The London School of Economics and Political Science

Theorizing Technology Affordances in Digital Innovation: Evidence from an Interactive Voice Response Pilot Project for Low-Income Markets in Ghana

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A thesis submitted to the Department of Management of the London School of Economics and Political Science for the degree of Doctor of Philosophy

London, July 2020

Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

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Statement of Conjoint Work

Paper 1 (Chapter 5) and Paper 3 (Chapter 7) were co-authored with Dr. Jonathan Liebenau. I confirm that the majority of work was completed by myself as first author. In both papers, my contributions included the literature review, data collection and analysis, the theoretical development, and the writing. In Paper 1, Dr. Liebenau provided critical guidance on the overall paper, including support in focusing and refining the contributions and other aspects to help prepare this paper for a top journal audience. In Paper 3, Dr. Liebenau provided essential guidance on the paper's theoretical underpinnings, including prior work he had accomplished which became foundational in the literature review.

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Dana D. Lunberry

London, 1 July 2020

Note on Data Access

My access to data was facilitated by my professional relationship with the case organization, Opportunity International. I had been an employee of Opportunity International since 2010, serving in various business development and global operations capacities. My history with the organization provided a solid foundation of existing knowledge and relationships which aided my PhD research.

During the time of this research, I carried out a research function for the organization, primarily serving the Global Digital Finance Initiative (described in Section 4.4.2). This role involved working closely with the global head of digital financial services (DFS) and the regional directors and local managers of DFS for the Africa and Asia regions. These interactions and the scope of my responsibilities provided me with a first-hand account of the development and diffusion of various digital financial innovations for low-income markets. I received approval and support from the organization to utilize the data that I collected through this role for my PhD research.

The organization does not take responsibility for this research, including the methodology, quality of the data collected and used, and interpretive results. Unless otherwise indicated, the views expressed in this thesis are mine and do not necessarily represent the views of the organization. All the work carried out for this thesis was done by me unless otherwise stated.

Papers Included in Thesis

The thesis presents a series of three papers which were researched, developed, and written during my enrollment in the PhD in Information Systems and Innovation at the Department of Management, London School of Economics and Political Science, 2016-2020. Versions of these papers, following the original works, have been published or are in review.

1. Lunberry, D. and Liebenau, J. "Organizational Improvisation: A Framing for Innovation Affordances"

   [Under review at a leading journal in innovation studies since June 2020; An earlier version was presented in the doctoral/junior faculty consortium of the 12th Mediterranean Conference on Information Systems (MCIS) 28 September 2018, Corfu, Greece.]

2. Lunberry, D. "A Technical Investigation into Strategic Customer Targeting: Digital Affordances as a Generative Mechanism"

   [Under review at a leading IS journal since June 2020; An earlier version was accepted for presentation and published in Proceedings of the 28th European Conference on Information Systems (ECIS 2020). Available at AIS Electronic library: https://aisel.aisnet.org/ecis2020_rip/.]

3. Lunberry, D. and Liebenau, J. (2020) "Human or Machine? A Study of Anthropomorphism through an Affordance Lens" in Concetta Metallo, Maria Ferrara, Alessandra Lazazzara, Stefano Za (eds.). *Digital Transformation and Human Behavior: Innovation for People and Organisations*. Lecture Notes in Information Systems and Organisation. Berlin, Germany: Springer. Available at The Springer Shop: https://www.springer.com/gp/book/9783030475383.

Abstract

This thesis consists of three studies that examine the role and dynamics of technology affordances in digital innovation. Following the work of James J. Gibson (1977, 1986), technology affordances refer to all possible actions corresponding to the materiality of technological artifacts in relationship with humans and the environment (Hutchby 2001). The studies use empirical evidence from the same case study– a pilot project introducing interactive voice response (IVR) with savings clients of a savings and loans company in Ghana in 2017-2018. Each study is distinct in its focus and builds upon different aspects of the concept of affordances within the Information Systems (IS) literature. The first study focuses on the practice and processes of innovating done by innovation leaders (managers). The findings suggest that innovation occurs through patterns which involve innovation leaders' conceptualizations of technology affordances and their applications. The second study focuses on how an affordance lens can be used to explain IT-associated change, specifically the phenomenon of strategic customer targeting. The findings suggest that the relationships among technologies, humans, and their environments are generating IT-associated changes within an organizational context by enabling strategic customer targeting through patterns of applied affordances in digital innovation. The third study focuses on the relationship between technology and anthropomorphic perceptions among technology users. The findings suggest that affordance-related patterns exist which individually and jointly enable the technology to exhibit human-like qualities within the user-technology interaction. All three studies develop arguments around the logics and consequences of technology affordances: how they are perceived and/or enacted within various technology development and diffusion

processes. From the analyses, the research explicates the relationship between digital materiality and digital innovation for an improved understanding of the role of the digital artifact in innovation.

Keywords: *Digital Innovation; Innovation Management; Innovation Strategy; Technology Development; Technology Affordances; Interactive Voice Response; Financial Services; Fintech; Fintech Innovation; Financial Inclusion; Microfinance; Microsavings; Ghana; Low-Income Markets*

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Abbreviations

DFS	Digital financial services
Fintech	Financial technology
ICT	Information and communications technology
IS	Information systems
IT	Information technology
IVR	Interactive voice response
M-banking	Mobile banking
MNO	Mobile network operator
NGO	Non-governmental organization
Opportunity	Opportunity International
Opportunity Ghana	Opportunity International Savings and Loans Ltd., Ghana
PRFI	Partnership for Responsible Financial Inclusion
SASL	Sinapi Aba Savings and Loans Ltd.
SMS	Short messaging service
Telco	Telecommunications company
Telecom	Telecommunications

Definitions

Actualizing affordances	*All possible actions that emerge within the development or diffusion of innovation which are connected to fulfilling the original organizational goals of the innovation.*
Affordance	*Possibilities for action that result from the relationship between humans and their environments.*
Affordance enactment	*Human action taken to exploit or otherwise use an affordance.*
Affordance perception	*Human awareness of an affordance which involves processing environmental and/or technical properties and potentialities in relation to human capabilities and other enabling (and/or constraining) characteristics.*
Agent banking	*The delivery of financial services through a network of non-bank entities, such as retail stores, kiosks, or roaming agents, that assist customers on behalf of a financial institution.*
Anthropomorphic design	*The design of features to cultivate anthropomorphic perceptions among users.*
Anthropomorphism	*The tendency and/or phenomenon of humans applying human-like attributes to non-human objects such as technology.*
Compensating affordances	*All possible actions that emerge within the development or diffusion of innovation which are connected to compensating or making up for an undesired outcome or existing condition.*
Counteracting affordances	*All possible actions that emerge within the development or diffusion of innovation which are connected to counteracting or offsetting an undesired situation or outcome.*

Digital affordance	*An affordance that is derived from a digital technology (i.e., digital infrastructure) or from the technology's affordance (Autio et al. 2018; Baiyere and Nieminen 2018).*
Digital artifacts	*Non-material elements comprised of bitstrings (sequences of zeros and ones) that are regulated by structures and take form on a screen or the backend of a computer program.*
Digital financial services	*The use of digital technologies in providing financial services to customers. Examples include: mobile banking, online banking, ATMs, and point-of-sale (POS) systems.*
Digital innovation	*The intentional efforts of organizations to orchestrate new products, processes, services, platforms, or business models within a given context (Hinings, Gegenhuber and Greenwood 2018).*
Digital technology	*Technology that consists of a combination of non-material, digital artifacts (bitstrings comprised of zeros and ones that are regulated by structures) and material, non-digital artifacts (i.e., a screen or the backend of a computer program which enables the non-material, digital elements to take form).*
Financial inclusion	*The act of providing populations who are excluded from the financial system, or underserved, with access to financial services such as loans, savings, money transfer services, and insurance.*
Financial technology (fintech)	*The use of technology aimed at improving activities in finance.*
Information and communications technology	*An extensional term of information technology (IT) which highlights the importance of communications. This thesis uses information and communications technology (ICT) and information technology (IT) interchangeably to be inclusive of the broader literature on information technology.*
Information technology	*Technology that involves the management (creation, storage, processing, distribution, etc.) of information in the form of electronic data.*

Innovation affordances	*All possible actions that emerge within the development or diffusion of innovation.*
Innovation leaders	*Human actors that play a decision-making role in the development and/or diffusion of the innovation.*
Intended affordances	*All possible actions that emerge within the development or diffusion of innovation which are connected to the organization's original goals for the innovation.*
Interactive voice response (IVR)	*A computerized phone system that enables a two-way conversation between a real person and a pre-recorded voice in an interactive manner.*
Meta-affordance	*A structure of affordances which may be analytically derived to explain a set of affordances and their relationships within a given context.*
Microfinance	*A sector of the financial retail industry that provides financial services such as loans, savings, insurance, and money transfer services to populations who have traditionally been excluded from the formal financial system, especially poor entrepreneurs and small business owners.*
Mobile banking	*The delivery of financial services through a mobile phone or other mobile device.*
Mobile money	*An electronic wallet service that enables users to store, send, and receive money using a mobile phone.*
Non-governmental organization (NGO)	*A non-profit organization operating independently of any government.*
Optimizing affordances	*All possible actions that emerge within the development or diffusion of innovation which are connected to reinforcing or enhancing a desired outcome or existing condition.*
Responsive affordances	*All possible actions that emerge within the development or diffusion of innovation which are connected to any emergent constraints and/or opportunities posed by the*

	organization, the socio-technical elements of the innovation, and/or the environment.
Short messaging service (SMS)	*A text messaging service component which uses standardized communication protocols to enable mobile devices an exchange of short text messages, typically up to 160 characters in length.*
Technical anthropomorphism	*The technological artifact which results from the human-machine mimicking process.*
Technology affordance	*Possibilities for action that result from the relationship among humans, IT artifacts, and their environments. This thesis follows Zammuto et al. (2007) in positioning technology affordances as capabilities that are enabled by technical and organizational features.*
Transforming affordances	*All possible actions that emerge within the development or diffusion of innovation which are connected to changing an undesired outcome or existing condition.*

PART I – THE FOUNDATIONS

Chapter 1: Introduction

1.1 Research Overview

Innovation has been studied by academic scholars for decades. Scholars of management, business, information systems, economics, marketing, operations, strategy, and other disciplines have sought to explain the nature, processes, and outcomes of innovation. In management and organizational studies, there is an extensive literature on innovation in organizations. Over the years, scholars have contributed an improved understanding of innovation, its practices, and outcomes. However, much work remains undone. In technology management and adjacent fields, more work is needed to understand the determinants of organizational-level performance particularly in product design as it relates to innovation. There is a lack of understanding of how technological design features relate to innovation strategy and practice. This research addresses this problem through a study of the relationship between technologies, users, and their environments. By examining IT-associated changes generated by these interrelationships, this research employs an analytical approach most suited to solving this problem, that of affordance theory.

James J. Gibson's (1977, 1986) affordance theory from ecological psychology has become popular in the field of information systems (IS) and adjacent disciplines to examine the role of technology and IT-associated change (Volkoff and Strong 2013). Affordances refer to possibilities for action that result from the relationship between

humans and their environments (Gibson 1977, 1986). In IS, affordance theory has primarily been used to theorize the relationship between technology and its users (Stendal, Thapa, and Lanamaki 2016), while more attention is being brought to other realms of society including groups, organizations, and society at large (see Strong et al. 2014; Zammuto et al. 2007; Volkoff and Strong 2013; Anderson and Robey 2017; Klecun, Hibberd, and Lichtner 2016). The recent interest in affordances in IS and management studies can be attributed to the applicability of affordances, specifically the work being done to understand the material nature of IT and its situated socio-technical relationships and consequences (Orlikowski and Iacono 2001; Anderson and Robey 2017).

The potential for affordance theory to expand its contribution to scholarship and practice is immense, and the existing literature beckons further research in various areas. Numerous authors have called for more research to examine IT-associated change in organizations (Pozzi et al. 2014; Strong et al. 2014; Zammuto et al. 2007; Klecun, Hibberd, and Lichtner 2016). To date, few studies have examined technology affordances and innovation, and no studies that we could find have examined technology affordances in relation to market-based approaches to digital innovation. Hence, this study hopes to be the first of many.

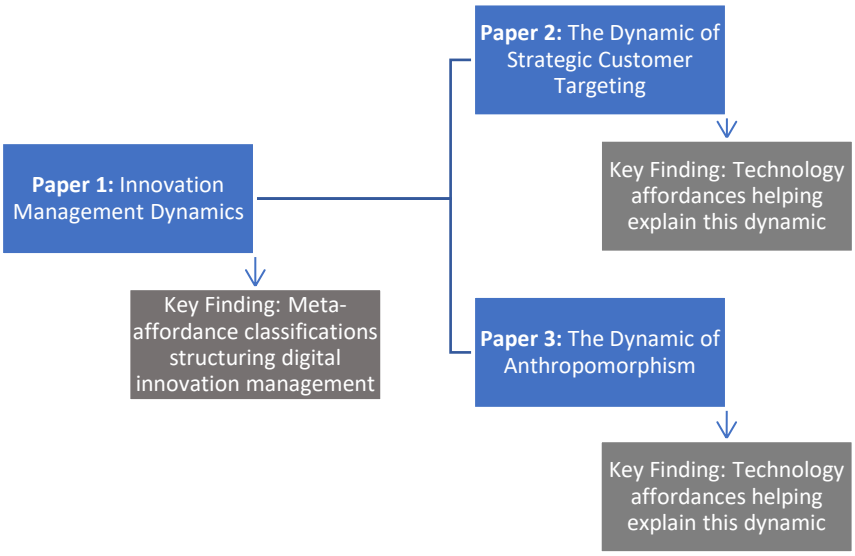
1.2 Research Design: A Three Paper Approach

The research was designed to employ a multi-level approach to studying technology affordances to enable an in-depth study of particular dynamics of digital innovation since this topic is too broad to study as a comprehensive whole. To address our research question, we developed a three-study approach to focus the research on three different

aspects of digital innovation. Developed as a research program, this thesis comprises of three standalone yet related papers which theorize the role and dynamics of technology affordances in digital innovation using evidence from the retail banking industry in Ghana.

Paper 1 examines the role and dynamics of technology affordances in digital innovation management more broadly, while papers 2 and 3 build on Paper 1 by focusing on particular dynamics of digital innovation to conduct an in-depth investigation into the technology affordances that underpin these phenomena. Following Zammuto et al. (2007), these affordances are enabled by technical and organizational features and notated as "capabilities" which organizational actors can enact (see Section 2.6 for details). Figure 1 and the following description outline the multi-level approach of our research program.

Figure 1. The Multi-Level Approach of Our Research Program



- In **Paper 1**, we identified and defined innovation affordances as a structure of affordances to explain the practices of digital innovation management in our case. These affordances, as identified and defined, enabled the fulfillment of organizational goals and the response to emergent barriers and opportunities within digital innovation.
- In **Paper 2**, we identified and defined technology affordances related to the digital innovation dynamic of strategic customer targeting as found in our case. In our analysis, we derived technology affordances– capabilities enabled by technical and organizational features– that enabled the fulfillment of organizational goals, specifically the strategic targeting of a specific customer segment (low-income female savings clients). We developed meta-codes to categorize and thereby structure these affordances.
- In **Paper 3**, we identified and defined technology affordances related to the digital innovation dynamic of anthropomorphism as found in our case. In our analysis, we derived technology affordances that enabled the response to emergent opportunities, specifically anthropomorphic outcomes (anthropomorphic perceptions found among users). We developed meta-codes to categorize and thereby structure these affordances.

1.3 Overview of Papers

Our three papers employ different research methods and address distinct yet related questions, as summarized as follows.

Paper 1 (Chapter 5): Organizational Improvisation: A Framing for Innovation Affordances

This paper explores the conceptualization and use of technology affordances within the organizational practice of digital innovation for an improved understanding of affordances. The research focuses on intense periods of innovation by innovation leaders, particularly when improvisation occurred, to understand how technology affordances shaped innovation strategy. From our analysis, we highlight how leaders' perceptions of technology affordances were guided by five main logics and often culminated in actionable decisions which had consequential outcomes for innovation. First, we find that innovation occurs through leaders' conceptualization of five main types of affordances, which we term actualizing, optimizing, transforming, counteracting, and compensating affordances. Second, we group these affordances into two main categories, intended and responsive affordances. Through our work, we provide various contributions. Our findings extend affordance theory by introducing new concepts and providing fresh theoretical insights on the application of technology affordances to digital innovation. Furthermore, we present practical implications for innovation management through our proposed framing.

Paper 2 (Chapter 6): A Technical Investigation into Strategic Customer Targeting: Digital Affordances as a Generative Mechanism

This paper develops arguments on the conceptualization of technology affordances in helping organizations innovate with digital technologies to strategically target their customers. This paper builds on concepts introduced in Paper 1 by connecting various technological aspects in digital innovation to organizational goals. These arguments are

developed by identifying ways in which technology affordances are conceptualized and utilized by decision-makers to tailor the development of the technologies to the target market: low-income female savings customers in Ghana. The findings highlight the significant roles played by technologies and their socio-technical relationships in generating changes to the innovation. The research generates new insights into the patterning and shaping of digital innovation for meeting the requirements and constraints of customers and their environments. It also offers theorization around the utility of affordances for understanding and potentially optimizing innovations for specific target markets.

Paper 3 (Chapter 8) Human or Machine? A Study of Anthropomorphism through an Affordance Lens

This paper builds on concepts introduced in Paper 1 by highlighting anthropomorphic design features and their underlying affordances which help users adopt technology. Anthropomorphism– the tendency of humans to apply human-like attributes to non-human objects– has received growing attention by scholars across multiple disciplines. With the increasing popularity of service and personal robotics and conversational agents such as Amazon's Alexa, IS scholars have begun to shed light on some of the technology features and processes related to anthropomorphism. This research contributes to these efforts by examining the relationship between technology and anthropomorphic perceptions among users using an affordance perspective. Evidence is drawn from user interviews and observations of the IVR technological system and its developments. The findings highlight four main ways that the IVR technology exhibited human-like qualities within the user-technology interaction (as perceived by users). This

paper illustrates how a study on the relationship between technology and anthropomorphism might be conducted using affordances. It builds on the IS affordance literature by arguing that a decomposition of anthropomorphism from an affordance perspective can offer new insights into the generation of anthropomorphic perceptions and design. The research also offers practical implications by highlighting how organizations might better facilitate anthropomorphic design into technology innovations.

1.4 Central Arguments

The central argument of the thesis is that a well-developed affordance perspective offers concepts and theories which are of relevance and importance for understanding digital innovation, particularly the role and dynamics of digital technology in innovation and IT-associated change.

Based on the findings of this thesis, the role and dynamics of technology affordances in digital innovation are theorized as follows:

- Technology affordances as a conceptual framework offers an improved understanding of digital innovation, particularly for certain aspects of technology development and diffusion.
- Technology affordances generate patterns within digital innovation particularly when improvisation occurs. We introduce “innovation affordances” (with proposed categories and subcategories) as a new concept for an improved understanding of digital artifacts, their socio-technical relationships and their impacts on innovation and organizations.

- Technology affordances can play a role in generating organizational change including the development and optimization of market-based approaches to digital innovation and the constitution of technology artifacts.
- Technology affordances can play a role in generating anthropomorphic perceptions among users and technical anthropomorphism.
- Technology affordance actualization may be triggered in part by the roles of imagination and affect (emotion) such as in the case of anthropomorphism as found in our case study.

This increased understanding of affordances carries implications for the utility of affordances and enables us to make substantial contributions to the innovation and affordance scholarship.

1.5 Contributions

In our analyses, we found phenomena not accounted for in the current literature. We therefore extend the literature by advancing the theoretical concept of technology affordances in applying it to innovation management and practice. Each paper makes contributions to the relevant issue domain and literature.

In our first paper, we offer and theorize "innovation affordances" – a new term we define as all possible actions that emerge within the development or diffusion of innovation. We present a theoretical framing with two main categories of innovation affordances which derived from our analysis– intended and responsive– to explain the role and dynamics of digital technologies based on how they were perceived and/or used by innovation leaders. Intended affordances refer to all possible actions that emerge

within the development or diffusion of innovation which are connected to the original goals of the organization for that innovation. Responsive affordances refer to all possible actions that emerge within the development or diffusion of innovation which are connected to any emergent constraints and/or opportunities posed by the organization, the socio-technical elements of the innovation, and/or the environment. From the analysis, intended and responsive affordances have been further classified into five subcategories (actualizing, optimizing, transforming, counteracting, and compensating affordances). Based on our findings, we provide an improved understanding of how digital technologies shape digital innovation strategy and practice. Our introduction and proposed framing of innovation affordances extends affordance theory and advances the current knowledge of technology affordances.

In our second paper, we contribute to the literature by generating new insights into the patterning and shaping of digital innovation for target markets. The research tests and builds on the theories presented by Volkoff and Strong (2013) and Bygstad, Munkvold, and Volkoff (2016). We explain organizational change by decomposing the relationship between organizational objectives and strategic customer targeting to show how strategic customer targeting was generated by technology affordances and contingent on other factors. We highlight the role of technology affordances in generating strategic customer targeting and demonstrate how digital technologies can have consequential outcomes for meeting organizational objectives. We also show how technology affordances play a role in constituting the technology artifacts through the innovation development processes. This paper offers practical applications for market-oriented practices of innovation. It provides new insights into how organizations might

leverage digital technologies to adjust their innovations to better fit the market and thereby further their business objectives (Kannan and Hongshuang 2017).

