outline of a theory of affordances," Ecological Psychology, vol. 15, no. 2, pp. 181–195, Apr. 2003, doi: 10.1207/S15326969ECO1502_5.

[25] W. van Osch and O. Mendelson, "A typology of affordances: untangling sociomaterial interactions through video analysis," presented at the 32nd International Conference on Information Systems (ICIS), Shanghai, China, 2011, Accessed: Oct. 15, 2019. [Online].

[26] A. Majchrzak, M. L. Markus, and E. Kessler, "Technology affordances and constraints in management information systems (MIS)," in Encyclopedia of Management Theory, Sage Publications, Forthcoming, 2012.

[27] I. Hutchby, "Technologies, texts and affordances," Sociology, vol. 35, no. 2, pp. 441–456, May 2001, doi: 10.1177/S0038038501000219.

[28] A. Andrade and B. Doolin, "Affordances and agentic orientations: An examination of ICT4D users," presented at the GlobDev 2013, Dec. 2013.

[29] M. Hatakka, D. Thapa, and Ø. Sæbø, "A framework for understanding the link between ICT and development: How affordances influence capabilities," presented at the SIG GlobDev 2016, Dublin, Ireland, Dec. 2016.

[30] M. Hatakka, Ø. Sæbø, and D. Thapa, "A framework to explain the relation between ICT and development: combining affordances and the capability approach," in Information and Communication Technologies for Development. Strengthening Southern-Driven Cooperation as a Catalyst for ICT4D, 2019, vol. 552, pp. 60–71, doi: 10.1007/978-3-030-19115-3_6.

[31] D. Thapa and M. Hatakka, "Understanding ICT in ICT4D: An affordance perspective.," in Proceedings of the 50th Hawaii International Conference on System Sciences, HICSS 2017, Hilton Waikoloa Village, Hawaii, USA, 2017, pp. 1–9, doi: 10.24251/HICSS.2017.316.

[32] M. P. Turmo, E. A. Castañ, and A. G. Guijosa, "Using the affordances of wiki to support collaborative argumentation in secondary science education," in Secondary education in the 21st century, D. Beckett, Ed. New York: Nova Science Publishers, 2010, pp. 1–56.

[33] Y. Zheng and A. Yu, "Affordances of social media in collective action: the case of free lunch for children in China," Information Systems Journal, vol. 26, no. 3, pp. 289–313, 2016, doi: 10.1111/isj.12096.

[34] O. Volkoff and D. M. Strong, "Critical realism and affordances: Theorizing IT-associated organizational change processes," MIS Quarterly, vol. 37, no. 3, pp. 819–834, 2013.

[35] D. Strong et al., "A theory of organization-EHR affordance actualization," Journal of the Association for Information Systems, vol. 15, no. 2, pp. 53–85, Feb. 2014, doi: 10.17705/1jais.00353.

[36] W. W. Gaver, "Technology affordances," in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, New York, NY, USA, 1991, pp. 79–84, doi: 10.1145/108844.108856.

[37] M. Davern, T. Shaft, and D. Te'eni, "Cognition matters: Enduring questions in cognitive IS research," Journal of the Association for Information Systems, vol. 13, no. 4, pp. 273–314, Apr. 2012, doi: 10.17705/1jais.00290.

[38] J. G. Greeno, "Gibson's affordances," Psychological Review, vol. 101, no. 2, pp. 336–342, 1994, doi: 10.1037/0033-295X.101.2.336.

[39] D. Kleine, Technologies of choice?: ICTs, development, and the capabilities approach. Cambridge, MA: MIT Press, 2013.

[40] A. Sen, Development as Freedom. Oxford, New York: Oxford University Press, 1999.

[41] S. Seidel, J. C. Recker, and J. vom Brocke, "Sensemaking and sustainable practicing: Functional affordances of information systems in green transformations," MIS Quarterly, vol. 37, pp. 1275–1299, Dec. 2013, doi: 10.25300/MISQ/2013/37.4.13.