In our third paper, we contribute to the literature by demonstrating how affordance theory can help shed light on the technological processes that underpin anthropomorphism by decomposing anthropomorphism from an affordance perspective. We bring to the forefront various technical aspects which helped generate perceived human-like elements thus provide an improved understanding of the role of technology in anthropomorphism. We also expand the IS affordance literature by highlighting the roles of human imagination and affect (emotion) for triggering affordance actualization. This paper offers an improved understanding of the technology and its role in anthropomorphism, which if applied, may improve technology design and thereby help facilitate user adoption.

The three papers when combined as a thesis make the contribution that technology affordances can play a consequential role in digital innovation, and they can do so in the following ways:

1. Through patterns of improvisation based on "innovation affordances" (with categories: intended and responsive affordances, and sub-categories: actualizing, optimizing, transforming, counteracting, and compensating affordances);
2. Through the interplay between business objectives, organizational learning processes, and interdependencies between humans, technologies, and their environments;
3. Through a complementarity between human and machine inputs; and

4. Through the development of the technology to include human-like qualities (technical anthropomorphism) to strategically cultivate user interpretations and experiences such as anthropomorphic perceptions, imagination, and affect (emotion).

This contribution is significant for not only bringing an improved understanding of technology but because of the relevance of this topic for contemporary society. As digital technologies become more pervasive in business practice across industries, digital properties and their implications require a greater understanding than what has been provided in the literature to date. In addition to furthering scholarship, a better understanding of these issues is useful for practitioners in aiding the direction and process of reconfiguring practices to make digital innovations more effective for the market and for meeting business objectives. For example:

- As highlighted in **Paper 1**, an application of some of the identified logics of responsiveness that we identify can help practitioners harness complexity during moments of improvisation in digital innovation;
- As highlighted in **Paper 2**, digital technologies can be configured to optimize the strategic targeting of customers, which in turn can help adjust the innovation to better fit the market and better achieve business objectives; and
- As highlighted in **Paper 3**, digital technologies can be configured in such a way that helps generate anthropomorphic perceptions among users, which can help facilitate user adoption.

1.6 Conclusion

This chapter has introduced the topic of the thesis, the motivation and purpose of the research, and has summarized the core themes and elements. It has outlined the three papers composed within this thesis and has summarized their key arguments and contributions to scholarship and practice. It also provides the main contribution of the overall thesis which addresses our main research question, *what are the roles and dynamics of technology affordances in digital innovation?*

The following chapters, 2 and 3, develop the theoretical foundations of the thesis by grounding the thesis in the concepts and bodies of literature on technology affordances and digital innovation. Chapter 4 provides a detailed description of the research context including the industrial, geographical, and organizational setting of the case study. These foundational chapters provide supplementary material for the three papers found in chapters 5, 6, and 7, which are necessarily truncated due to publication constraints.

The three papers are presented in the order of increasing development. Paper 1 (Chapter 5) introduces and theorizes the concept of "innovation affordances" which decomposes key underpinning logics of innovation that center around the driving forces, proactivity and reactivity. Paper 2 (Chapter 6) theorizes the role and dynamics of technology affordances in digital innovation for target markets by building on themes from Paper 1. Paper 3 (Chapter 7) also builds on themes from Paper 1 by theorizing the role and dynamics of technology affordances in generating technology design outcomes, specifically, anthropomorphic perceptions among users. Chapter 8 presents concluding remarks and discusses how the findings from each paper interrelate and jointly develop arguments that address the main research question.

Chapter 2: Affordances

2.1 Introduction

This research employs affordances[1] as a conceptual tool for examining digital technologies within innovation for an improved understanding of affordance theory. This chapter presents the conceptual foundations of affordances and is divided into four parts. First, we outline the origins of affordance theory, which was founded in the 1960's by American psychologist James J. Gibson. Next, we provide an overview of the affordance literature in IS and adjacent disciplines which analyzed technology affordances, especially in relation to organizational innovation and change. We then outline the relevant conceptualizations of affordances. Next, we focus on the significance of affordances and the conceptual dimensions which constitute our research framework. Lastly, we provide an overview of how this research applies affordances.

2.2 Gibson's Affordance Theory

The term "affordance" was first introduced by Gibson in his 1966 book, *The Senses Considered as Perceptual Systems,* and refers to all action possibilities that are physically possible. Affordances were used by Gibson as an approach to visual perception to explain how people perceive meanings which are inherent in our environment. His use of affordances centered on behavior in relation to perception, intentions, and the environment. Gibson's views promoted ecological psychology and

[1] This thesis applies affordances as defined by "technology affordances," which refer to all possible actions corresponding to the materiality of artifacts in relationship with humans as well as the environment (Hutchby 2001). In reference to our application of this concept, the terms "affordances" and "technology affordances" are used interchangeably in this research.

challenged the notion that the nervous system solely constructed a person's vision perception. Affordances positioned the properties of objects as necessary but not sufficient conditions for action. In this way, affordances as a relational concept helped ecological psychologists explain action non-deterministically (Markus and Silver 2008). While affordance theory was originally applied in the field of ecological psychology, it has since been used in various disciplines including psychology (i.e., perceptual, cognitive, environmental), design (e.g. industrial, interaction, instructional), media and communications, and organization and technology management studies (i.e., IS, human-computer interaction (HCI), artificial intelligence). The following section summarizes how the concept of affordances has been applied and developed in IS.

2.3 The Technology Affordance Literature

The origins of affordance theory in IS can be traced back to Stamper (1985) who applied the concept of affordances as a new approach to organizational analysis and information systems development. Stamper (1985) went beyond Gibson's focus on biological patterns of behavior in extending affordances to social patterns of organized behavior. Through this extension of affordances, he highlighted the social aspects of information systems. This enabled affordances to encompass an integrated socio-technical perspective which provided the foundations for the technology affordance literature.

Since around 2000, interest in affordance theory in IS and related disciplines has intensified. Pozzi, Pigni, and Vitari (2014) provided a synthesis of the literature on affordances within IS, management and organizational studies, which involved a review of 124 articles that were subsequently categorized into four topical concepts: affordance existence, affordance perception, affordance actualization and affordance effects.

Shortly after, a review of the affordance literature specific to IS was conducted by Stendal, Thapa, and Lanamaki (2016) who revealed key assumptions and debates in the literature. A list of seminal works has been provided in *Appendix A*.

Chapters 5-7 of this thesis outline and build on the IS affordance literature focused on innovation management and IT-associated change. In the remainder of this chapter, we describe various conceptualizations of affordances from the literature which relate to and constitute our conceptualization of affordances in building our arguments.

2.4 Affordance Conceptualizations

Within and across disciplines, affordances have been understood in various ways. In the technology affordance literature, there have been various conceptualizations and uses of the term affordance (see Stendal, Thapa and Lanamaki 2016). Many scholars for instance follow the work of Norman (2013) in focusing on the role of perception, such as Leonardi and Vaast (2017) who considered affordances as unique to the particular ways in which the user of the artifact perceives its materiality. In alignment with Gibson's original use of term affordance (Gibson 1986; Stendal, Thapa, and Lanamaki 2016), this research does not limit affordances to those which are perceived. While perception can play a key role in affordance actualization, possible actions can still exist even when users do not perceive them. Moreover, affordances may be enacted without having first been perceived such as in the case of unintended use.

Stendal, Thapa, and Lanamaki (2016) highlighted key assumptions in the IS literature: whether affordances are intended or emergent through action, functional or non-functional, and potential or actual.

Intended / Emergent. "Intended" refers to the notion that affordances are pre-existent in the technology, whereas "emergent" refers to affordances as being generated through a human-object interaction (Stendal, Thapa, and Lanamaki 2016). This research adopts the concept of affordances as emergent, which also aligns with the notion that capabilities can be facilitated through design and that affordances may or may not become actualized (*ibid.*).

Functional / Non-Functional. "Functional" refers to affordances that are specifically functional, whereas "non-functional" refers to those that are not specifically functional, i.e., social affordances (Stendal, Thapa, and Lanamaki 2016). Similar to Leonardi (2013), this research identifies functional and non-functional affordances.

Potential / Actual. "Potential" and "actual" refer to the enabling of action, whether it is the potential for action or the performed action itself (Stendal, Thapa, and Lanamaki 2016). Scholars may study affordances that are perceived by human actors or are actualized. This research adopts the concept of potential which broadly includes performed and unperformed action.

The following sections provide an overview of the key conceptualizations that have been employed in this research.

2.4.1 Technology Affordances

Foundational to this research is the concept of "technology affordances," a term coined by Ian Hutchby in 2001 to refer to all possible actions corresponding to the materiality of artifacts in relationship with humans as well as the environment. In developing this

term, Hutchby applied Gibson's concept of affordances to the context of technology by transposing technology into the notion of environment (Baiyere and Nieminen 2018). Technology affordances as possibilities for action have become conceptualized and understood due to the enabling and constraining aspects of technology within a socio-technical relationship and given context (Hutchby 2001). While the focus of the IS affordance literature has been on the enabling aspects, the notion of constraints plays a key role in some of the literature in bringing attention to the limitations and boundary conditions of affordances (i.e., Leonardi 2011). In our depiction of "false affordances" (Gaver 1991), Paper 2 of this thesis presents constraints which pose limits to the technology affordances in our study.

This research combines two main notions of technology affordances. It follows Gaver's (1991) notion of affordances as a way of focusing on the strengths and weaknesses of technologies in relation to all the possible options that these technologies offer to users and potential users, who in our study are human actors within the organization. This research also follows Volkoff and Strong's (2013) notion that affordances are mechanisms through which action is enabled or constrained and potentially results in offered power and/or the threatened liabilities. By combining these two notions, this research sheds light on the possible actions (and non-actions) and potential effects of technological artifacts while focusing on the strengths and weaknesses of these artifacts for a particular market. In doing so, a study of change is not only made possible, but is focused on significant and non-neutral outcomes for innovation.

2.4.2 Affordances as Relational

Also important for this research is the notion that affordances are constituted in relationships (Leonardi 2011). According to Gibson, affordances are manifested as properties of the environment[2] but they are not exclusive properties of the environment (Robey, Anderson, and Raymond 2013; Hutchby 2001). Instead, they are relational[3] and inherently dependent on humans. Technology affordances are constituted within the socio-technical relationship and embedded within a particular environment. They can therefore be enacted upon in various ways and have multiple effects (Leonardi and Vaast 2017; Zammuto et al. 2007; Fayard and Weeks 2007). As a result, technologies can differ between contexts despite having identical materiality (Hutchby 2001; Leonardi and Vaast 2017). Moreover, there can be instances when technologies perform ironically and paradoxically depending on their contexts (Arnold 2003). This conceptualization of technology, as highlighted in various studies (see Chae and Yeum 2010; Awad and Krishnan 2006), is important because it recognizes that there can be intended and unintended consequences from affordance actualization. This thesis covers an example of an unintended consequence (anthropomorphism) in Paper 3 (Chapter 7).

2.4.3 Affordances as Contributing to Organizational Change

Various scholars have studied and built on the notion that technology affordances have contributed to organizational change, which can come in various forms including new

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[2] Some scholars do not position affordances as manifested properties but as relations between humans and their environment (Robey, Anderson, and Raymond 2013).

[3] While the concept of affordances is inherently relational, we recognize that ICT artifacts are not infinitely relational (see Section 3.3.1).

forms of organizing and new technology (Leonardi 2011; Fayard and Weeks 2007; Zamutto et al. 2007). Within the affordance literature focused on IT-associated change (see Table 10), technology affordances are often depicted as influencing the decisions and actions of human actors which can lead to change outcomes. Robey, Anderson, and Raymond (2013), for example, applied affordances alongside organizational routines theory to explain how the materiality of IT artifacts can play a central role in generating organizational change. In this study and others, organizational change occurs because of the relational nature of affordances, which are constituted in dynamic relationships among humans, technologies, and their environments.

Following the work of Volkoff and Strong (2013) who grounded their work on some of the basic tenets of critical realism, this research applies the theory of technology affordances as generative mechanisms as a foundational concept for Paper 2 (Chapter 6). This concept offers researchers an analytical tool for identifying and analyzing mechanisms (Bygstad, Munkvold, and Volkoff 2016). Mechanisms have been defined by Bhaskar as a causal structure that explains a phenomenon (Bhaskar 1989; Bygstad, Munkvold, and Volkoff 2016). Mechanisms are not deterministic but probabilistic and contingent on other mechanisms within open systems (Bygstad, Munkvold, and Volkoff 2016).

Through their work, Volkoff and Strong (2013) connected organizations and technological artifacts and their assemblages of nested structures containing "emergent causal properties" to IT-associated organizational change. While this concept of technology affordances as generative mechanisms is not universally accepted by scholars, we adhered to this concept in exploring our empirical data. We followed

Volkoff and Strong's (2013) arguments, along with Bygstad et al. (2016), who provided a blueprint for research. Following their lead, our study examined: (1) How the affordances of ICT artifacts and their socio-technical relationships arise in innovation; (2) How technology affordances are actualized; and (3) How these actualizations lead to change and affect innovation (see Chapter 6). In doing so, this theoretical grounding placed the ICT artifact, including its socio-technical relationships, at the center of the research.

2.4.4 Affordances as Contributing to Digital Innovation

A type of organizational change, which is the focus of this thesis, is digital innovation, which includes changes to the technology itself. In the affordance literature, various scholars have studied and built on the notion that technology affordances have contributed to understanding innovation and the role of technology in innovation in organizational settings (see Table 3). To study digital innovation, scholars have applied an affordance lens to identify and examine the perceived (and unperceived) capabilities and potentialities of the technology. Following this scholarship, our research identifies affordances as preconditions for innovation, but this does not imply that such innovative activity will occur (Greeno 1994; Pozzi et al. 2014).

While various studies have applied affordances to study digital innovation, few of them have shed light on what makes this type of innovation distinctly digital. Such studies have discussed uniquely digital properties and affordances without attributing them to the term “digital.” Zammuto et al. (2007), for instance, spoke of digital aspects by referring to the IT’s capabilities, such as integration capabilities and computing power. The three studies highlighted below applied affordances for an improved understanding

of the distinct properties of digital materiality[4] and digital materiality's implications for innovation.

- Tumbas, Schmiedel and Vom Brocke (2015) identified institutional logics employed by innovation leaders in relation to technology affordances. These affordances included properties that are distinctly digital in nature or contain distinctly digital elements. Such affordances included the rapid editability of <digital> drawings, the visualization and presentation of digital content, and the recombination of physical and digital components. Their work highlighted affordances that are distinctly digital and have implications for the types of organizational logics that are employed by the innovation leaders when innovating with digital technologies. They found that digital innovation was carried out by the combination of old and new practices and symbols.
- Autio et al. (2018) theorized digital affordances and some of their implications for business value. They defined digital affordance as a type of technology affordance which is derived from the technical architecture of digital infrastructures. In their review of the digitalization literature, they highlighted the transformative effect that digital affordances can have on business models and processes, which they linked to increased economic and societal value. They identified three key affordances that are supported by digitization: a decoupling between form and function, disintermediation, and generativity.

[4] The broader literature on digital innovation and the role of digital materiality in digital innovation has been summarized in Chapter 3.

- Baiyere and Nieminen (2018) theorized digital affordances to help identify the essence of digitalization in their case study. They positioned digital affordance as a type of affordance which is derived from a technology's affordance. They used this concept to theoretically ground their identification of digital capabilities in innovation agility. They employed qualitative methods to study various aspects of digital innovation including innovation processes and perceived application and utility. Through their work, they advanced the concept of technology affordance by extending the notion of derived affordance which they used as a theoretical bridge enabling the study of digital materiality and its distinctiveness. In doing so, they focused on the applicability of digital artifacts for generating business value by drawing on the technology capability literature. They found that the contextual and relational nature of affordances enabled them to address innovation agility in digital innovation.

This research builds on this literature by applying affordances to address particular aspects of digital innovation, as we have done in our three papers. In the discussion of this thesis (Section 8.3), we utilize the term "digital affordance" as defined by Autio et al. (2018) and Baiyere and Nieminen (2018) who conceptualized the distinction between technology affordance and digital affordance.

2.5 Applicability and Significance of Affordances for this Research

Based on all of these different yet complementary conceptualizations of affordances, it is reasonable to conclude that an affordance lens is a suitable construct for enabling this

research to understand and theorize the ways in which technology artifacts generate change within digital innovation for low-income markets. This conclusion is supported by various arguments from the literature. First, the affordance perspective enables researchers to understand the roles of technology artifacts within their contexts (Leonardi and Vaast 2017; Majchrzak, Markus, and Wareham 2016). Secondly, the affordance perspective provides a better understanding of IT-associated change along with how and why a technology can (non-deterministically) generate different outcomes and be used in different ways in different contexts (Anderson and Robey 2017; Volkoff and Strong 2013). Such applications are integral to this study. This research therefore draws on technology affordance theory as a relevant lens for explaining the role and dynamics of digital technologies in digital innovation.

Furthermore, the contextual and relational nature of affordances allows this research to address the generativity and malleability of digital innovation in ways that are rigorous and insightful. Affordances addresses the material aspects of technology, which exist independent of people, alongside the relational and functional aspects, which exist dependent of people and are constituted within relationship (Leonardi 2011). According to Sørensen (2011), "the concept of affordances establishes clarity in the distinction between the possible (design) and the actual (use), thereby replacing the uneasy distinction between the interrelation of social and technical systems."

During the design phase of the research, we considered possible alternative perspectives including organizational routines (i.e., Feldman and Pentland 2003; Robey, Anderson, and Raymond 2013), Actor-Network Theory (Latour 2005), and sensemaking (i.e., Seidel, Recker, and Brocke 2013). While various possible alternatives would address

relevant issues, an affordance lens was employed to reveal how the relationships among technologies, humans and their environments were interacting to generate effects within this context of low-income markets and in relation to market-based approaches to digital innovation more broadly. This use of affordance theory is significant because it helps sheds light on some of the most important and conceptually significant features of the conditions of digital innovation that would not have been possible through other theories.

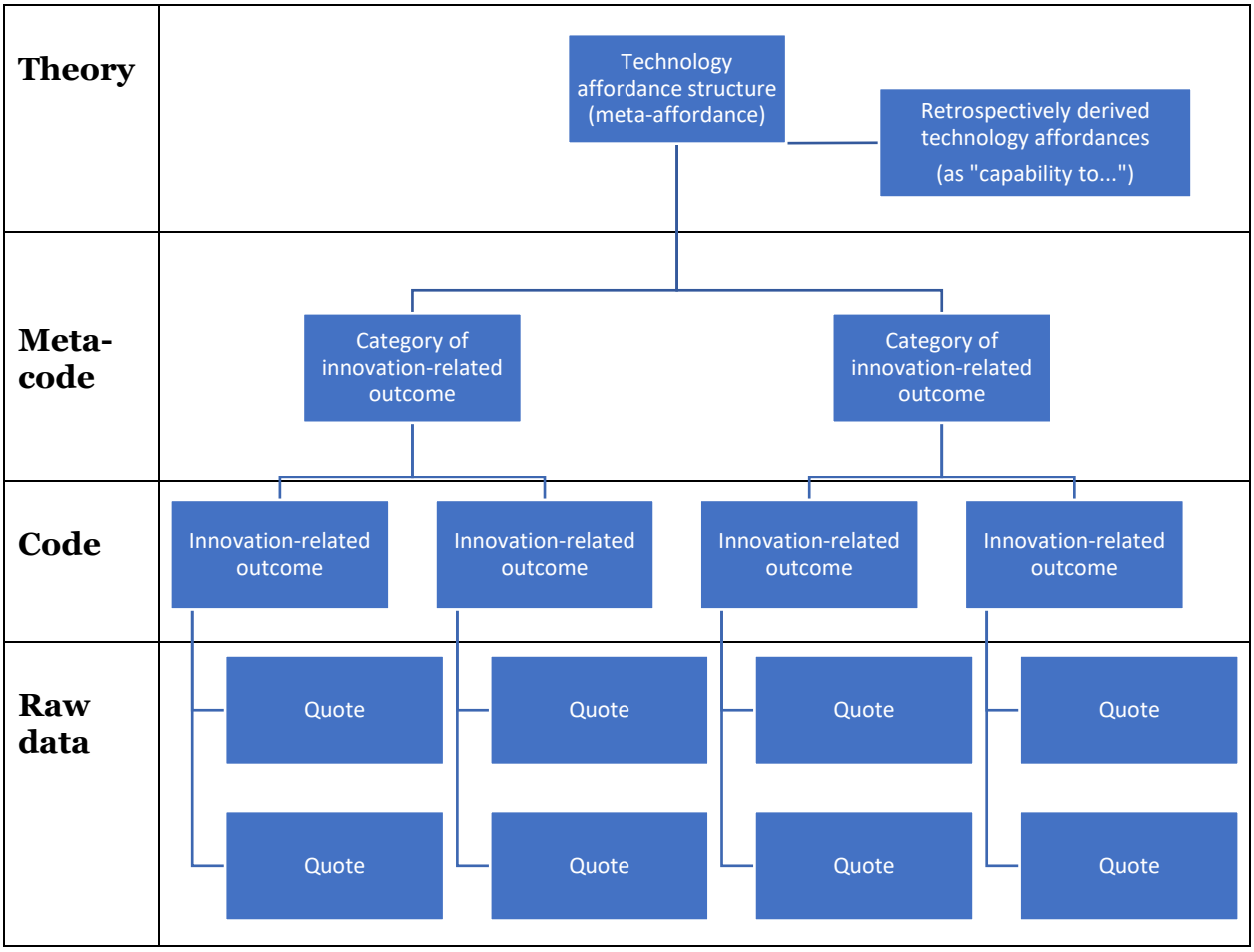
2.6 Application of Technology Affordances in this Research

Our research followed the IS affordance literature in our methodological approach, particularly in our application of affordances and in our selection of units of observation, as highlighted in this section and expounded upon in papers 1-3.

Affordances Application

We applied affordances as a conceptual tool following Zammuto et al. (2007) who defined affordances in terms of "capabilities" and depicted them as being enabled by the symbiosis of technology and organizational features. It is these capabilities which independently and/or jointly enable organizations to develop new forms of organizing and new outputs, such as refined technologies and processes (*ibid.*). Our approach to identifying such affordances in our data is illustrated by the Coding Tree in Figure 2 and described as follows.

Figure 2. Coding Tree



The research identified affordances through a multi-step analytical process that involved coding the data derived from our case study observations. Our three studies (papers 1-3) followed Miles and Huberman's (1994) guidelines for thematic coding in applying codes and meta-codes to our data. The codes were descriptive and interpretive in nature, while the meta-codes were inferential and were used to categorize the codes into themes to explain the phenomena being studied. Our analyses identified innovation related-outcomes which pertained to the various digital innovation dynamics: the fulfillment of organizational goals and response to emergent barriers and opportunities

(Paper 1); the fulfillment of organizational goals, specifically strategically targeting a specific customer segment (Paper 2); and the response to emergent opportunities, specifically anthropomorphic perceptions among users which can help facilitate user adoption (Paper 3). In this way, papers 2 and 3 directly built on Paper 1 by providing an in-depth examination of two of the categorical areas that were identified in Paper 1, as was further elaborated upon in Section 1.3.

Our application of codes and meta-codes enabled the research to explain and theorize organizational form and function (Zammuto et al. 2007). In Paper 1, the research introduced and developed the meta-affordance "innovation affordance" and its core dimensions to explain how technology affordances were perceived and used by innovation leaders in our case. We use the term "meta-affordance" to depict a structure of affordances that explains a set of affordances and their relationships within a given context. In papers 2 and 3, sets of technology affordances were derived from the coding structure to help explain the capabilities that were enabled by technical and organizational features which underpinned the innovation dynamics of strategic customer targeting and anthropomorphism. These theories, derived directly or inferentially from the coding structure, helped address our research question, *what are the roles and dynamics of technology affordances in digital innovation?* By having papers 2 and 3 focus and expound upon subtopics from Paper 1 for a more in-depth analysis, our study reveals how a multi-level approach (which we have described in Section 1.2) can provide additional value in addressing our research question.

Through our multi-level approach to studying affordances, this research combined approaches used by IS scholars to identify a multi-level structure of affordances. Prior

research has applied and identified affordances as multi-level, which is made possible because chains of affordances can emerge when the technology is being utilized (Stendal, Thapa, and Lanamaki 2016). Zhao and Zhu (2016), for instance, identified "task affordance" and five underlying affordances which they positioned as dimensions of task affordance. To conceptualize a multi-level approach to affordances, Baiyere and Nieminen (2018) introduced "derived affordance" as a term for second order derivatives of affordances. Our multi-level approach to studying affordances employs sequential interrelated studies and thereby enables an in-depth research program that is not possible through a single conceptual approach. This novel approach presents a significant methodological contribution of this research.

Units of Observation

As described below, this research followed various scholars in placing decision-making and managerial intent as key events to be observed.

> *Decision Making*. This research examines how technology affordances can enact and foster digital innovation especially through the recombination of affordances based on organizational decisions. The technology affordance literature has only recently begun to examine the role of decision-making. Sørensen (2011) and Leonardi (2011) provided the conceptual link between affordances and decision-making. Sørensen (2011) positioned the notions of affordances and constraints in the context of decision-making pertaining to the development of organizational

information services[5]. Leonardi (2011) highlighted the role of decision-making based on whether humans perceive that a technology will afford or constrain their goals. In a more recent study, Verhulst and Rutkowski (2018) examined the effects of mobile technology affordances on the decision-making processes used by a police force in their daily routines.

Managerial Intent. This research also examines how technology affordances can enact and foster digital innovation especially in relation to managerial intent. To date, few technology affordance scholars have examined managerial intent. Zammuto et al. (2007, 760) provided the conceptual link between affordances and managerial intent in stating: "We have offered affordances, created by the conjunction of IT and organization features coupled with managerial intent, as one way of moving forward in developing conceptualizations of organizations appropriate in an IT-intensive world."

Other related conceptualizations are also highly relevant for studying affordances and to this research. Pozzi, Pigni and Vitari (2014), for instance, conceptualized an organizational affordance as the potential for action which is coordinated by a group of individuals such as a business unit or team. When an affordance is considered by a group using the technology in a similar way, Leonardi (2013) argued that such shared affordances have the most profound implications for organizational change. It is

[5] The focus of this research's analysis is on digital innovation management hence an elaboration of the concept of services and its relevant literature has not been provided in this thesis. As depicted in this thesis, this research encompasses a broader perspective than "the services perspective" which, according to Mathiassen and Sørensen 2008, "focuses mainly on the everyday and at times idiosyncratic use of IT artifacts." Nonetheless, the author recognizes that much work has been done by scholars to theorize the concept of IT-based services (see Mathiassen and Sørensen 2008).

through these actions of perceiving and enacting the affordance within a social, organizational setting that innovation is moved forward in development and implementation.

Along with the notion of shared affordances, the human construct of organizational goals is also highly relevant. This research highlights the role and dynamics of organizational affordances that are typically shared among innovation leaders in relation to existing organizational objectives. The technology affordance literature establishes a consensus around the relation of affordances to the materiality of objects and goal-oriented action (Stendal, Thapa, and Lanamaki 2016). In the literature, affordances have been defined as arising "from the relation between objects such as IT artifacts and goal-directed actors" (Volkoff and Strong 2013, 832) and they have also been conceptualized as "possibilities for goal-oriented action" (Pozzi et al. 2014). While the centrality of organizational goals varies among affordances studies (i.e., Strong et al. 2014; Zammuto et al. 2007), organizational goals are often positioned as contextual elements that play a key role in helping shape managerial attitudes and perceptions which in turn can have consequential outcomes for innovation. Organizational goals can affect how technology affordances are perceived and enacted, and can also signpost some of the underlying logics used in managerial decision-making related to affordances. This research, particularly papers 1 and 2 (chapters 5-6), demonstrates how technology affordances generated changes to the innovation in related to associated goals (among other socio-technical and contextual characteristics).

2.7 Conclusion

This chapter presented the theoretical foundations of this thesis through an overview of affordance theory and its application for technology studies. We provided an overview of the technology affordance literature and discussed relevant definitions and conceptualizations of affordances which facilitate our research on digital technology and its socio-technical relationships. We also outlined our application of affordances in this research.

This thesis extends the affordance literature in IS by identifying the role and dynamics of technology affordances in digital innovation. It employs an affordance lens to explain how technology affordances play a central role in constituting innovation practice which has significant implications for innovation strategy and management. Through this work, the research provides an improved understanding of affordance theory and extracts more of its value for scholarship and practice. The following chapters further develop these ideas by elaborating upon the theories and concepts of digital innovation and digital materiality, which facilitate this research on digital innovation for low-income markets.

Chapter 3: Digital Innovation

3.1 Introduction

Since the start of this millennium, rapid developments in digital technology have occurred as evidenced by the growing prevalence of digital infrastructures and techniques such as cloud computing, interrelated computing devices (i.e., IOT systems), service-oriented architectures, distributed ledger technologies, virtual and augmented reality, digitally-powered automation (i.e., robotics and 3D printing), service-oriented architectures, open source, big data, machine learning, and many others (Yoo et al. 2010). Digital technologies have become ubiquitous across the globe and are transforming the lives of individuals and organizations. Today, it is estimated that over five billion people own a mobile phone (Silver and Cornibert 2019), which is more than the number of people who have access to basic utilities such as toilets and running water (UNICEF and WHO 2019). Many organizations around the world and in every industry have adopted digital technologies and are increasingly on a path toward digitization.

Technological change in organizations, which is now broadly understood as innovation (Dodgson 2017), has become increasingly commonplace and for a variety of reasons. Innovation is helping organizations meet their business objectives, stay relevant in the market, and adapt to their ever-changing environments (Dodgson 2017; Nylén and Holmström 2015). Innovation also offers organizations a way to improve or create new products, services, and processes, and at times, expand into new markets and adjacent industries. In addition to transforming organizations, digital technologies are reshaping entire markets by changing traditional industrial boundaries and business models.

Organizational spending on innovation is on the rise across all industries (Jaruzelski, Chwalik, and Goehle 2018) and this investment has been directed disproportionately toward certain types of innovation, particularly those that societies deem of great value. For instance, innovations that involve trendy technologies (i.e., nearing the peak of the Gartner Hype Cycle) or have the potential for higher rewards for customers and shareholders receive disproportionately more attention and investment. Financial technology (fintech) innovation, which is the focus of this thesis and involves innovating with technologies in ways that aim to improve the delivery and use of financial services, has experienced growing attention on a global scale. The value of global venture capital investment in fintech companies has skyrocketed since 2013 and it nearly doubled during the time of this research, climbing from $26.7 billion to $55.4 billion in 2017-2018 (Szmigiera 2020).

This chapter presents the conceptual foundations of innovation for this research. It progresses in the following manner. First, we provide background on the context of digital innovation and its growing prevalence. Next, we outline the literature on digital innovation and highlight the main conceptualizations and categorizations of digital innovation and innovation management. Subsequently, we define the ICT artifact (digital technology) and present various conceptualizations of ICTs which are foundational to this research. We then briefly describe the ICT under review in our case study and the extent to which it is examined. We conclude by outlining other key literature that is highly relevant to our research context: ICT innovation for low-income markets and digital financial services in microfinance. Throughout this chapter, we establish our working definitions for this thesis.

3.2 Digital Innovation Management

Digital innovation is distinctly and inherently different from analog innovation processes of the Industrial Era (see Ciriello, Richter and Schwabe 2018 and Nylén and Holmström 2015). This is because digital materiality consists of unique properties that create new types of innovation and innovation processes. Examples of such properties include architectural and material components– typically the combination of physical and material elements– which afford new opportunities such as the introduction of new "powerful forms of digital flexibility and scalability" (Henfridsson, Mathiassen and Svahn 2014, 30). Such opportunities make innovating with digital technologies attractive for organizations in helping them meet business objectives and discover new business models (Ciriello, Richter, and Schwabe 2018; Nylén and Holmström 2015). It is therefore unsurprising that innovating with digital technologies has become ubiquitous across industries. Organizations across sectors are increasingly digitizing their products, services, and processes.

The unique properties of digital technologies have implications for the design and management of digital innovations (Henfridsson, Mathiassen, and Svahn 2014; Yoo et al. 2012). The nature of innovation and the act of innovating has evolved. With the introduction of digital, innovation processes are relatively rapid and a challenge to predict and control (Nylén and Holmström 2015; Henfridsson, Mathiassen, and Svahn 2014; Yoo et al. 2012, 2010). Hence, digital innovation is associated with a new organizing logic for innovation and thus requires new sets of dynamic tools to support innovation practice (Ciriello, Richter, and Schwabe 2018; Nylén and Holmström 2015). Scholars have called for more innovation studies to examine these dynamics. This

research responds to this call, particularly to Yoo et al.'s (2010) call for scholars to develop and validate analytical models to understand how various stakeholders are related to innovation patterns.

According to Nylén and Holmström (2015), managing digital innovation shares many of the same elements as managing non-digital innovation, such as the analog innovation processes of the Industrial Era. Digital innovation processes, however, have additional elements which must be considered in innovation strategy and management (*ibid.*). These additional elements stem from the distinct and unique characteristics of digital technology, which we will discuss in Section 3.3. Such elements (i.e., technical malleability and generativity) make innovation processes particularly rapid, difficult to control, and complex (Yoo et al. 2012, 2010; Henfridsson, Mathiassen, and Svahn 2014). Scholars have debated whether existing management theories are still applicable for studying digital phenomena or whether digital theories are required to understand some of the foundational concepts of digital materiality, such as a new type of scaling, a shift away from physical production, and Yoo's notion of "deferred and temporary binding" (Baiyere et al. 2019). A stream of innovation literature is dedicated to understanding and exploring digital innovation and the effects of digital materiality. Before providing an overview of this literature, we first summarize some of the key aspects of innovation management, drawing from the broader innovation literature.

3.2.1 Literature Review

Innovation Management

In categorizing innovation and the work of innovation leaders, the literature identifies four main types of innovation which also apply to digital innovation: technical,

administrative, product, and process (Utterback 1994). Under each of these categories, the work of innovating encompasses a variety of activities, which Oliveira, Machado, and Gustavo (2017) characterize as "discovery, experimentation, development, imitation, adoption of new products, processes or organizational configurations." In Kohli and Melville's (2018) review of digital innovation management, they categorize the various activities they studied into four main groups: initiating, developing, implementing and exploiting as defined below.

- Initiating refers to the triggers behind innovation which involve opportunity identification and decision-making;
- Developing refers to the designing, developing and adoption of the innovation;
- Implementing refers to the diffusion of the innovation, including the installation and maintenance;
- Exploiting refers to the work done to enhance performance such as reusing and recombining data and artifacts, and leveraging existing systems for new purposes and to maximize returns (i.e., Cooper and Zmud 1990).

Kohli and Melville's (2018) theoretical framework of digital innovation can be found in *Appendix B*.

According to the literature, innovation management is complex and involves interdisciplinary work which can be crosscutting within organizations (Bagno, Salerno, and Oliveira da Silva 2017; Tatikonda and Montoya-Weiss 2001; McDermott and O'Connor 2002). As defined by Avgerou (2000), the ICT development process from a social perspective is an interaction that changes the technical means and information available in people's work within an organization. In this definition, the importance of

the social dynamics and social requirements is emphasized (*ibid.*). Also emphasized is the organizational and social change which emerge from the development and/or adoption of processes (*ibid.*).

In organizations, innovations rely on information and how it is selected, gathered, and used by stakeholders. Someone within the organization must decide what information is required, by whom, where, when and how (Liebenau and Backhouse 1990). Furthermore, new sets of challenges and opportunities have emerged as a result of the increased use of digital technologies and the integration of digital and physical materiality in work practices (Yoo et al. 2010). Effectively dealing with information requires resources and analytical skills which managerial stakeholders often lack (Liebenau and Backhouse 1990). Digital tools and other information technologies have been used to help solve such problems, but this has led to a massive increase in the volume of available information at any given time– an amount that is perhaps beyond the capacity of an organization to effectively utilize (*ibid.*). Conclusively, digital innovation requires new skills, some of which involve analysis, design, and the synthesis of information to make it useful (Nylén and Holmström 2015; Liebenau and Backhouse 1990).

The work of innovating is especially important for stakeholders who are developmentally oriented because digital innovation requires continuous learning (Nylén and Holmström 2015). The practices of experimenting, adapting, and developing are a response to changing conditions, new insights, emerging challenges, and user feedback (Patton 2011). According to Patton (2011), innovation leaders aim to discover

and articulate principles of intervention and development, not arrive at a fixed model that is generalizable.

> *They <innovation leaders> are committed to continuous progress, ongoing adaption, and rapid responsiveness. No sooner do they articulate and clarify some aspect of the process than that very awareness becomes an intervention and acts to change what they do. <They also> assume a world of multiple causes, diversity of outcomes, inconsistency of interventions, interactive effects at every level.* (Patton 2011, 41)

Technological determinism has no place in such a work practice. Nevertheless, this does not preclude that the role of technology is insignificant or cannot be studied. On the contrary, this thesis argues that technology plays a significant role in digital innovation which has consequential effects for innovation strategy and management. Such roles can be studied and better understood by employing conceptual tools such as affordance theory, which this research and prior studies have demonstrated.

Digital Innovation

The digital innovation literature is diverse and diffuse. Within this growing body of literature (see *Appendix C*), scholars have studied various topics and units of analysis such as structures (i.e., infrastructures (Tilson, Lyytinen, and Sørensen 2010), platforms (De Reuver, Sørensen, and Basole 2017), and social media (Alaimo and Kallinikos 2017)), organizing logics (Henfridsson, Mathiassen, and Svahn 2014; Yoo et al. 2010), and boundary resources (Eaton et al. 2015). Kohli and Melville (2018) categorize the literature into three broad streams: adoption antecedents (Fichman 2004; King et al. 1994; Teo, Wei, and Benbasat 2003), design and development (Markus, Majchrzak, and

Gasser 2002; Siponen, Baskerville, and Heikka 2006; Barrett et al. 2015), and organizational change (Leonard-Barton 1988; Orlikowski 1996; Singh et al. 2011). Some studies span across streams and cover topics that do not fall succinctly into one stream or another (Kohli and Melville 2018), such as digital innovation initiation (Agarwal and Sambamurthy 2002; Segars and Grover 1999), the exploitation of existing information systems (Bygstad 2010; Armstrong and Sambamurthy 1999), the role of knowledge (Alavi, Maryam, and Leidner 2001; Carlo, Lyytinen, and Rose 2012), assimilation gaps (Fichman and Kemerer 1999), and the role of technological framing (Mishra and Agarwal 2010).

Digital innovation, according to Nylén and Holmström (2015), is associated with a new logic and therefore requires a micro-level examination of digital technologies to identify the concrete ways in which value can be generated from these artifacts. To extract the benefits of digital innovation, organizations must understand the unique properties of digital innovation processes (Orlikowski and Iacono 2001; Nylén and Holmström 2015). Yet, understanding digital technology presents a challenge for many organizations (Yoo et al. 2010; Nylén and Holmström 2015). This involves generating new knowledge which can challenge existing views and assumptions (Nylén and Holmström 2015). Organizations must also develop new sets of tools and innovation managers must acquire new skills in addition to existing skills (*ibid.*). Research has begun to shed light on some of these managerial issues. A summary of highly relevant literature is presented in Table 1.

Table 1. Key Literature on Digital Innovation Management

Key Literature: Digital Innovation Management	
Andrade-Valbuena and Torres (2018)	Analyzed how managers within organizations reflect on technological shifts when they recognize innovation opportunities. They argued that a deliberated reflection of technological shifts by managers is useful because it enhances innovative performance, i.e., it promotes the use of new technological releases in the development of innovation processes.
Nylén and Holmström (2015)	Argued that digital innovation is associated with a new logic and that a micro-level examination of digital technologies is required to identify the concrete ways in which value can be generated from these artifacts. They used secondary sources to develop a managerial framework for diagnosing and improving digital product and service innovation by identifying five areas that need managed and evaluated: (1) user experience based on levels of usability, aesthetics and engagement, (2), value proposition to users based on dynamics of product and service bundling, commissions to channel owners, and customer segmentation, (3) data gathering through various digital channels, termed "digital evolution scanning," (4) human capability within organizations, and (5) coordination through improvisation (p. 58).
Ringberg, Reihlen and Rydén (2018)	Argued that technology and mindsets of managers should be analyzed jointly "as they are fundamentally co-constitutive albeit with different levels of interaction." They developed a Technology-Mindset Matrix consisting of four interaction types: incremental innovation, radical technological innovation, radical mindset innovation, and revolutionary innovation. They claimed that each interaction type generates unique innovative outcomes which they substantiated with evidence from case examples.

Next Steps for the Literature

Until now, the existing literature on digital innovation in organizations has largely overlooked the nature of digital technology and its distinct and unique characteristics (Nylén and Holmström 2015). Another gap in the literature highlighted by Nylén and

Holmström (2015) is that most of the research tends to study digital technology from a macro-level perspective and thus fails to offer strategic recommendations based on deep technical insights. This thesis therefore helps address some of these issues by providing insights into digital technologies within an innovation process from an affordance perspective.

This thesis is a response to the call by various scholars for more research to examine digital innovation strategy and management (i.e., Nylén and Holmström 2015; Ringberg, Reihlen, and Rydén 2018). Nylén and Holmström (2015) state that more research is needed to understand the distinct and unique roles of digital technologies and their influence on the innovation process. Yoo et al. (2010) called for innovation scholars to develop and validate analytical models to understand how various stakeholders, specifically heterogenous actors at the periphery of digital innovation, are related to innovation patterns. This research helps address some of these issues through an empirical study of digital technologies within an innovation process using empirical evidence and an affordance perspective. Through our three studies (papers 1-3), our research contributes to this literature by demonstrating how an affordance lens can shed light on digital innovation, with theoretical and practical implications for innovation strategy and management.

3.2.2 Conceptualizations of Digital Innovation

Digital innovation, similar to innovation generally, has been conceptualized by scholars in a variety of ways over the years. Kohli and Melville (2018) identify three main conceptualizations of digital innovation in the literature, as follows:

- One conceptualization, “IT innovation,” consists of an already-existing technological artifact that would be new to an organization. Research following this conceptualization, such as Fichman (2004) and Jeyaraj, Rottman, and Lacity (2006), focuses on the adoption and diffusion of the artifact which would involve reconfigured organizational processes, products and services (Kohli and Melville 2018). As discussed later in this section, this thesis follows this conceptualization for identifying digital innovation in our case study.
- Another conceptualization, labeled “digital innovation,” consists of a product-centric standpoint whereby new combinations and configurations of physical and digital elements form new products (Yoo et al. 2010; Lee and Berente 2012; Kohli and Melville 2018). This conceptualization focuses on the development of new technological artifacts and relevant implications for innovation design and management (Kohli and Melville 2018). Research using this second conceptualization may consider the underlying architectures of the artifacts along with external factors which influence the innovation (Kohli and Melville 2018). This conceptualization provides key foundations for our research in focusing on digital affordances and their relationship to technology development.
- The third conceptualization, termed “IS innovation,” consists of the application of IT within organizations which leads to significant changes including new products, services, business models, or processes (Kohli and Melville 2018; Fichman, Dos Santos, and Zheng 2014; Swanson 1994). Within this conceptualization, the dimensions of change associated with the development of IT enabled services– technical and/or organizational– tend to be the focus of research (Kohli and Melville 2018). Furthermore, digital innovation may be

marked by the reconfiguration of human and other resources, with a constant evolution of roles, identities, relationships, and practices within organizations (Yoo et al. 2010). This conceptualization provides key foundations for our research in our examination of IT-associated change (i.e., organizational processes involving strategic customer targeting) and socio-technical outcomes (i.e., social and technical anthropomorphism).

According to Kohli and Melville (2018), these three conceptualizations have commonalities. These conceptualizations consist of outcomes that involve IT-enabled changes to products, services, and processes (*ibid.*), hence the technology is central to the phenomena under review. This can be differentiated from the IT and innovation literature which focuses on the development of non-IT products that are supported by use of IT, i.e., open innovation (*ibid.*). The three conceptualizations also consider design, development, and implementation to be key aspects of innovation (*ibid.*). Finally, internal and external environmental factors are important for shaping the innovation and for being shaped by the innovation. This considers the role of the organization and its culture, structure, strategies, processes, capabilities, resources, routines, and ways of working and communicating. It also considers external forces and other influencers which might be economic, political, cultural, social, physical, and/or environmental in nature. Digital innovation therefore pertains to the intentional efforts of organizations to orchestrate new products, processes, services, platforms, or business models within a given context (Hinings, Gegenhuber and Greenwood 2018).

Following the first conceptualization of innovation, "IT innovation" (Kohli and Melville 2018), this research identifies digital innovation as the case organization's adoption and

diffusion of digitally enabled products, services and processes that are new to the organization (Fichman 2004; Jeyaraj, Rottman, and Lacity 2006). This follows Heeks (2012) who described innovation as *doing new things in new ways*. For organizations, this may mean trying something for the first time which others in the market might already be doing (Rogers 1983). Innovation originates from a new idea or market opportunity (Oliveira, Machado, and Gustavo 2017). Innovation is particularly important for organizations entering low-income markets, the context of this research, because it can help organizations succeed in these new and low-resourced markets by enabling the organizations to adapt and overcome market constraints (Krämer 2015). Scholars also note that it can help drive economic development in countries with limited infrastructure or resources (Barrett et al. 2015).

Under our definition, the term "innovation" does not imply *successful* innovation. Innovation projects may not lead to successful innovations or intended user or business outcomes immediately or in the longer term. The CTO of Stanley Engineered Fastening stated, "If everything we do is a success, then we're not trying hard enough and not going far enough from the core" (Jaruzelski, Chwalik and Goehle, 2018, 21). Service innovation, which is the type of innovation studied in our research, is particularly nebulous in terms of expected outcomes. While the tendency to fail is similar for product and service innovation (Cass and Wetzels 2018), service innovation tends to involve greater levels of risk and its outcomes are usually ambiguous, according to Visnjic, Turunen and Neely (2013). Furthermore, digital technologies enable a relatively lower cost for innovating which equates to lower costs of failure (Nylén and Holmström 2015). We might therefore expect growing rates of innovation and innovation failure in

the market. However, it could be argued that innovation failure may not increase at the same rate as innovation because organizations are developing and strengthening their capacity to innovate over time. Global Innovation 1000 studies have shown that innovation standards have increased as businesses have become more competitive (Jaruzelski, Chwalik and Goehle 2018, 21-22). While various scholars have examined factors that separate successful from unsuccessful innovations (Storey and Hughes 2013), our research does not offer such evaluations but instead focuses on particular innovation processes and dynamics.

Dimensions and Nature of Digital Innovation

Innovation is dynamic, integrated and networked (Liebenau and Khiaonarong 2009; Yoo et al. 2010). Dodgson (2017) writes:

> *Innovation is the arena where "rational," quantitative assessments of risk and market and technological opportunities, and evidence-based impartial decision-making, meet the "irrational" realities of organizational politics, and personal ambitions, enthusiasms, intuitions, and conflicts.*

Given these various dimensions and intersections, it may seem unsurprising that scholars have identified the nature of innovation as inherently uncertain, complex, and evolutionary (Freeman 1994). Innovation, for such reasons, is difficult to study and understand. Hence, innovation scholars have approached the topic from various disciplines and perspectives and have focused their research on subtopics, such as innovation strategy, management, and organizational competencies.

According to the literature, digital innovation is a type of innovation that refers to an intrinsic integration between physical and digital elements (Kohli and Melville 2018; Lee and Berente 2012; Yoo 2010). According to Yoo et al. (2010), digital innovation

comprises of an emerging structure which results from various forces of uncoupling and integration. Like innovation more broadly, it is categorized as multi-dimensional and complex. Scholars have identified various properties and dimensions which help explain the behavior of digital innovation and how it is different from other types of innovation (Tuomi 2002; Zammuto et al. 2007; Zittrain 2006; Yoo 2010). Yoo et al. (2010, 2) suggested six dimensions of digital innovation: convergence, digital materiality, heterogeneity, generativity, distributed locus of innovation, and accelerated pace. Of this list, the dimensions that most affect innovation processes, according to Yoo et al. (2010, 3), are heterogeneity, generativity, distributed locus of innovation, and accelerated pace. Yoo et al. (2010, 3) stated that the combination of these dimensions "leads to the emergence of dynamic, non-linear patterns of digital innovation." This can help explain how digital innovation contains certain generative properties (Henfridsson and Bygstad 2013; Tilson, Lyytinen, and Sørensen 2010) which not all types of innovation possess.

Boland, Lyytinen, and Yoo (2007), Van De Ven et al. (1999), and Yoo (2010) depict how the generative properties of digital technologies– which we expound upon next– can grow in magnitude and lead to increasing nonlinearity and complexity for the digital innovation process. This provides challenges and opportunities for organizations innovating with digital technologies. In the coming section, we define and conceptualize the technological artifact at the center of digital innovation: information and communication technology (ICT) and specifically digital ICTs.

The technological malleability and social heterogeneity of digital technology will make digitalized products generative, the capacity to produce unpromoted changes derived by uncoordinated and heterogenous actors (Tuomi 2002;

> *Zammuto et al. 2007; Zittrain 2006). As digitized products become more generative – and thus their innovations more unbounded – the organizational challenges to manage the innovation process will become increasingly nonlinear and complex (Boland et al. 2007; Van De Ven et al. 1999).*
> (Yoo 2010, 224)

3.3 The ICT Artifact: A Socio-Technical Interpretation

Alongside digital innovation, an understanding of what constitutes the technological artifact under investigation– the ICT– is required. This research borrows from Wilson and Heeks (2000) in defining an ICT as an "electronic means of capturing, processing, storing, and disseminating information." The following paragraphs highlight some of the key conceptual foundations which underpin our usage of this term in the research. This subsection highlights how the material nature of digital ICTs is significant because digital has unique properties which enable new types of innovation and innovation processes.

3.3.1 ICT properties – for designing and implementing digital innovation

The ICT artifacts of particular interest to this research are digital technologies, which consist of a combination of material and non-material, digital elements. The digital elements (AKA digital artifacts) are non-material bitstrings– sequences of zeros and ones– that are regulated by structures (Hui 2016; Faulkner and Runde 2013). These elements take form on the material elements of the technology, such as on a screen or the backend of a computer program (Hui 2016). Digital technologies consist of unique properties which enable new types of innovation and innovation processes (Nylén and Holmström 2015). These processes are comparatively rapid and difficult to predict and

control (Nylén and Holmström 2015; Henfridsson, Mathiassen, and Svahn 2014; Yoo et al. 2012; Yoo 2010). Some of the key characteristics of digital technologies include data homogenization, editability, programmability (and reprogrammability), addressability, sensibility, communicability (including openness and interactivity), memorability, traceability, associability, and distributedness (Yoo et al. 2012, 2010; Kallinikos, Aaltonen, and Marton 2010). In Yoo et al. (2010), participants of a workshop identified three main design characteristics that are particularly relevant in facilitating digital innovations: the homogenization of digital data, the programmable digital architecture, and digital technology's self-referential nature.

ICTs as Malleable

The literature appears to have reached a consensus that a key attribute of digital technology is malleability, that is, the ease at which the technologies can be edited and reconfigured (Tiwana, Konsynski, and Bush 2010; Yoo et al. 2010). Various scholars have discussed the degree of malleability (see Kallinikos, Aaltonen and Marton 2013). As summarized by Kallinikos, Aaltonen, and Marton (2013), digital artifacts have an ambivalent ontology and are in a perpetual state of development. Related attributes assigned to digital technologies include: incomplete and evolving (Zittrain 2008; Garud, Jain, and Tuertscher 2008); open, interactive, and having transfigurability (Kallinikos, Aaltonen, and Marton 2010; Kallinikos and Mariategui 2011); having recombinability and infinite expansibility (Faulkner and Runde 2009); having transferability and adaptability (Zittrain 2008; Benkler 2006; Lessig 2006); unbounded, resisting reification, and largely unstable (Ekbia 2009). This conceptualization of digital

technologies as malleable is foundational for our research which examines technological changes within the innovation development process as a key unit of analysis.

ICTs as Generative

Alongside malleability many scholars agree that a key attribute of digital technology is generativity (Avital and Te'Eni 2009; Yoo et al. 2012). Generativity refers to "a technology's overall capability to produce unprompted change, driven by large, varied, and uncoordinated audiences" (Zittrain 2006, 1977). In our study, we closely examine how digital technologies generate change in and through digital innovation, which includes unprompted change (i.e., anthropomorphic outcomes in our case study).

ICTs as Relational

In honoring the socio-technical tradition of IS research and practice (Land 1987; Checkland 1981; Mumford et al. 1985) and in recognizing that technology's effects on organizations are socially constructed (Leonardi and Barley 2010), the conceptualization of the technological artifact for this research includes the relationship between the technology and people, termed the "socio-technical" relationship, which is where technology affordances are situated within particular environments. Our conceptualization of digital innovation, for instance, accounts for the socio-technical systems, infrastructures, and relationships required to support the existence of the ICT artifacts.

In applying this conceptualization, digital innovation can be articulated and identified as the configuration or reconfiguration of socio-technical elements within relationships. These relationships are important especially given the dynamic state of digital

technologies which are constantly evolving as a result of social and economic practices (Orlikowski and Iacono 2001). These notions align well with the concept of digital as being editable, unbounded, and infinitely expansible. The infinite number of ways that digital technologies can be configured are generating consequential outcomes for the humans and organizations involved in addition to the ICT. For example, as digital technologies are configured in new ways, a myriad of opportunities and challenges are introduced such as through technological discontinuity and market fragmentation (Benner 2010; Rothaermel and Hill 2005; Yoo 2010; Tilson, Lyytinen, and Sørensen 2010). These socio-technical notions help ground our usage of affordances, which refer to action possibilities stemming from situated interrelationships.

ICTs as Distinct (Not Infinitely Relational)

While this research focuses on the relational aspects of technology (in focusing on the dynamic interactions between people and technology and the environment), this research also recognizes that technology is distinct from its user. This notion is supported by the concept of *functional simplification and closure* (Kallinikos 2005; Luhmann 1993) which helps explain how human interaction with technology is conditioned and limited as a result of certain attributes that are inherent to technology. This can be distinguished from the literature drawing from the sociomaterial tradition, which does not draw a line between the relational and physical. This research's adherence to the conceptualization of technology as not infinitely relational aligns well with the concept of affordances, which is relational and particular to situated interactions (see Chapter 2).

ICTs as Purposeful

Given the research's primary interest in a specific set of perceptions, utilizations, and effects of technology affordances, this research examines the materiality of technological artifacts to the degree in which these material properties were considered useful within the socio-technical relationship. The usefulness of ICT for users (i.e., the organization under review and its clients) was not evaluated by the research but built into the research as a starting assumption. Hence, a conceptualization of technology as purposeful (Orlikowski and Iacono 2001) was also foundational to this study. This conceptualization is illustrated by the case study's framing of the terms "digital financial services" and "innovative solutions" (see Section 4.4.1) as well as the study's focus on the digital innovation process, which was intrinsically linked to the organization's intended use of the artifacts.

3.3.2 Overview of the ICT Artifact under Review: Interactive Voice Response

The research examined a pilot project involving the development and use of interactive voice response (IVR) technology. IVR is a computerized phone system that enables a two-way conversation between a real person and a pre-recorded voice in an interactive manner. Although invented in the 1970s, IVR remained cost prohibitive and was not commonly used by organizations until decades later. In the 2000s, IVR became especially prevalent in call centers for supporting customer service activities.

IVR presents a configuration of technology that provides a conversational user interface, thus taps into contemporary trends around the growing proliferation of conversational platforms. According to the 2019 Gartner Report (Cearley and Burke 2019),

conversational platforms are on the rise and are "changing the way people interact with the digital world." Financial service customers, for instance, are becoming accustomed to conversational interfaces that offer services instantly and at any time (Marr 2019). IVR is especially useful for companies because it allows customers to service their own enquiries by accessing the company's database and following step-by-step instructions provided by a pre-recorded voice.

IVR as used in our case study is based on a programmed algorithm which matches a pre-recorded voice response to a person's communication input. While some IVR systems enable human interaction using voice applications and by typed commands on a phone keypad, the case in this study was limited to only typed commands and lacked the voice capability.

IVR messaging is voice-based so it is considered more effective than text-based messaging (like SMS) in engaging customers in low-income markets who have low levels of literacy. The temporal nature of IVR is a limitation however since messages can only be heard if clients engage with the phone call at a set time. SMS– the delivery of short text messages electronically– is not bound by time but allows users to see messages at a time convenient for the user since the message is stored on the user's phone and is accessible under general conditions (i.e., phone display is working, battery is charged, the user knows where to find the SMS and can read the SMS or get help in reading the SMS, etc.).

IVR was used by the case organization primarily as a method to push out communications to a high volume of customers. Calls were sent by the IVR system to provide basic information and the IVR functionality enabled customers to obtain more

information via increased interaction with the system. For example, one IVR message provided customers some savings tips and then an option to hear additional tips or other information by pressing a number on the customer's phone keypad.

3.4 Literature on ICT Innovation for Low-Income Markets

In following socio-technical ideas which can be traced back to the early 1970s (Land 2015), a basic premise of this research is that ICT innovation involves complex and dynamic techno-social processes which exist over time and in particular contexts. Hence the wider context in which the technological artifact and the innovation activities are embedded is of great interest to the research (Avgerou 2000).

In our research, the innovation was implemented with customers of a financial institution operating in Ghana. For this reason, the innovation had many similar characteristics of ICT innovation in "developing" or "emerging" countries as presented in prior research. According to the International Monetary Fund (2018), this classification of "developed," "emerging" and "developing" is "not based on strict criteria, economic or otherwise, and it has evolved over time." Following the World Bank, which removed the term "developing country" in its presentation of data in 2016 (Fermholz 2016), this thesis uses classifications based on relative levels of income, such as "low-, medium-, and high-income markets" and gross national income (GNI) per capita. The terms "developing" and "emerging" were useful for the research for identifying literature with contextual relevance.

3.4.1 Conceptual Foundations of ICT Innovation for Low-Income Markets

This research situates itself in the context of ICT innovation for low-income markets[6]. As the term suggests, this subcategory of innovation embeds ICTs as a component of the innovation and focuses on low-income markets as the end user. This subsection highlights three conceptual foundations of ICT innovation for low-income markets which are of utmost relevance to this research: the marketization of low-income customers, the significance of low-income markets for the future of IT, and the unique and diverse characteristics of low-income markets.

The Marketization of Low-Income Customers

Highly relevant for this study is the literature that initially conceptualized "low-income customers" as a market, and not only that, but a significant market for commercial interests. In 2004, C. K. Prahalad introduced the concept of the "bottom-of-the-pyramid" (BOP) which became popularized. BOP refers to the world's poorest residents, a socioeconomic group that has been defined in a variety of ways. This research is agnostic in terms of establishing a precise definition and like Prahalad (2004) uses terminology such as "low-income markets" as a social construct to loosely refer to the poorest two-thirds of the world's population. Importantly, this population, according to the Encyclopædia Britannica (Winn 2015), consists of more than four billion people living in abject poverty. In pointing out the sheer volume of this group of people– four to

[6] We situate the research within the context of ICT innovation for low-income markets to correspond to the literature. The literature on ICT innovation for low-income markets encompasses the literature on digital innovation for low-income markets.

five billion– Prahalad stressed the immense opportunity presented by this market segment for organizations globally.

The Significance of Low-Income Markets for the Future of IT

Heeks (2012) called attention to the BOP as the next frontier for IT. He pointed out that the regions of the world where the BOP are associated, namely emerging markets of low-income nations, are high growth in terms of IT. This is exemplified by Sub-Saharan Africa which is embracing the mobile revolution and growing faster than any other region in mobile adoption (GSMA Intelligence 2019; PwC 2016). Following innovations in mobile funds transfers (i.e., M-Pesa in Kenya in 2007), Africa was deemed five years ahead of Europe in mobile money services by 2012 and the idea of mobile money has transferred from poor nations to rich nations (Heeks 2012).

The Unique and Diverse Characteristics of Low-Income Markets

Following Prahalad (2004), many scholars and practitioners have since argued that market-based solutions must be tailored to the particular characteristics of resource-poor markets in order to be effective. Low-income segments of the population are very diverse. Numerous studies have examined innovation for low-income markets, showcasing the uniqueness of this market as well as the need for contextualized solutions (Akter, Ray, and D'Ambra 2013; Jagtap, Larsson, and Kandachar 2013; Heeks 2012; Posthumus et al. 2013). For example, organizations working in low-income markets often face a number of challenges. Ghosh et al. (2015) summarized key challenges to the deployment of digital financial tools and services for low-income markets as follows:

- Infrastructural challenges (i.e., power shortages, intermittent connectivity, and inadequate storage facilities);
- User uptake and adoption challenges (i.e., limited education, lack of immediate perceived benefit, and deficiency of other human resources) (Parikh and Lazowska 2006); and
- High inertia against adopting new and alien technologies which can be heightened by low awareness of the tool.

Based on the unique and diverse characteristics of low-income markets, Heeks (2012) identified six emerging IT innovation models (intermediated, collaborative, grassroots, frugal, innofusion, and reverse innovation), arguing that these models represent best practices surrounding IT innovation for low-income markets. Three concepts presented by these models are particularly relevant for this thesis, namely: (1) Partnerships between multinational organizations and IT innovation intermediaries can offer contextualization support to innovation; (2) The end user is not just a consumer but actively contributes to the innovation work; and (3) The innovation process is largely characterized by incremental alterations to the technology and the way it is configured, packaged, marketed, sold, used, supported, serviced, etc. These concepts align particularly well with other scholars' conceptualizations of innovation, which characterize innovation as being dynamic, integrated, networked, and as encompassing both product and process innovations (Khiaonarong and Liebenau 2009). While various scholars have also pointed out numerous limitations to innovation, such as limited access to resources and to markets, this topic is not relevant to this research hence is not discussed in this thesis.

3.4.2 Literature on Digital Financial Services in Microfinance

Specific to our research context (elaborated upon in Chapter 4), we review the relevant literature on digital financial services (DFS) for low-income markets. DFS is a term that comes from the industry and refers to the delivery of services through ICTs (although not exclusively through ICTs). It can be defined as the use of digital technologies often along with networks of small-scale agents to offer basic financial services, often at greater convenience, scale, and at lower costs than traditional banking (CGAP n.d.). The scarcity of literature specific to DFS could be due in part to the novelty of these services within microfinance (Kauffman and Riggins 2010) and perhaps also due in part to the term itself since "digital financial services" was used interchangeably with electronic banking and perhaps other terms not that long ago (Maumbe 2006). For this reason, the literature review focused on ICTs in microfinance, specifically the literature that focuses on frontend ICTs which are deployed with clients in order to stay as close as possible to the client-institution interface (thus purposefully excluding back-office technologies)[7].

Microfinance, according to Riggins and Weber (2013), is a valuable, interesting, and unique research context for IS researchers to explore. Microfinance refers to the provision of financial services such as loans, savings, insurance, and money transfer services tailored to populations who have traditionally been excluded from the formal financial system, especially poor entrepreneurs and small business owners. Financial services are provided as tools to individuals to help them safeguard and manage their

[7] Since the literature focused exclusively on technologies that were implemented at the client-institution interface for service provision, the terms *ICTs* and *digital financial services* are used interchangeably in this section.

money, generate income, build assets, smooth uneven cash flows, and manage risks such as by building a safety net for times of emergency. The effectiveness of microfinance to empower people or alleviate poverty, which microfinance organizations often claim, has been examined and debated within academic and industry literature (Banerjee, Karlan, and Zinman 2015; Roodman 2012). While this thesis does not join the debate, this discourse among others presents a backdrop for this research which may present implications for data collection and the research findings.

The literature on ICTs in microfinance spans a broad range of disciplines including ICTs for development, management and organizational studies, information systems, economics, feminist studies, and sociology. To date, the majority of studies on ICTs in microfinance have focused on the adoption of ICTs along with their benefits (Kauffman and Riggins 2010). Within this literature, ICTs are typically portrayed as deliverers of "cheaper, better and faster" performance (Davamanirajan et al. 2006). Also, there is general consensus among scholars that ICTs have the potential to help microfinance institutions fulfill outreach and sustainability goals through increased effectiveness, efficiency, and cost-savings in the long term. Benefits to microfinance clients are also well captured in the literature. For example, one study by Gascó-Hernandez, Equiza-Lopez and Acevedo-Ruiz (2007) found that ICT deployment by microfinance institutions facilitated income-generating opportunities for clients, while another study by Islam, Takanashi and Natori (2013) linked ICT deployment with higher levels of customer satisfaction. Karlan et al. (2016) summarized findings from various studies that have looked at the effects of DFS on client wellbeing, concluding that these services

can have important positive impacts on client wellbeing, although in practice, this is not always the case.

Comparatively less research has examined the challenges and limitations brought by ICTs in microfinance. Examples include Malady (2016), who pointed out that DFS have often been supply-driven and have lacked value and trust from customers, and De' and Ratan (2009), who asserted that ICT deployment in microfinance is a political process which inherently brings negative consequences for microfinance institutions and clients. Various studies have identified barriers to DFS adoption. Sagib and Zapan (2014) highlighted how mobile banking was not perceived by many people in Bangladesh as an alternative to services provided by a bank branch, apart from quick money transfers (and attribute this perception to the different nature of mobile banking). In the context of Niger, low-income groups compared to more wealthier groups were found to have low adoption rates of DFS services and found that more optimal digital financial measures were needed to educate clients on the services in order to address financial exclusion of low-income groups (Ifere and Okosu 2017). Various studies have shown that educating clients on the benefits of DFS is required to improve adoption rates (see Ifere and Okosu 2017; Sagib and Zapan 2014).

The literature specific to the effects of ICTs on microfinance organizations, particularly on business models and practices, is especially scarce. Key examples include: Riggins and Weber (2013), who examined the impact of ICTs on intermediation structures in microfinance, and Kauffman and Riggins (2010), who asserted that ICTs are blurring the boundary between microfinance institutions and traditional lending institutions and

are forcing microfinance institutions into a more competitive business arena which can lead to mission drift.

The debate around whether DFS complement or substitute human interaction in microfinance business models has been discussed by academics and practitioners (see Wahedi and Kienzle 2015; Watkins et al. 2017). The 2016 Financial Inclusion Banana Skins survey report (Lascelle and Patel 2016) summarized the debate on whether the digitalization of financial services will negatively affect the relational models of microfinance. On one side of the debate, arguments have been made that the automation of banking services will depersonalize and eventually damage client relationships, as illustrated by Dr. Steve Ogidan, CEO of Successory in Nigeria, in stating:

> *I am concerned that the financial inclusion industry hasn't fully realized the impact that going digital will have on the way financial services are provided. Microfinance has always been high-touch with lots of opportunities for financial service providers to interact with clients through loan officers, group meetings, and branch interaction. As we increasingly utilize lighter touch methods of interaction, such as mobile banking and agent platforms, there will be many benefits to clients -but do we fully understand the downsides of that transition?* (Lascelle and Patel 2016, 34)

Miguel Herrera, partner at Quona Capital Management, Peru, represents the other side of the debate, bringing attention to the ways in which human interventions might be improved as a by-product of increased automation:

> *Greater automation should help not make the problem worse, by freeing up resources to spend on better customer support, service, call centers and having products that are better designed for a digital generation who can less and less afford or want to take time off from work to go to a physical branch to solve their financial needs.* (*ibid.*)

To date, various angles of this topic have been examined through a small number of empirical studies and the findings are nuanced. Donner (2007) and Bhandari (2015), for instance, found that the introduction of mobile banking systems both reflects and alters relational structures for existing microfinance practices. Kenechi and Uchenna (2014) found that the adoption of mobile banking systems in rural Nigeria generated negative effects on social relationships and weakened microfinance's joint liability lending methodology as a result of making peer monitoring more difficult and due to increased information asymmetry. Such findings align with Arvind (2010) who attributed drops in repayment rates to depersonalized financial services. Lastly, on the other end of the spectrum, Kusimba et al. (2013) demonstrated through a case study in Kenya that certain practices involving mobile banking enhanced and created social capital within relationships.

The work of Berger and Nakata (2013) is of utmost importance to this research because it provides a practical framework for ICT innovations and resides closest to the research context (even sharing the same case organization). In summary, Berger and Nakata's (2013) study examined the socio-technical deployment of ICT innovations in resource-poor environments to understand how such innovations are and can be effectively implemented for these markets. From their findings, they established that the move toward an ICT solution should be accompanied by significant knowledge about the unique socio-human, government-regulatory, and market conditions existing in BOP settings, along with an understanding about the technologies themselves (*ibid.*). They argued that ignoring any one of the aspects listed below can cause a technology to be avoided by users or prevent installation in the first place (*ibid.*, 1209):

- *Adapting to the BOP's religious/cultural beliefs,*
- *Training staff and support agents in acceptance and use,*
- *Patiently cultivating governmental ties and regulatory reform,*
- *Investing in costly equipment in the face of uncertainty, and*
- *Producing creative educational and promotion campaigns for low literate populations.*

Berger and Nakata's (2013) framework for ensuring that ICT deployment works well and delivers quality financial services for low-income markets offers theories on best practices which were foundational to this research.

3.4.3 Role of the Literature for this Thesis

Within these bodies of literature (ICT innovations for low-income markets and DFS in microfinance), no studies to date have examined how the technologies themselves are shaping the ICT innovations. This could in part be due to the lack of distinct theories of IT innovations that can adequately explain innovation within low-income contexts (Rai, Harindranath and Liebenau 2013). Given such limitations, this research does not contribute directly to these bodies of literature (nor the broader ICT4D literature) but focuses on contributing to the vibrant discussions taking place within the technology affordance literature as it relates to innovation and ICT-associated change. Nonetheless, these bodies of literature provide substantial insights into ICT innovations for low-income markets which is foundational for this study. They offer this research a solid foundation of key concepts and frameworks for understanding our research context.

3.5 Conclusion

This chapter has laid the foundation for this thesis' use and development of the key concepts related to digital innovation. We have summarized the most relevant bodies of

literature on digital innovation, innovation management, ICT innovation for low-income markets, and DFS in microfinance. In doing so, we discussed relevant definitions and conceptualizations which are foundational to our research. We also drew important links within and among the literature, such as by highlighting distinct properties of digital materiality and their implications for innovation strategy and management.

This thesis advances the scholarship on digital innovation by identifying the role and dynamics of technology affordances in innovation. It also decomposes certain logics and practices of innovation through an affordance lens. These contributions to the literature showcase how technology affordances can provide a deeper conceptual understanding of digital innovation which improves the value of affordance theory for utility and application. The next chapter describes the context for this research. We subsequently present the three studies which include our methodology and key findings.

Chapter 4: Research Context

4.1 Introduction

The research is situated in discourses about the significance of time, place and community for digital artifacts, technology affordances and digital innovations for low-income customers, as well as relationships among them. As noted by Orlikowski and Iacono (2001), the materiality of IT artifacts is inseparable from the cultural and historical elements surrounding the development and use of the artifacts. These contextual conditions have significant implications for digital innovation, including the ways in which the technologies are designed, developed, diffused, and utilized.

This chapter describes the context of the research, specifically the industrial, geographical, and organizational settings. This chapter progresses in the following manner. First, we provide an overview of the financial sector of microfinance. Next, we describe the country context of Ghana. Lastly, we describe the organization and the pilot project which were selected for our case study. Our research methodology is presented in our three papers (chapters 5-7) so will not be covered in this chapter. The intent of this chapter is to provide a high-level description of key contextual elements.

4.2 Microfinance

The broad context for this research is the microfinance sector (described in Section 3.4.2) within the financial retail industry. Various sectors within this industry focus on different markets, perhaps most notably differentiated by income levels. High-end commercial banks have traditionally developed products and services tailored to wealthier segments of the population, while smaller savings and loans companies and

microfinance organizations have traditionally served less wealthy segments. Of course there are many overlaps in customer profiles among these institution types. Some high-end commercial banks are increasingly going "down market" while some microfinance institutions are trending "upmarket."

4.2.1 Origins and Growth of Microfinance

Microfinance, which has its roots in microcredit, originated due to a gap in the formal financial market. Financial institutions were excluding large segments of the population because they were deemed too risky or costly to serve. These populations tended to live in low-income, rural, and resource-poor environments. The origins of microfinance as an institutionalized practice can be traced to the 1970s in Bangladesh and parts of Latin America where social innovators, such as Mohammed Yunus in Bangladesh, recognized a gap in the market and began offering small loans to help poor entrepreneurs start or expand businesses. Since this time, microfinance has expanded to include a broad set of financial services, especially savings, insurance, remittances, and financial education.

Since the 1970s, microfinance gained popularity and has been replicated worldwide, penetrating low-, medium-, and high-income countries. It now comprises of roughly 10,000 microfinance institutions serving 111 million clients worldwide (Platteau and Siewertsen 2009; Convergences 2015). According to the World Bank's International Finance Corporation, microfinance is estimated at US$60-100 billion and has experienced double digit growth per annum for over five years (Convergences 2015). Funding sources have included institutional and private donors as well as social and commercial investors. In many cases, financial incentives for developing DFS (as defined in Section 3.4.2) for resource-poor populations have come from the donor

community which is eager to use DFS to extend financial services to reach populations most difficult to serve.

4.2.2 ICT innovation in Financial Services and Microfinance

While innovation is taking place everywhere, it is not evenly spread across industries. According to the 2018 Global Innovation 1000 report, four industries– computing and electronics, healthcare, auto, and software and Internet– account for three-quarters of all R&D spending (Jaruzelski, Chwalik, and Goehle 2018). The financial industry, while not among the top four spenders, has experienced substantial movement in innovations in the last decade, particularly since the Great Recession of 2008-2012.

Financial innovation is not unique to high-income countries, as evidenced by China (Jaruzelski, Chwalik, and Goehle 2018) which like Ghana is a middle-income country. Digital innovations have been particularly prevalent in the microfinance sector in developing and emerging economies. During the decade starting 2000, the launch of peer-to-peer mobile phone money transfers, commonly known as "mobile money," placed countries such as the Philippines, Kenya, Bangladesh, Pakistan, and Afghanistan as leaders in mobile transactions (Runde 2015).

Microfinance is experiencing significant change as an increasing number of microfinance organizations shift toward "branchless banking" service models and adopt DFS as prominent and promising delivery channels. Such shifts are consistent with broader trends of the financial services industry which is facing rapid digitalization (Hugener, Mavros, and Courbe n.d.). The recent consumer-facing fintech boom, which took off following the Great Recession and has spread globally, has influenced microfinance and has permeated industry discourse (Lascelle and Patel 2016). It must

be noted, however, that ICT innovations in microfinance preceded today's fintech "hype" (Lascelle and Patel 2016) which has largely been dominated by western countries and China as of late. Before "mobile banking" was commonly used to mean mobile-phone banking, this term referred to the deployment of vehicles to serve low-income and rural populations with financial services (Nguyen Tien Hung 2004). This phenomenon, also known as *banks-on-wheels* or *mobile ATMs,* can be traced back to the late 1970s (Nagarajan 2008).

Fintech in the form of DFS has developed alongside the rapid penetration of mobile phones in developing and emerging economies. During the five year period between 2005 and 2010, the percentage of individuals who owned a mobile phone increased from around 25% to over 75% (World Bank 2016). Today, roughly 80% of individuals in the developing world own a mobile phone (*ibid.*). With increasing mobile phone and network penetration in countries where they operate, microfinance organizations among other entities have leveraged and built on this infrastructure to provide clients with new types of services and new methods of accessing services.

With the onset of DFS, which gained momentum in the early 2000s and has accelerated in recent years, microfinance as an industry and practice has become increasingly differentiated. Digital technologies are bringing new opportunities (and challenges) to microfinance and are changing the way that microfinance is practiced. Some argue that microfinance has entered a new era coined "the digital finance services revolution" (Convergences 2015). What once was a development practice dominated by charities and NGOs has become an information infrastructure swarming with a broad range of players: commercial banks, payments service providers, mobile network operators

(MNOs), fintech startups, merchant aggregators, retailers, energy service providers, agent franchises, and social networks alongside traditional microfinance institutions (Lahaye, Abell, and Hoover 2017). New types of organizations such as agent network managers and payment aggregators have also emerged to build and maintain the DFS ecosystem (CGAP n.d.). For traditional microfinance organizations, strategies and business models are changing, as exemplified by organizations such as Opportunity International (Opportunity), which is the case organization in this research. The former CEO of Opportunity, Vicki Escarra, remarked, "Advanced technology will reinvent microfinance and make it even easier to serve clients more effectively" (Nsehe 2017).

4.2.3 Microfinance Organizations Pressured to Digitize

From the back office to the client interface, organizational systems and processes across the microfinance landscape are changing and for a variety of reasons. According to Mathison (2005), organizations are being "forced" to adopt modern information systems for three reasons, all of which relate to institutional sustainability: increased regulatory requirements, the need to scale up outreach to obtain more clients, and to attract capital from investors and donors. New technologies are helping institutions meet their sustainability objectives and remain viable in an increasingly competitive market (Kauffman and Riggins 2010). At the client interface, DFS have become widely recognized as efficient and cost-effective delivery channels, enabling organizations to facilitate a variety of services through digitized monetary transactions, record-keeping, and communications. According to Lascelle and Patel (2016), the transformations experienced by financial service providers have set microfinance on a path to becoming "a more technologically-driven financial inclusion business." Furthermore, some have

argued that the microfinance sector is evolving and being incorporated into the mainstream financial system (Garikipati et al. 2017; Lascelle and Patel 2016).

Another key motivating factor for many microfinance organizations to adopt DFS is related to the social objective of financial inclusion, which in recent years has become part of national and global development agendas worldwide. The Center for Financial Inclusion (Accion n.d.) defines financial inclusion as reaching excluded and underserved people with a full suite of quality financial services including credit, savings, payment services, and insurance. DFS and fintech more broadly are considered by some as key solutions to achieving global financial inclusion (Lascelle and Patel 2016; Malady 2016). According to the latest World Bank Findex Report (Demirgüç-Kunt et al. 2015), the number of people worldwide who lack access to formal financial services– roughly two billion– is declining largely as a result of new technologies. With the majority of unbanked people living in low-income and remote regions of the world, such populations which were once considered "unbankable" because they were too expensive to serve are now increasingly within reach. Various studies such as Sagib and Zapan (2014) have made the connection between DFS and the ability of financial institutions to reach underserved populations.

The potential for all types of financial institutions to go down-market, reaching underserved populations especially in rural areas, is immense and this shift in target markets is being realized. The populations targeted by microfinance organizations, commercial banks, and technology companies are converging as digital technologies provide a more efficient and cost-effective means of financial service provision. In some markets, mobile network operators and fintechs have partnered with microfinance

providers or have acquired payments or bank licenses of their own. Furthermore, e-commerce and tech giants such as Alibaba, Amazon, Apple, Google, and Facebook are increasingly playing a role in financial services and are expanding product offerings in developing and emerging economies. The shifting competitive landscape is thus yet another factor for which microfinance organizations must contend.

4.2.4 Systems of Governance in Microfinance

In every country, there are numerous legal and institutional frameworks that govern microfinance and DFS. At the country level, legal and regulatory frameworks that govern DFS involve multiple regulators such as financial/banking, telecommunications, and competition (Chen and Hanouch 2015). Regulatory frameworks often specific to microfinance institutions cover a host of topics such as capitalization requirements, funds restrictions, risk management, and customer protection. Central banks often work closely with microfinance institutions helping to foster enabling regulatory environments for such institutions to serve clients through digitized services.

Institutional frameworks also play a key role in overseeing and influencing the development and innovation of DFS. Such frameworks consist of a variety of policies and strategies at the global and national as well as industry and organizational levels. They are often aimed at determining and enforcing compliance with regulation and other governance structures. For instance, a country's national poverty alleviation strategy, economic and monetary policy, and youth and women strategies may provide layers of governance and corresponding incentives for the microfinance sector. At a global and industry levels, the GSMA (Global System for Mobile Communications

Association) develops and sets mobile payment standards, along with recommendations for DFS best practices.

The microfinance community, which consists of providers, investors, donors, and other supporters, provides yet another layer of governance. Global efforts have been made to establish industry agreed-upon client protection principles under an initiative called the Smart Campaign. According to the latest figures, 1,841 microfinance institutions around the world have endorsed this campaign, but only around 120 institutions have become Smart Certified in client protection (Accion 2020). Smart Certification is the gold standard for microfinance institutions and requires verification by a third party on adherence to the certification's 25 standards which fall under the following categories: (1) Appropriate product design and delivery, (2) Prevention of over-indebtedness, (3) Transparency, (4) Responsible pricing, (5) Fair and respectful treatment of clients, staff ethics, and non-discrimination, (6) Privacy of client data, and (7) Mechanisms for complaints resolution.

4.2.5 Environmental Conditions of Low-Income Markets

As we described in Section 3.4.2, the environments where low-income microfinance customers live often have unique socio-human, government-regulatory, and market conditions that must be addressed in order for the delivery and adoption of ICT innovations to be successful (Berger and Nakata 2013). By taking into consideration the conditions and constraints of low-income populations and their environments, changes have been made to adjust the practices of microfinance and its regulatory framework to make microfinance services more appropriate for these markets. For instance, the global financial inclusion agenda has recognized the importance of consumer protection

policies, financial literacy, and building consumer financial capabilities (CGAP n.d.). Progress has been made over time as microfinance organizations have better understood the contexts in which they operate along with the specific requirements of clients living in resource-poor settings (CGAP n.d.). However, there is still much work to be done to make ICT innovations appropriate and demand-driven in these markets.

4.3 Country Context: Ghana

Ghana was selected as a geographical focus because this country has strong underlying conditions for digital finance including an enabling regulatory environment and generally high rates of literacy, numeracy, phone ownership and phone usage (Financial Inclusion Insights n.d.). Ghana has largely been cash-based but is currently in the process of rapidly adopting digital systems of banking and payments. It has legislation supportive of its shift to digital finance, with new regulations[8] released in July 2015 which have been deemed by industry and external observers as a best practice framework (Zetterli 2015). The government of Ghana has been very vocal about its strong commitment to enable digital financial inclusion, signing onto the Maya Declaration in 2012 and joining the Better Than Cash Alliance in 2014 (Financial Inclusion Insights n.d.).

[8] Bank of Ghana's guidelines for e-money issuers and agent guidelines can be found at https://www.bog.gov.gh/privatecontent/Banking/NOTICE%20-Guidelines%20for%20E-Money%20Issues%20in%20Ghana.pdf and https://www.bog.gov.gh/privatecontent/Banking/E-MONEY%20GUIDELINES-29-06-2015-UPDATED5.pdf, (accessed January 15, 2019).

Although transitioning at a slower pace than Kenya and Tanzania, Ghana has rapidly adopted mobile money which is an electronic wallet service that enables users to store, send and receive money using a mobile phone. Arriving in Ghana around 2008-2009, mobile money is used by 25% of Ghanaians (as of 2015) which is nearly at par with the percentage of bank account holders which stands around 29%, or 36% of adults. In just five years, between 2010-2015, mobile money and other non-bank formal financial services drove Ghana's increase in access to formal financial services to nearly 50% of the population (Zetterli 2015; CGAP 2017b).

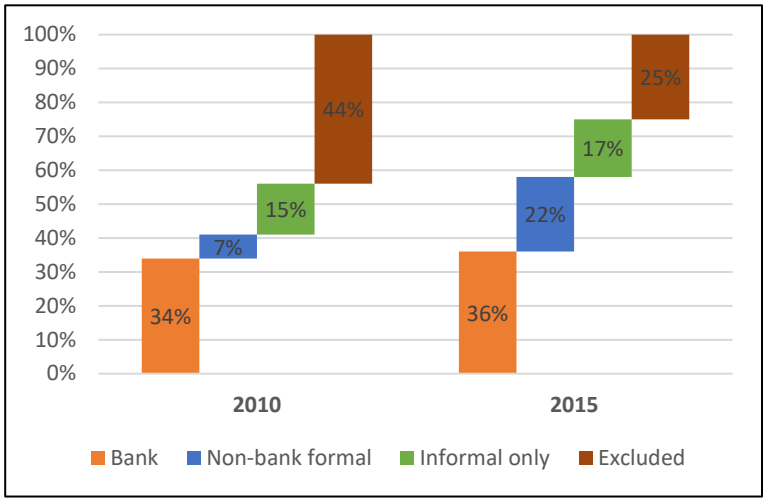


Figure 3. The Fall of Financial Exclusion in Ghana, 2010-2015 (Zetterli 2015)

While the growing popularity of mobile money is expected to continue in Ghana, other financial service providers will continue to play a significant role in Ghana's growing economy. For instance, 86% of active mobile money users have savings but are generally not using their mobile money account for this purpose (Financial Inclusion Insights n.d.). Credit is also borrowed primarily through other sources. Certain types of payments are also not generally conducted through mobile money, such as insurance premiums which are paid by around 60% of Ghanaian adults (*ibid.*). The broader industry discourse on the topic of whether mobile money is a zero-sum game for banks and mobile network operators is recognizing the resurgence of bank accounts in

countries like Kenya which has found that bank account penetration commonly goes hand-in-hand and as a by-product of digital inclusion (Cook 2017).

4.3.1 Ghana's Financial Services Landscape

Around the start of this research, Ghana's financial services landscape consisted of six main DFS providers (MTN, Tigo, Airtel, Vodafone, Fidelity Bank, and e-Zwich), 27 commercial banks, 60 nonbank financial institutions (NBFIs), 138 rural and community banks, 503 licensed microfinance institutions and hundreds of licensed individual deposit collectors (Financial Inclusion Insights n.d.). Extensive information is available on the microfinance sector in Ghana which has had four stages and can be traced back to the 1950s when subsidized credit was provided by the government under a poverty alleviation initiative (Asiama 2007).

4.3.2 Environmental Factors

Ghana has a distinct market in relation to various aspects including cultures, languages, religions, geographical location, and economic and political environment. Ghana is a low-middle income country with a population of 28 million people, of which 20-25% are living below the poverty line of US$1.90 daily in purchasing power parity (PPP) (ADB 2017; Cooke, Hague, and McKay 2016).

In the years leading up to the research, a few of the most pressing economic challenges facing Ghana included a high debt burden, expensive and unreliable energy sources, and high currency inflation. During the research period, Ghana experienced what became known as the banking crisis of 2017-2018, which involved the merger and consolidation of eight failed banks and cost taxpayers 12.5 billion Ghanaian Cedis (US$2.2 billion) in

bailouts (GhanaWeb 2020; Dontoh 2020). The banking crisis followed an industry cleanup by the Central Bank of Ghana starting in August 2017 to "remedy years of poor governance and weak regulatory oversight" (Dontoh 2020). As part of the cleanup efforts, the Bank of Ghana revoked the operating licenses of 23 savings and loans companies (GhanaWeb 2019) and 347 microfinance institutions (Shone 2019). According to the President, all depositors of these collapsed entities would be paid in full (GhanaWeb 2020). At the time of this research, however, this assurance from the government was unknown or mistrusted by the general public. There was a strong lack of confidence in the financial industry as evidenced in news media (i.e., GhanaWeb 2020) and in the data we collected in our research. This environment of our case study underscores the importance of context for our research.

4.4 Case Study Organization: Opportunity International

Within this context of financial services in Ghana, we employed case study research and the organization Opportunity International (Opportunity) was selected for the following two reasons:

First, Opportunity provides a leading case for examining the research question. According to Berger and Nakata (2013), this organization has been at the forefront of introducing technological innovations for low-income markets. Since around 2000, Opportunity has implemented a variety of technology-based innovations to expand the scope, increase the penetration, and lower the cost of financial services delivery to poor populations especially in rural areas (*ibid.*). An overview of Opportunity and its digital finance initiative has been provided in Section 4.4.2.

Secondly, Opportunity is representative of global not-for-profit microfinance organizations worldwide, especially those that are members of the Partnership for Responsible Financial Inclusion (PRFI). PRFI is a collaborative effort of leading international organizations whose members and their 260+ local partners work with more than 89 million clients in 87 countries (Scofield 2017). Along with Opportunity, the PRFI members include Accion, Aga Khan Agency for Microfinance, BRAC, CARE, FINCA, Grameen Foundation, Pro Mujer, VisionFund International, and Women's World Banking. Digital finance makes up one of the seven peer groups for the PRFI (Scofield 2017), which during the time of this research, was chaired by Opportunity's global head of digital finance. The PRFI members represent a variety of stages in adopting digital finance along with varying degrees of resources and commitment. One of the largest members, Accion, started the "first global fintech fund for the underserved" which as of September 2017 had raised US$141 million (Accion 2017a). Opportunity, also one of the largest members, has been among those at the forefront of introducing ICT innovations into resource-poor markets (Berger and Nakata 2013).

Table 2 displays some key characteristics of the PRFI members to provide a rough, high-level comparison between organizations. The data in this table consists of the latest numbers (2015-17) from the organizations' homepages and annual reports which we gathered at the time of the research. The table does not reflect nor intend to reflect an accurate comparison.

Table 2. PRFI Members by Total Number of Financial Service Clients

	Year of Origin	Total Clients (Financial Services)	Total Borrowers	Outstanding Loan Portfolio	Implementing Partners	Program Countries	Digital finance mentioned in annual report?
Women's World Banking	1976	24,500,000	*Not specified*	$9.1 billion	29	32	Yes
Opportunity International	1971	9,600,000	4,700,000	$1 billion	47	22	Yes
Accion	1961	6,000,000	6,000,000	$7.9 billion	35	21	Yes
BRAC	1972	5,400,000	5,400,000	$1.6 billion	11	11	Yes
CARE	1946	2,700,000	*Not specified*	*Not specified*	14	94	Yes
FINCA	1984	1,622,867	909,251	$777 million	22	20	Yes
VisionFund International	2003	1,259,580	1,259,580	$546 million	31	28	Yes
Aga Khan Agency for Microfinance	1950s	*911,300*	*423,600*	$230 million	*Not specified*	10	*Not found*
Pro Mujer	1990	253,000	253,000	$135 million	*Not specified*	5	Yes
Grameen Foundation	1997	171,431	*Not specified*	Not specified	*Not specified*	26	Yes

4.4.1 Overview of Opportunity International

Opportunity is a global not-for-profit organization dedicated to providing financial services such as loans, credit, and insurance, along with basic financial training, to small-scale entrepreneurs in developing and emerging economies. Opportunity's global network consists of a workforce of around 20,000 people. Eighty-nine percent of Opportunity's 9.6 million clients are women and the average loan size is US$239. Over US$9 billion in loans has been provided to clients over the course of Opportunity's

existence. By 1984, Opportunity's loans worldwide had already exceeded US$1 million in a single year.

The organization was founded in 1971 through the efforts of two entrepreneurs from the United States and Australia, Al Whittaker and David Bussau. Opportunity was registered as a non-profit organization in 1988 and ten years later, it formalized its partnerships into the Opportunity International Network– a group of partners that includes 47 entities in Africa, Asia, Latin America and Eastern Europe (at the time of this research). Opportunity is a non-denominational Christian organization and does not discriminate on the ground of religion. It hires and serves people of all different religious backgrounds and beliefs. Opportunity's global headquarters are in the United States with other key offices in Australia, Canada, Germany, Hong Kong, Singapore, Switzerland, and the United Kingdom.

During its first phase of existence until the early 2000s, Opportunity's core services consisted of microcredit along with financial and business training, delivered through a network of partners in developing and emerging economies. In the early 2000s, Opportunity expanded its product line to begin offering other financial products including savings accounts and insurance. Opportunity built a series of permanent and mobile banks through the support of donors and investors worldwide. To date, Opportunity has built 45 regulated microfinance institutions including nine banks serving clients with deposit accounts. During the time of this research, Opportunity had begun to divest its ownership of the nine banks and revert to supporting its implementing partners through a non-ownership model.

Opportunity considers itself a "next generation microfinance organization that invests philanthropic and social impact capital to spark and scale innovative solutions to global poverty" (Opportunity International 2015). In 2002, Opportunity began offering microinsurance and subsequently launched the world's first microinsurance intermediary, MicroEnsure (Opportunity International n.d.). In 2006, MicroEnsure was registered as its own entity and today it works in 20 countries with over 40 million clients, of which 85% of them had never before had an insurance product. Its products include weather-indexed crop insurance, affordable health insurance, and protection against other risks. In 2015, MicroEnsure won the Transformational Business Award from The Financial Times and The World Bank's International Finance Corporation.

Shifting Business Models

Over the years, Opportunity has delivered financial services to clients primarily through face-to-face interactions and a hub-and-spoke model consisting of brick and mortar structures such as bank branches and field offices. Like other microfinance organizations, Opportunity began developing infrastructure to offer digitized services to clients starting in the early 2000s. Since then, the organization has tested and rolled out a number of technologies to support the client interface including ATMs, mobile banks (IT-equipped "banks-on-wheels" serving rural populations), point-of-sale (POS) systems, tablets, laptops, mobile phones, mobile banking systems, biometric security systems, and networks of third-party agents who typically serve clients from kiosks or retail shops.

During 2005-2010, Opportunity began its shift from predominantly physical interactions between financial institutions and clients to introducing virtual and

mediated interactions, as new methods of service delivery such as mobile banking[9] and agent banking[10] became integrated into core business operations. This shift toward intermediation is especially significant because, since it gained popularity in the early 1970s, microfinance has been grounded in theories of social capital[11] and has relied on physical human interaction to extend access to formal financial services to underserved populations (Rankin 2002). Human interaction has been considered a key ingredient of success to microfinance practice. A plethora of literature from various disciplines has engaged this topic (see Haldar and Stiglitz 2016). Given the more recent onset of digital technologies, the role of human interaction in microfinance is changing as established microfinance methodologies evolve toward digitized means of engagement. Ba et al. (2010) described, "Digital systems enabled by technology advancement are revolutionizing the way business is conducted and reshaping how companies interact with their customers." Services which have traditionally been human-intensive are being replaced or supplemented by technologies to improve efficiency and cost-effectiveness (*ibid.*). As previously mentioned (Section 3.4.2), this question of whether digital technologies will complement or substitute human-intensive methods of building trust and social capital within microfinance has been debated since the mid-2000s (Donner 2007; Wahedi and Kienzle 2015; Lascelle and Patel 2016). Opportunity, among others,

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[9] Mobile banking, or m-banking, refers to financial services that are accessed via mobile phone or other mobile device.

[10] Agent banking refers to a network of non-bank entities such retail stores and kiosks, or roaming agents, which assist customers with financial services on behalf of a financial institution.

[11] Social capital was famously defined by Putnam (1993) as "features of social organization, such as trust, norms and networks, that can improve the efficiency of society by facilitating coordinated actions."

has taken an integrated approach in employing a "high tech, high touch" strategy and business model (Watkins et al. 2017).

The following excerpt from Opportunity's website (accessed November 2016) portrays the main methods used by Opportunity in reaching underserved populations, particularly those living in remote areas.

Excerpt from Opportunity.org:

Opportunity International is addressing the financial needs of isolated rural communities through innovative technologies and an expanding network of banks.

- *Low-Cost Branches. Opportunity deploys hub branches in trade centers and surrounds them with small, low-cost outlets as spokes that reach surrounding rural communities. New branches are in development worldwide. Whether full service, mobile or satellite kiosk, these banks bring hope through economic opportunity to families who have no other access to financial services.*
- *Mobile Vans. Armored banking vehicles travel to bring banking services to rural clients.*
- *Agent Banking. Opportunity installs point-of-sale devices in bank branches, mobile vans and local businesses to allow clients to conveniently bank in a variety of easy-to-reach locations. This extends the reach of the bank without the cost of establishing a full satellite branch.*
- *ATMs. These machines enable clients to bank at any time.*
- *Cell Phone Banking. Mobile phones are used as a channel for financial information and services, providing clients with banking access anywhere with cellular reception.*

Our client-facing technologies provide convenient financial access, allowing impoverished people to quickly access their funds so they can focus on generating income and achieving their financial goals. These groundbreaking client services equip Opportunity International banks to reach more people outside of urban centers—and at a lower cost through increasingly cashless and paperless processes.

4.4.2 Opportunity's Global Digital Finance Initiative

Opportunity's operational strategy has increasingly placed emphasis on the role of DFS. Former Opportunity CEO Vicki Escarra explains the benefits of DFS in stating:

> *DFS enable us to more quickly and efficiently scale our reach to serve more clients, including those living in even the most remote communities of Africa, Latin America and Asia. And, instead of having to take time to travel long distances to brick and mortar banks, clients can bank using their cell phones from wherever they are. ...DFS can also serve more people quicker and at a more affordable cost than traditional microfinance, as they do not require expensive infrastructure. It is an exciting time to be part of Opportunity International and we're thrilled to use DFS to change the face of poverty in the developing world.* (Nsehe 2017)

In 2012, Opportunity officially launched its Global Digital Finance Initiative, although projects implementing DFS had already been in existence for several years. The work of this initiative is managed and conducted by the global DFS team in partnership with Opportunity's country operations. Each year, Opportunity's global DFS strategy and plan are developed by the global digital finance team in partnership with the DFS teams based in each program country. Through special projects– funded by donors based primarily in the United States and the United Kingdom– the initiative targets specific client segments, namely low-income underserved populations. Within a 10 year period, more than $20 million was invested in electronic and mobile technologies by Opportunity to reduce transaction costs and bring services to the most marginalized and remote clients (Opportunity International 2017).

The DFS that are provided to microfinance clients under the Global Digital Finance Initiative are blended with the existing use of technology. Over the years, the countries where Opportunity operates have adopted and developed a variety of technologies and a

growing number of Opportunity clients own mobile phones. Opportunity's transition to digitized services has been accelerated by new partnerships with IT firms, telecommunication companies (telcos), and fintech startups. By integrating mobile banking with a mobile money service of an MNO, for example, an Opportunity client can transfer funds in and out of his/her bank account and deposit or withdraw cash at a nearby mobile money agent. Due to the vast telecom networks that are present in most of Opportunity's program countries, partnerships with telcos are enabling Opportunity to significantly broaden its reach beyond its branch and office locations. With a mobile phone and network connectivity, an Opportunity client can carry out basic financial transactions from almost anywhere in the country, even without a smartphone and internet connectivity. Through such partnerships, and the work of the Global Digital Finance Initiative more broadly, Opportunity's goal of making its "services reachable within an hour of each person in the countries it serves" (Berger and Nakata 2013) is evermore put to the test.

4.4.3 Opportunity International's Operations in Ghana

Opportunity operates in Ghana as Opportunity International Savings and Loans Ltd., also known as Opportunity Ghana. Opportunity Ghana was established in 2004, and at the time of this research, was owned by Opportunity International, its parent organization and primary shareholder. Opportunity Ghana is among the largest microfinance providers in Ghana. It operates in 7 of Ghana's 10 regions from 44 branches, serving over half a million clients. This institution has strong working relationships with the Bank of Ghana and Ghana's leading MNOs to offer mobile banking services to clients. It also offers savings products that have been tailored to

mirror traditional money-collection methodologies with the daily deployment of contracted agents who roam through marketplaces to collect cash deposits from small business owners and convert them to electronic deposits into the clients' bank accounts. Certain products and services offered by Opportunity Ghana, such as this deposit product, joint liability group loans, and agriculture-focused training, target low-income markets.

Along with Opportunity Ghana, Opportunity partners with and supports other entities in Ghana including Sinapi Aba Savings and Loans Ltd (SASL). SASL started in 1994 as the NGO *Sinapi Aba Trust*, which later became the origins of both Opportunity Ghana and SASL (Acheampong et al. 2017).

4.4.4 The Pilot Project

The research involved studying an in-depth case of innovation, namely a pilot project that involved the development and testing of IVR (as described in Section 3.3.2) with Opportunity Ghana clients. The project was carried out under Opportunity's Global Digital Finance Initiative and through a partnership with a third-party IVR technology supplier. The IVR technology supplier was a Ghana-based organization that operated globally, providing customer engagement services using IVR and SMS messaging.

The development and deployment of IVR in our case study involved the work of multiple human actors and their collaboration within various settings. The project was an international effort and involved stakeholders based in Ghana, the United States, and the United Kingdom. Hence the empirical evidence used in this research pertains to actions and events that occurred within and across national borders. Key actors included global and country level developers, technology partners and consultants, and

clients of the financial institution. Each study (chapters 5-7) provides key details of the pilot project and stakeholders which are of most relevance to the research.

4.5 Conclusion

This chapter has provided an overview of the research context by describing the industrial, geographical, and organizational setting. We have outlined a brief history of microfinance and have highlighted key and relevant characteristics, including the sector's adoption of ICTs and DFS. We have described the country context of our research, Ghana, and have highlighted the country's transition toward DFS. We have also described Opportunity International, providing key details as to why this organization provides a leading case for this research. Lastly, we provided an overview of the pilot project which was investigated to address our research question.

This section provides a rich and relevant description of the research context which was not possible in the three papers as they exercise parsimony. Through this chapter, we have shown that the context was much more than an insignificant, inconsequential backdrop; it actively influenced and shaped our research. This chapter concludes the background of our research. The following section– PART II– presents our three papers.

PART II – THE THREE PAPERS

Chapter 5: <Paper 1> Organizational Improvisation: A Framing for Innovation Affordances

Abstract

This paper explores the conceptualization and use of technology affordances in digital innovation. The research focuses on intense periods of innovation by innovation leaders, particularly when improvisation occurred, to understand how technology affordances shaped innovation strategy. The analysis reveals how leaders' perceptions of technology affordances were guided by five main logics and often culminated in actionable decisions which had consequential outcomes for innovation. First, we found that innovation occurs through leaders' conceptualization of five main types of affordances, which we term actualizing, optimizing, transforming, counteracting, and compensating affordances. Second, we classified these affordances into two categories: intended and responsive affordances. Our findings extend the technology affordance literature by introducing new concepts and providing fresh theoretical insights on the application of technology affordances to innovation management. Furthermore, the research offers significant implications for the strategy and practice of digital innovation.

Keywords: Technology Affordances; Digital Innovation; Innovation Management; Innovation Strategy; Organizational Improvisation; Technology Development; Decision Support Framework; Interactive Voice Response; Financial Services

5.1 Introduction

This study employs affordances as a conceptual tool for examining digital technologies within innovation by focusing on the actions and mindsets of innovation leaders, especially when moments of improvisation occurred. We structure the paper as follows. First, we highlight digital innovation management, including organizational improvisation, and provide an overview of the relevant literature. The next section grounds our work in the literature on affordance theory, our theoretical framework. Next, we outline our research methods including our data collection and analysis procedures. We examine the perception and use of technology affordances by innovation leaders using data from an in-depth case of innovation: a 1-year pilot project involving the development and testing of an interactive voice response (IVR) system with savings clients in Ghana. Finally, we share our research findings and discuss how they extend the existing literature by identifying new types of affordances. We offer a strategic framing for digital innovation and recommend future directions for research.

5.2 Digital Innovation Management

This study focuses on two dynamics of digital innovation management in our case: the actions and mindsets of innovation leaders (managers) and organizational improvisation.

The Actions and Mindsets of Innovation Leaders

To date, various researchers have studied innovation practice by focusing on the actions and mindsets of innovation managers. This is in contrast to the interaction-centered view which focuses on the end-users' interpretations to determine what the technology

affords (see Vyas, Chisalita and van der Veer 2006). Ringberg, Reihlen and Rydén (2018), for example, studied the interaction between the mindsets of managers and technology, which they argued are fundamentally co-constitutive. They developed a Technology-Mindset Matrix consisting of four interaction types of innovation: incremental, radical technological, radical mindset, and revolutionary. Using evidence from case examples, they claimed that each interaction type generates unique innovative outcomes.

Andrade-Valbuena and Torres (2018), as another example, analyzed how managers within organizations reflect on technological shifts when they recognize innovation opportunities. They argued that a deliberated reflection of technological shifts by managers is useful because it enhances innovative performance, i.e., it promotes the use of new technological releases in the development of innovation processes. Andrade-Valbuena and Torres (2018, 84) wrote:

> *The adoption of a new technology is a result of personal beliefs about the attributes conferred to a given technology, which create an attitude towards it. Managerial reflection on the benefit and threats of a new technology is highly influenced by prior experiences involving similar technologies (Schweitzer et al. 2015). Such experiences trigger reflections that form the way in which subjects understand how technology works. When subjects receive feedback from technology implementation, they can reinforce their beliefs or modify their prior understanding (Boud et al. 1985). The complexity of analyzing technology reflection lies in the fact that two people do not perceive technological phenomena equally (Hammedi et al. 2011).*

Following Ringberg, Reihlen and Rydén (2018) and Andrade-Valbuena and Torres (2018), the insights drawn from human reflections and actions are foundational to this study. Our research investigates the nature of the relationship between innovation leaders and their perceptions of technologies, which as past studies have substantiated,

influences the leaders' engagement with these technologies. This engagement with technology is complex and is shaped by individuals' experiences and personal beliefs, thus making any encounter with the same technology inherently different for each person (Williams and Edge 1996; Andrade-Valbuena and Torres 2018).

Our research most closely follows Tumbas, Schmiedel and Vom Brocke (2015) who highlighted the dearth of research on the topic of how organizational leaders outside the IT function innovate with digital technologies. Their study synthesized and re-interpreted data from three qualitative case studies using a theoretical lens of institutional logics and affordances. They found that innovation leaders outside the IT function conduct digital innovation using various institutional logics. They built a case that these various logics enabled the innovation leaders to combine distinct practices and thereby trigger organizational change. They called for future research to further examine such logics, arguing that a better understanding of such logics will help innovation leaders drive innovation. This paper directly responds to this call and also the general call for more thick, empirically grounded qualitative research to explore the dimensions and dynamics of digital innovation (Yoo et al. 2010).

Furthermore, our research builds on the work of Nylén and Holmström (2015) who examined how digital innovation can be managed and introduced a managerial framework consisting of five key areas: user experience, value proposition, digital evaluation scanning, skills, and improvisation. In this paper, we focus on this last area, improvisation, for our in-depth investigation into the role of technology affordances.

Organizational Improvisation

Cunha, Cunha and Kamoche (1999) defined improvisation as "the conception of action as it unfolds, drawing on available material, cognitive, affective and social resources." In the 1990s, early scholars of organizational improvisation studied improvisation in the context of jazz music to explore the phenomena of structure and arrangements, particularly how performing and composing are done simultaneously (see Weick 1998). Scholars since then have drawn on these principles to study improvisation in other contexts including various organizational group settings (Moorman and Miner 1998). Examples of applying improvisation within innovation studies include Kyriakopoulos (2011) who examined improvisation in product innovation as it relates to market effectiveness, and Vera and Crossan (2005) who found a contingent impact of improvisation on innovative performance. Hadida, Tarvainen, and Rose (2015) reviewed the organization improvisation literature and developed a consolidating framework to help classify improvisation degrees and levels.

Organizational improvisation is characterized by a temporal and substantive convergence of composition and execution, an extemporaneous quality of action, and a degree of intentional deviation from existing routines (Baker, Miner, and Eesley 2003). Nylén and Holmström (2015, 65) suggested that in the digital arena, improvisation is typically an act of reconfiguration and stated that "the malleability of digital technologies affords a higher degree of improvisation than their analogue counterparts." Improvisation is particularly important for digital innovation because it helps organizations respond to the rapid unfolding of digital innovation processes and outcomes. Resources, processes, and structures within an organization are often forced

to change to accommodate the innovation. External factors pose other controls and constraints. Throughout the innovation lifecycle, innovators must consider all the moving pieces and reconfigure the elements that are controllable to develop and refine the innovation. Such reconfiguring must work in tandem with the constraints imposed by internal and external forces. Innovators must carefully assess these constraints and use calculated guestimates to make decisions aimed at reinforcing the impact of positive outcomes while minimizing the impact of negative ones. It is therefore through improvisation, or reconfigurations of structures, processes, and materials, that organizations can harness this complexity (Nylén and Holmström 2015).

The act of improvisation operationalizes innovation and moves the innovation forward. This is particularly relevant for complex environments, whereby project stakeholders must "assume a world of multiple causes, diversity of outcomes, inconsistency of interventions, interactive effects at every level" (Patton 2011, 41). Innovation through improvisation involves experimenting, adapting, and developing as a response to changing conditions, new insights, emerging challenges, and user feedback (*ibid.*). Innovation leaders who are adaptive and developmentally oriented are better suited for these tasks because greater progress can be made when leaders change their course of action to rapidly respond to unfolding processes and outcomes (*ibid.*). Improvisation therefore is a key managerial process for which innovations rapidly adapt to their environments.

This paper builds on scholarship that has theorized the emergence of strategy in organizational improvisation (Baker, Miner, and Eesley 2003) and contributed to improvisational learning (Cunha et al. 2015). These areas in innovation systems

research compared to other knowledge areas are underrepresented (Rakas and Hain 2019) and provide valuable opportunities for an increased understanding of innovation theory and management.

5.3 Technology Affordances

Affordance theory provides the theoretical framework for our study on digital innovation. Affordances are not properties of the organism nor the environment but are situated within an interaction and are a link between perception and action (Gibson 1986). Gibson (1986, 129) writes,

> *An affordance cuts across the dichotomy of subjective-objective and helps us to understand its inadequacy. It is equally a fact of the environment and a fact of behavior. It is both physical and psychical, yet neither. An affordance points both ways, to the environment and to the observer.*

Given such complexity, it may be unsurprising that the literature presents disagreement on what constitutes an affordance (see Stendal, Thapa and Lanamaki 2016). Some scholars include the actualization of affordances as essential for the concept. Other scholars expand the boundary even further in considering affordances as a building block of a more complex mechanism (Stendal, Thapa and Lanamaki 2016). In this paper, we use Gibson's (1966) original, more tightly bounded conceptualization of affordances as "action possibilities."

Affordance theory has been explored by scholars across various disciplines and has been applied increasingly in IS and organizational studies. The 2000s marked the advent of intensified interest in affordances by scholars of IS and technology. Key works include Markus and Silver (2008), Leonardi (2011), Leonardi (2012), Yoo et al. (2012), Robey, Anderson, and Raymond (2013), Seidel, Recker, and Brocke (2013), Volkoff and Strong

(2013), and Strong et al. (2014), Zhao and Zhu (2016), and Anderson and Robey (2017). As constituted within this body of technology affordance literature, affordances are particularly useful as a lens for studying and explaining IT-associated change (Volkoff and Strong 2013). They enable scholars to study technologies and their consequences while avoiding technological determinism (Anderson and Robey 2017; Bygstad, Munkvold, and Volkoff 2016). Affordances also help scholars understand how the materiality of an artifact shapes, invites, and constrains a set of specific applications (Zammuto et al. 2007). An affordance lens is therefore suitable for studying technological innovations for understanding the roles, dynamics, and outcomes of technologies within and because of the innovation. In recent years, innovation scholars have applied affordances to investigate how innovation tools and infrastructures facilitate the process and practice of innovation in specific contexts (Nambisan, Wright, and Feldman 2019). Key literature is outlined in the following table.

Table 3. Scholarship Examining Technology Affordances in Relation to Innovation

Technology Affordance Literature Related to Innovation	
Zammuto et al. (2007)	Examined the intersection of technology and organizational features, offering five relevant affordances which can result in new forms of organization. The five affordances are: visualizing entire work processes, real-time/flexible product and service innovation, virtual collaboration, mass collaboration, and simulation/synthetic reality.
Dijk et al. (2011)	Introduced the concept *micro-institutional affordance* "to refer to those conditions of the institutional logics and structures within organizations that actors may exploit in strategic action." Using case studies of radical innovation, the authors identified the most important and strongest relationships between affordances and responses. They claim to be the first to link different strategic actions to types of affordances.

Abrishami, Boer and Horstman (2014)	Studied the adoption dynamics of medical innovation and found five key interrelated affordances in the adoption process: characteristics-related, research-related, entrepreneurship-related, policy-related, and communication-related.
Tumbas, Schmiedel and Vom Brocke (2015)	Examined how non-IT functions innovate with digital technologies using the lens of institutional logics and affordances. They found that innovation draws on various institutional logics, which are reshaped as actors perceive different affordances of the technology and by combining old and new practices and symbols when appropriating the technology.
Endrissat and Noppeney (2016)	Examined how newness and familiarity in innovations in the creative industries might be reconciled using an affordance lens. They explored how analogical processes are drivers of innovation and found that innovation resulted from a combination of schematization and recombination.
Zhao and Zhu (2016)	Introduced the concept *task affordance* and decomposed the concept into five dimensions: design affordance, presentation affordance, assignment affordance, task-platform fit affordance, and task-worker fit affordance.
Abhari, Davidson and Xiao (2017)	Developed and validated a general instrument to measure co-innovation platform affordances. Using two cases, the authors found three distinctive components: ideation, collaboration, and communication.

5.4 Research Question

This study provides an in-depth examination of the roles and dynamics of technology affordances during intense periods of innovation, particularly when improvisation occurred, to understand how technology affordances shape innovation strategy. We address the research question: *How are technology affordances perceived and used by digital innovation leaders?* By addressing this question, this research provides an improved understanding of the concept of technology affordances along with a more nuanced understanding of the relationship between digital technologies and innovation.

We argue that a better understanding of affordances would enable innovations scholars and practitioners to obtain more of the potential value offered by affordance theory and thereby help direct future scholarship. The following section details our research approach.

5.5 Research Setting and Methods

We employed an in-depth case study using multiple data sources which we collated, analyzed and triangulated (Yin 2003). The global microfinance organization Opportunity International (Opportunity) was selected as the case organization because of the organization's history of innovating with digital technologies and its provision of dedicated resources in the form of a team which managed its digital innovations projects. Our research involved studying an in-depth case of innovation, a pilot project from start to finish which involved the development and testing of interactive voice response (IVR) with financial services clients in Ghana. The project was carried out through a collaboration between Opportunity, its operating partner in Ghana (Opportunity Ghana), and a third-party IVR technology supplier. The strategy and management of this pilot was executed across these three organizations; hence we studied the perceptions and actions of innovation leaders from these three organizations taking into account their respective organizational roles.

Table 4. General Presentation of the IVR Project Partners

Key Partners	**Description**	**Project Roles**	**Innovation Leaders**
Opportunity International	A global not-for-profit organization that provides financial services such as loans, credit, and insurance, along with basic financial training, to small-scale entrepreneurs through a network of 47 implementing partners in over 20 countries in Africa, Asia, Latin America and Eastern Europe. Over a 10-year period, more than $20 million has been invested in electronic and mobile technologies by Opportunity to reduce transaction costs and bring services to the most marginalized and remote clients[12].	This organization sponsored the project and helped produce the message content, analyze and manage the data, and lead the project evaluations. The researcher was part of this organization and helped carry out these activities.	Two innovation leaders: program leads on the digital innovations team.
Opportunity Ghana	A financial service provider operating in 7 of Ghana's 10 regions and serving nearly 500,000 clients. This institution has strong working relationships with the Bank of Ghana and partners with Ghana's leading telecommunications companies. It serves clients through 44 branches and mobile banking services.	This organization managed the project implementation with its branches and clients. It also helped produce and test the message content, gather and synthesize the data, and assist with the project evaluations. Finally, it operated the staff and customer hotlines and maintained records of communication and lessons learned.	Seven innovation leaders: functional heads and managers in operations, customer engagement and marketing.
Third Party IVR Supplier	A Ghana-based organization that provides	This organization implemented the	Three innovation

[12] Source: https://opportunity.org/what-we-do/products-and-services/global-technology, accessed January 21, 2019.

	customer engagement services using digital technology, specifically interactive voice response (IVR) and Short Messaging Service (SMS). It operates in over 20 markets across Africa and Asia.	project by operating IVR and SMS technologies. It outsourced the message scripts to a translation and recording firm. It also worked with the MNOs, collected data, delivered reports, and maintained a live dashboard.	leaders: project, technical and support managers.

The digital innovation under review was complex, involving multiple partners, multiple technology systems, and 12 innovation leaders based in multiple countries including Ghana, Rwanda, and the United Kingdom. It was also complex in the sense that it involved many similar characteristics of technological innovation in "developing" or "emerging" countries as presented in prior research, such as inadequate infrastructure, cumbersome regulations, and various market barriers (see Weiser 2007). This setting for our study enhanced our ability to examine manager improvisation as a response to emergent constraints and other risk factors.

Digital Artifacts

The pilot project involved the introduction of IVR in conjunction with the use of SMS.

- **IVR** is a computerized phone system that enables a two-way conversation between a real person and a pre-recorded voice in an interactive manner. IVR as used in the case is based on a programmed algorithm which matches a pre-recorded voice response to a person's communication input. While some IVR systems enable human interaction through the use of voice applications or by

typed commands on a phone keypad, the case in this study was limited to typed commands and lacked the voice capability. IVR is especially useful for companies in allowing callers to access the company's database to service their own enquiries by following step by step instructions provided by the pre-recorded voice. In this case, IVR was used by the organization primarily as a method to push out communications to a high volume of customers. Calls were sent by the IVR system to provide basic information and the IVR functionality enabled customers to obtain more information via increased interaction with the system. For example, one IVR message provided savings tips and gave listeners the option to receive additional information by pressing a number on their phone keypad which led them to a menu of options.

- **SMS** is a text messaging service component which uses standardized communication protocols to enable mobile devices an exchange of short text messages, typically up to 160 characters in length. The short messaging services of MNOs are relatively cheap and the adoption of such services has become ubiquitous worldwide. Many organizations use SMS to communicate with customers, such as sending SMS as confirmation of payment. Limitations of SMS include its inability to be directly encrypted and that its information is often stored without proper security on a mobile device. These limitations must be factored in by organizations designing and using SMS. In the pilot project carried out in our case study, SMS was already familiar to the institution and its clients. Prior to the pilot project, SMS was used by the institution with clients to provide e-banking notifications. What was new in this case was the joint use of SMS with

IVR messaging and the SMS' technological origination– the platform hosted by the IVR supplier.

These digital artifacts were owned and operated by the third-party IVR supplier and hosted on a platform which integrated with the mobile network systems of some of Ghana's most prominent MNOs.

Case Overview

The innovations team at Opportunity initiated the project to help improve the experience of customers by providing voice-based banking information tailored into local languages. The goal of the project was to test the effectiveness of IVR as a customer engagement channel for existing clients of Opportunity Ghana. This project became the first of two pilot projects carried out by Opportunity that were implemented during similar and overlapping time periods. Data from the second project, based in Uganda, which started a few months after the project in Ghana, was used to help validate the research findings.

Ghana is a low-middle income country in West Africa with an estimated population of 28 million people. Ghana has rapidly adopted digital financial services since around 2010, although it has transitioned at a slower pace than Kenya and Tanzania. At the time of this pilot project, IVR was not widely used in Ghana. SMS however was widely used by MNOs, financial institutions, and the general public– the vast majority of whom owned or had access to a mobile phone when this research was conducted. When a small sample of 23 clients was asked during the mid-project evaluation if they had ever received pre-recorded voice messages before this project, nearly half of the clients

expressed unfamiliarity with IVR or pre-recorded voice messages. In other discussions, many staff of the institution voiced similar unfamiliarity. Those who had heard IVR messages before this project said the messages they had received or heard about were typically product advertisements that were sent infrequently by MNOs or large commercial banks. Based on the project team's awareness, this IVR pilot was the first of its kind in Ghana especially due to the message content.

The messages provided information focused on encouraging positive savings behaviors among existing savings clients. Some messages provided reminders for clients to save, while other messages contained general savings tips or institution-specific information. The breakdown of topics is shown in the following table.

Table 5. Summary of Messages sent to Clients during the Pilot Project

Message Topic	**Description**	**No. of IVR messages**	**No. of SMS messages**
Savings tips/ guidance	General information about the importance of savings and tips on how to develop positive savings habits.	12	0
Relational	Holiday greetings, inspirational quotes, and general information about the project.	5	3
Savings goals	Information on how to set a savings goal and the benefits of having goals.	2	1
Savings account balance	Generic information about the client's account balance, i.e., whether it has increased or decreased in recent months.	3	0
Savings channels	Information on where or how to save, i.e., at a bank branch or using the institution's mobile banking service.	3	3
TOTAL		**25***	**7**

**The total number of messages (25) exceeded the number of messages that were sent to clients (23) because not all messages were sent to every client (i.e., some messages were only sent to specific customer segments).*

The project targeted savings clients with low account balances and low account activity. Clients who met either criteria and had a general savings account were selected for the project, for a total of 46,671 participants. The participants were located across Ghana in seven of the country's ten regions.

The pilot participants received the IVR messages weekly or biweekly and the SMS messages monthly or bimonthly on average over an 11-month period from December 2017 to October 2018. At the start of the project, messages were sent to clients on Mondays-Wednesdays during typical work hours. In the second half of the project, the schedule was revised so that messages were sent over the weekend instead of regular business hours as a result of customer feedback which was gathered during the mid-project evaluation.

5.6 Research Approach and Methods

The researcher was embedded as a member of the innovations team at Opportunity for a year and a half period, which provided additional insights from the pre- and post-project activities along with a general understanding of the team's strategy and work. The main methods of data collection consisted of internal documents and participant observations. The researcher's observational memos were analyzed thematically and iteratively alongside internal documents such as strategy documents, project reports, communications logs, and message scripts throughout the data collection process. These

methods provided an in-depth exploration of the research topic by enabling the research to actively shape the research inquiry process as new findings emerged.

The data that were gathered contained various content and focused on the innovation leaders' reflections of the pilots' operations and technologies. The leaders, for instance, regularly reflected on findings from the data and the reports on call performance and savings balances. They also reflected on the feedback that was collected from clients and staff throughout the project and through the mid and end-of-project evaluations. In such reflections, key design features of the technologies were discussed, and comparisons were made to help provide a frame of reference for the discussants (i.e., the affordances of IVR vs. SMS, the affordances employed in past projects, etc.). The following excerpt from the data provides an example of how technology affordances were discussed and considered for decision-making during the innovation process.

> Excerpt from a Project Communications Log:[13]
>
> *Steve (innovations leader, Opportunity): Kisi - is this message still being sent out?*
>
> *Kisi (innovations leader, IVR vendor): The incoming call is still open so they can call in to listen at any time, but we are not pushing calls from our end. Would you want me to prevent people from calling in to listen? I can just close it.*
>
> *Steve: I think you can close it completely at end of today, please Kisi.*

Using an affordance lens, we analyzed the technological reflections of the innovation leaders during intense periods of innovation, particularly when improvisation occurred, to identify affordances and their patterns within the data. We used Miles and

[13] Pseudonyms have been used.

Huberman's (1994) guidelines to thematically code the affordance perceptions, actualizations, and attributed effects of the IVR system and related systems for which the innovation was integrated and/or dependent (i.e., core banking and MNO systems). These codes, descriptive and interpretive in nature, were then categorized into explanatory and inferential codes called meta-codes (Miles and Huberman 1994). As a final step, we employed the analytical tools pattern matching and explanation building (Yin 2003). Following Andrade-Valbuena and Torres (2018), we queried the data to determine if technology affordances provided a systematic synchronized approach to developing and testing the innovation.

Table 6. Links between Methodology and Data

Corresponding Step	**Theory**	**Sources**
1. Observe the interactions between innovation leaders and the digital technologies with which they are innovating, and specifically how the leaders reflect on these technologies.	Studying the interaction between humans and technologies can provide an improved understanding of how the mindsets of innovation leaders and technology are fundamentally co-constitutive (Ringberg, Reihlen and Rydén 2018).	*Documents:* Strategic plans, technology and programmatic reports, organizational structures, policies, processes, procedures, product data and manuals, performance measurement reports including social performance, etc. *Observations:* Interactions with innovation leaders and other key project stakeholders.
2. Identify technology affordances, along with any associated conceptualizations, conditions, and effects.	Technology affordances are a useful lens for understanding IT-associated change and the material nature of technological artifacts and situated socio-technical relationships (Zammuto et al. 2007; Strong et al. 2014; Volkoff and Strong 2013; Anderson and Robey 2017).	
3. Identify any existing patterns based on the	The analytic tools of pattern matching and	

Corresponding Step	Theory	Sources
conceptualizations and uses of these affordances.	explanation building can generate new theory development (Yin 2003).	

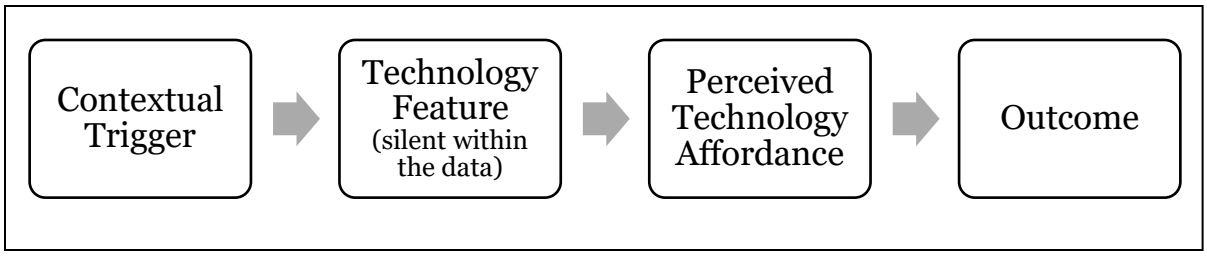
5.7 Findings

The findings showed that innovation leaders employed technology affordances to (1) strengthen the alignment between an innovation and the organizational goals for that innovation and (2) to help the innovation address barriers and leverage opportunities that emerged within the innovation process. This section details how these findings were derived from our data.

In addressing the question on how technology affordances are perceived and used by innovation leaders in our case, we identified a list of 61 types of perceived affordances (see examples in *Appendix D*). These were coded using NVivo software during the first round of coding. Our analysis also captured three related components of the innovation process: (1) the contextual circumstances and/or characteristics associated with why the technology affordance was perceived, which we term the "contextual trigger;" (2) the feature of the digital technology that enables this technology affordance to be perceived; and (3) the outcome of whether the perceived affordance is enacted and any associated conditions. Components 1 and 3 were evident in the data, while the second component– the technology feature– was derived by the researcher based on the nature of the perceived affordance.

The following figure provides the sequence of the key components of the innovation process as derived from the analysis.

Figure 4. Sequence of Key Components of the Improvisation Process



Examples of these key components from the data have been listed in the following table.

Table 7. Examples of the Key Components of the Improvisation Process

Contextual Trigger	**Technology Feature**	**Perceived Technology Affordance**	**Outcome**
Clients are dropped from the call if they don't select a language after being given two chances to select their preferred language. – Innovation leader, IVR vendor	Digital malleability	A change in the system so that messages continue in a default language instead of dropping off. - Innovation leader, Opportunity Ghana	The perceived affordance is confirmed to be possible and enacted by the IVR vendor.
Clients do not always hear or understand the messages. They may want to hear the message again or share the message with another person. - Innovation leader, Opportunity Ghana	Digital malleability	The callback feature can be setup so that the messages will be "like a library." People could then call back and listen to old messages. - Innovation leader, IVR vendor	The perceived affordance is enacted by the IVR vendor.
Clients come to branch staff to ask questions about the messages, but the staff are not always aware of the messages	Digital scalability and malleability	Branch staff can receive the messages so that they have the same experience as the clients.	The perceived affordance is enacted through coordinating efforts by

or how to answer questions. - Innovation leader, Opportunity Ghana		- Innovation leader, Opportunity Ghana	Opportunity Ghana, Opportunity and the IVR vendor.
Clients who do not respond to prompts may lose interest if they get too many messages with prompts. They may get annoyed and stop picking up the calls. - Innovation leader, Opportunity Ghana	Digital malleability	The clients who do not respond to our prompts could be treated as a separate customer segment and provided with a different set of tailored messages. - Innovation leader, IVR vendor	The perceived affordance was not enacted by Opportunity and the IVR vendor.

After identifying different types of perceived affordances, we examined how the affordances were being used by the innovation leaders who had perceived them. We identified five main logics underpinning the leaders' reflections and uses of technology affordances. Here we use logics to mean the approach given to problem framing and problem solving by the innovation leaders in our study. In the analysis, logics were particularly useful for understanding affordances and behaviors, and helped the research in identifying and specifying affordances. The five main logics that were identified are as follows.

#1. The Logic of Actualizing. This logic refers to the perception and use of technology affordances to fulfill organizational goals, particularly the original goals for the innovation. Enacting an actualizing affordance helps innovation leaders operationalize the planned benefits of the project.

Example from the data: The project strategy, which was developed and enacted by the project team, focused on how IVR would help the organization fulfill its

goal of increasing savings balances, especially among savings clients who had low account balances and low account activity.

Excerpt from the Project Messaging Strategy Document:

Increase total average savings balance by encouraging existing customers to keep higher balances with Opportunity Ghana…Messages should be actionable and clearly demonstrate the associated benefits to the clients. "Set a savings goal because this will help you to…"

#2. The Logic of Optimizing. The second logic is like the first in that it is also related to the organizational goals. The key difference is that this logic, as observed, constitutes technology affordances as responsive mechanisms, enabling innovation leaders to leverage unplanned opportunities, those not part of the original goals for the innovation. These opportunities can be foreseen or emergent. Enacting an optimizing affordance helps innovation leaders operationalize unplanned benefits which are or could be derived from the project.

Example from the data: From clients' feedback, the project team discovered that the IVR messages added "positivity" to the client-institution relationship. The team subsequently introduced more relationally focused elements into the messages to try to enhance any positive relational effects that were derived from the calls.

Excerpt from a Project Report:

Ideas for Future Messages:
…Tell clients we're calling to check on them, asking how they are doing, how their families and businesses are doing. (Just as a greeting, to show concern even if a response is not gathered)

#3. The Logic of Transforming. This third logic constitutes technology affordances as a responsive mechanism used to address barriers and undesired outcomes by changing or reconfiguring an existing component of the innovation, such as a digital artifact or a process. In shifting one or more elements, the aim is to change the path of the innovation in such a way that it eliminates or lessens the impact of barriers and/or undesired outcomes. Enacting a transforming affordance helps innovation leaders operationalize an approach to risk-mitigation by offering a change to the makeup of existing components.

Example from the data: During times when the call volumes were high, the project's message schedule was adjusted to help smooth the call load in order to lessen some of the negative effects caused by the IVR system's limited capacity.

> Excerpt from a Project Communications Log:[14]
>
> *Kisi (innovations leader, IVR vendor): Hello Steve, the calls have retired and the problem of phones not dialing still persist. I have been asked to break down the calls and dial in batches of 5,000 each, this is because our system has been flooded with high volumes of calls over the period causing a malfunction. I will push the calls out in bits starting tomorrow and we can monitor for improvements. Other high-volume projects launched during the weekend, hence the malfunction.*

#4. The Logic of Counteracting. This forth logic is like the third in that it constitutes technology affordances as a responsive mechanism to address barriers and/or undesired outcomes. However, instead of addressing these by changing the makeup of an existing component, this logic addresses them by counteracting or offsetting the undesired elements. Enacting counteracting

[14] Pseudonyms have been used.

affordances helps innovation leaders operationalize an approach to risk-mitigation by offering a direct response to the problem.

Example from the data: When various challenges with the mobile network arose during the project, the IVR vendor stopped its integration with the existing mobile network technology and switched to a different MNO.

> Excerpt from an Observation Memo:[15]
>
> *They <staff of the financial institution> said they would get repeat messages, and at times, messages late in the night. One staff said the message would wake her up in the night. <The IVR vendor> didn't seem aware of how bad the repeats were, but then later they changed <MNOs>.*

#5. The Logic of Compensating. This fifth logic also constitutes technology affordances as a responsive mechanism to address barriers and/or undesired outcomes but does so by compensating for their negative effects through the generation of positive effects. Enacting compensating affordances helps innovation leaders operationalize an approach to risk-mitigation by offering a counter-effect which is positive.

Example from the data: When messages were accidently sent to the wrong segment of clients, the project team discussed how to "make up for this mistake" by considering various possible technologies and technology uses for communicating with the clients.

[15] Pseudonyms have been used.

Excerpt from an Observation Memo:[16]

...there was the pilot mix up and <the IVR supplier> wanted to know if we should just resend the message again, but just to the right segments this time around. ... From Steve's perspective, we couldn't repeat messages- the damage was done so we couldn't just redo. So we needed to amend another way. We discussed addressing what was actually done- meaning more clients would need to be followed up with. ...Charlotte and I had suggested using IVR or SMS but Nathan said we had to make up for this mistake and do it as quickly as possible.

Identifying these five logics initiated our second round of coding. In identifying and categorizing the technology affordances based on their underlying logics, we developed the five meta-codes: actualizing, optimizing, transforming, counteracting, and compensating affordances, as described in the following table.

Table 8. Meta-Codes: Classifications of Affordances Perceived and Used by Innovation Leaders

Meta-Code	**Description**	**Examples from the Data**
1. Actualizing Affordance	A technology affordance which is connected to fulfilling the original organizational goals of the innovation.	- IVR messages were used as a channel to deliver savings-related information to a large volume of clients in local languages. - IVR messages were used to prompt positive savings behaviors among clients.
2. Optimizing Affordance	A technology affordance which is connected to reinforcing or enhancing a desired outcome or existing condition.	- IVR messages were used to reinforce the work already being done by the institution and enhance the client-institution relationship. - SMS messages were used to reinforce the IVR messages by providing relevant information.
3. Transforming Affordance	A technology affordance which is connected to changing an undesired outcome or existing condition.	- IVR messages were used to help clients feel more comfortable engaging with the institution via mobile devices, as a step toward mobile banking.

[16] Pseudonyms have been used.

		- IVR messages were used to inform clients about the institution's policies and key announcements.
4. Counteracting Affordance	A technology affordance which is connected to counteracting or offsetting an undesired situation or outcome.	- IVR messages were used to counter effects of Ghana's recent banking crisis by instilling clients' trust in the institution. - IVR messages were used to lessen the effects of account dormancy by prompting inactive clients to come reactivate their accounts.
5. Compensating Affordance	A technology affordance which is connected to compensating or making up for an undesired outcome or existing condition.	- When clients were too busy to pick up a call, IVR was used to provide clients the messages at a later time through a limited number of call retries and a tollfree client callback option. - When the IVR system experienced a failure, SMS messages were used in place of IVR messages.

Based on further analysis, we studied the usage and interactions of these affordances, particularly how they were used by the innovation leaders in a complementary manner to develop the innovation. Based on the type of affordance, we categorized the meta-codes into two groups: "intended affordances" for the first meta-code and "responsive affordances" for the other four meta-codes.

Intended affordances are closely aligned to the original goals of the innovation, which are typically documented in project plans, strategy documents, and reports. As in the case of actualizing affordances, a type of intended affordance, these affordances are potentially perceived and/or enacted for the purpose of actualizing one or more of the original innovation goals. There is a growing body of IS literature on the inherent relationship and interplay between technology

affordances and organizational objectives (see Strong et al. 2014; Klecun, Hibberd and Lichtner 2016; Anderson and Robey 2017), which has substantiated a direct relationship between technology affordances and organizational objectives in the context of innovation and beyond. Anderson and Robey (2017) wrote that when people perceive a technology, "they see either affordances or constraints based on how the technology fits with their current goals." Furthermore, Strong et al. (2014) conceptualized affordance actualization as actions taken to achieve outcomes that are in support of organizational goals by taking advantage of one or more technology affordances. Hence our concepts of actualizing affordances and intended affordances more broadly are underscored by this literature.

Responsive affordances, on the other hand and as the name implies, refer to the use of technology affordances as possible response mechanisms to leverage unplanned opportunities or address barriers and/or undesired outcomes (whether real or perceived). The existing affordance literature does not address the logic of responsiveness within the innovation process, which our analysis contributes.

While intended and responsive affordances were underpinned by dominant logics– such that intended affordances most closely follows the logic of actualizing, and responsive affordances most closely follows the other four logics we identified, optimizing, transforming, counteracting, and compensating– there were instances when one action was grounded in more than one logic which spanned across categories. We will use the following example to illustrate this point. IVR was perceived and employed to inform

clients with low levels of literacy about various banking channels for savings. This affordance of IVR tapped into multiple logics: a way to *transform* clients' levels of awareness by helping clients move from less aware to more aware; a way to *transform* the institutions' communication on this topic to a digitalized channel; and a way to *compensate* for the institution's previous lack of ability to send mass communications about this topic to clients with low levels of literacy. As shown in this example, one stakeholder may be guided by multiple logics when perceiving an affordance, and multiple logics may also arise due to the involvement of multiple stakeholders who contribute different perspectives. Furthermore, the underpinning logics may be appropriated in different ways, i.e., a transforming affordance as illustrated in this example might consider transformation for the client and transformation for the institution.

These categories, intended and responsive affordances, enable the research to introduce and develop a meta-theory of "innovation affordances," which we refer to as action possibilities that emerge within the development or diffusion of innovation. Innovation affordance is a useful term for structuring various types of affordances and depicting their dynamics in innovation. Our research showcases various dynamics of innovation affordances by identifying its key dimensions (the five classifications and two categories of affordances) as found in our case study. In the coming sections, we will describe how these affordances, through their applications and interactions, jointly built and refined the innovation. A sample list of codes by meta-code and category can be found in the following table. Examples from the data can be found in *Appendix D*.

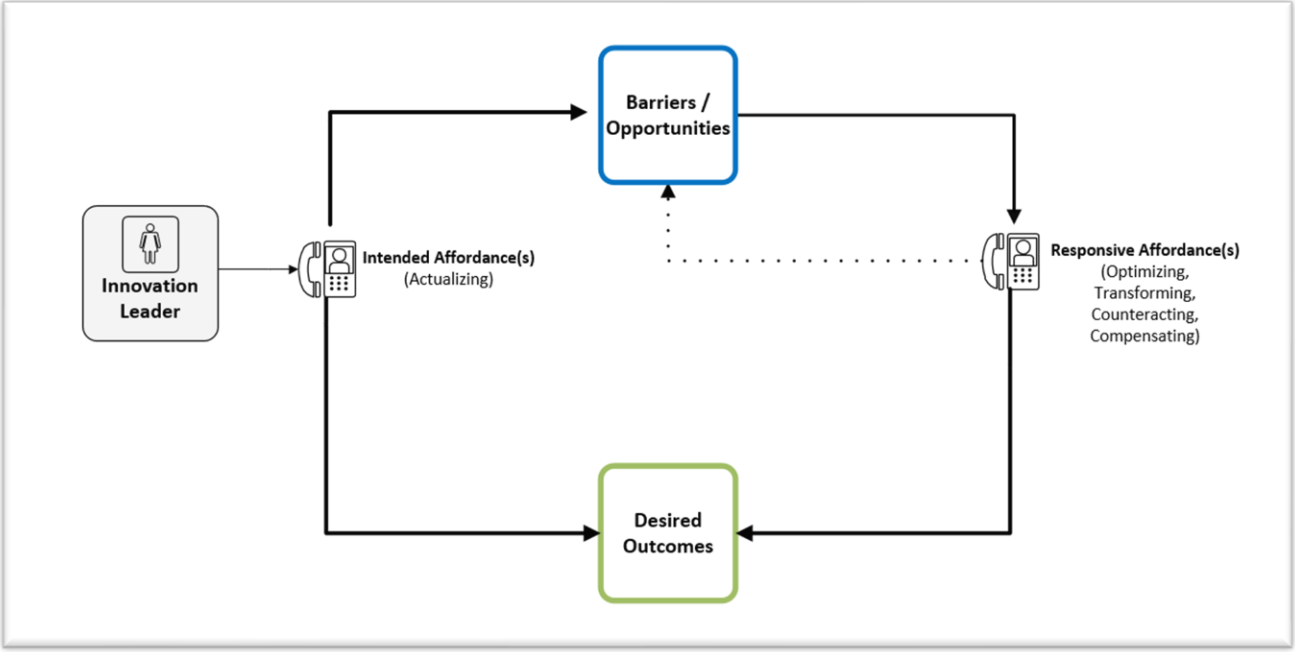
Table 9. Sample List of Codes, Meta-Codes, and Categories of Innovation Affordance

Category of Innovation Affordance	**Meta-Codes**	**Codes**
Intended Affordances	Actualizing Affordance	Target clients Deliver scale Deliver information Prompt behavior change Connect to client relationally
Responsive Affordances	Optimizing Affordance	Reinforce existing work practices Reinforce key messages Strengthen relationships
	Transforming Affordance	Educate and inform Change behaviors Change attitudes
	Counteracting Affordance	System delay response Poor performance / miscommunications response Banking crisis response Dormant account response (savings/mobile banking)
	Compensating Affordance	Adjustments New elements Workarounds

The Innovation Process

Following the categorization of our meta-codes into intended and responsive affordances, we situated these meta-codes in relation to one another and within the broader innovation process, producing the following conceptual model.

Figure 5. Conceptual Model of the Innovation Process



Model Description

Our conceptual model begins with the innovation leader who, at the start of this model, perceives a technology affordance as being useful for helping fulfill the original goals for the innovation. As previously mentioned, these affordances, which we termed "actualizing affordances," are typically enacted by innovation leaders to actualize one or more original goals of the innovation.

At this point in our model, there are two paths that the innovation leaders' reflections can take. Immediately following a perceived intended affordance, the leader may reflect on: (1) desired outcomes and (2) barriers or opportunities.

In this first type of reflection– desired outcomes– which is displayed at the bottom of our model, the leader foresees that the intended desired outcomes will come to fruition once the intended affordance is enacted. As shown in the model, the end goal of the

innovation process is to achieve the desired outcomes, whether it be through intended affordances, responsive affordances, or a mixture of both.

The second type of reflection– barriers or opportunities– provides the possibility of a much more extensive reflection. Here, the innovation leader perceives one or more undesired or desired elements related to the enactment of the intended affordance. We can use the following example. An innovation leader perceives IVR as a possible way to communicate to clients in their local language but that there are possible barriers and undesired outcomes[17] related to this affordance enactment. There may also be unexpected opportunities that arise. Examples of perceived barriers may include the infeasibility of having all 80 of Ghana's local languages[18] in the project and an inability to assign the appropriate local language to each participating client with 100% accuracy. An undesired outcome could be that clients misunderstand the message due to its delivery in the incorrect language or dialect. An example of an opportunity is that IVR could help the institution reach more clients than originally planned if it is used to bridge the communication gap with clients who speak languages or dialects that are unfamiliar to staff. In this way, it could afford a translation service.

Next in our model, after a barrier or opportunity is perceived, the innovation leader may reflect on yet another technology affordance, a "responsive affordance," to address these

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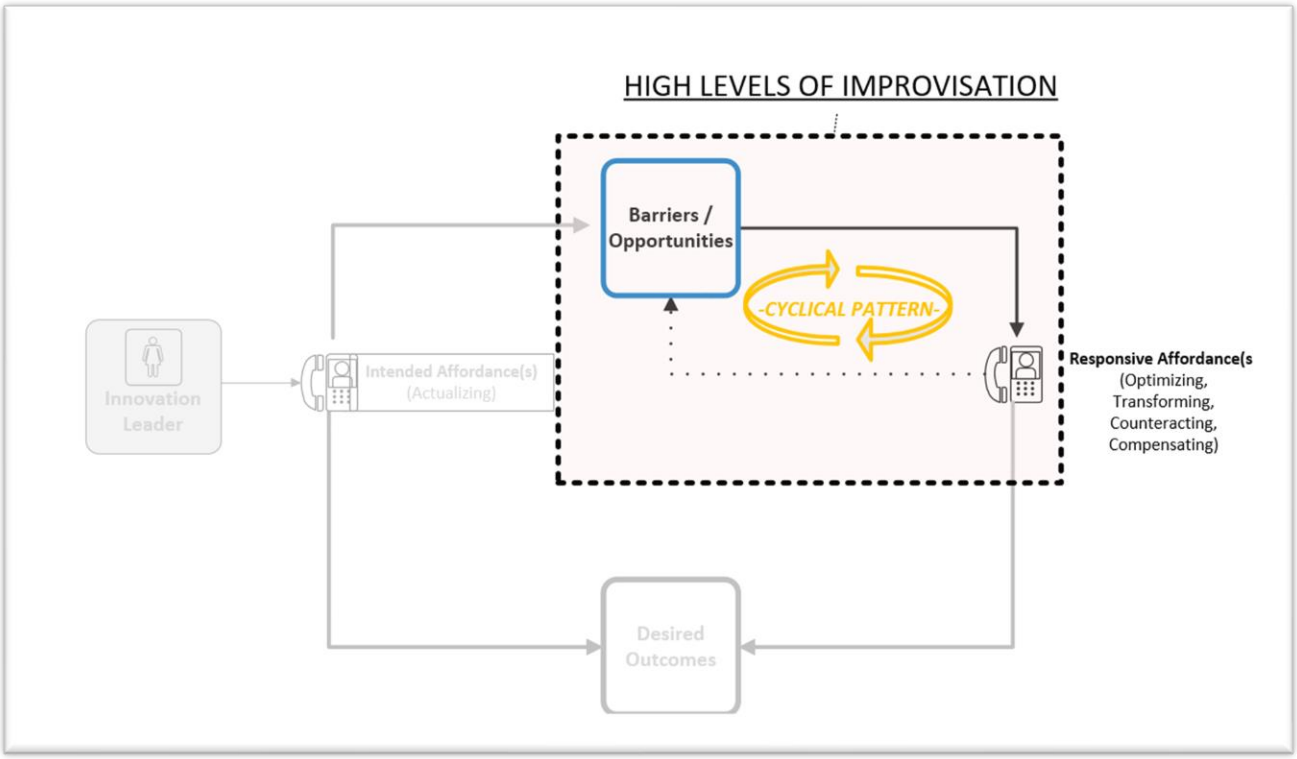
[17] To help distinguish barriers from outcomes, barriers can become visible before or after affordance enactment, whereas outcomes must always follow affordance enactment because they are a direct consequence of it.

[18] There are 80 native languages in Ghana, according to WorldAtlas.com (https://www.worldatlas.com/articles/what-languages-are-spoken-in-ghana.html, accessed January 21, 2019). When including local dialects, the number of spoken languages and dialects in Ghana is 250, according to the Ghana Embassy (http://www.ghanaembassy.nl/index.php/faqs-mainmenu-25/121-what-is-the-official-language-of-ghana.html, accessed January 21, 2019).

negative or positive potentialities. As mentioned earlier, responsive affordances refer to the use of technology affordances as possible response mechanisms to address barriers or opportunities (whether perceived or real). The four subcategories of responsive affordances are optimizing, transforming, counteracting, and compensating affordances. These subcategories specify the key ways that responsive affordances are perceived and used in our data, as described in Table 8 and further elaborated upon in the discussion.

As illustrated by the arrows in the model in Figure 6, the relationship between barriers or opportunities and responsive affordances tended to be cyclical in nature. For example, a perceived barrier could trigger the innovation leader to perceive a technology affordance which may stimulate other undesired elements for which other responsive affordances were considered, and so on. The same was true for a perceived opportunity, which could trigger the innovation leader to perceive related barriers which would need addressed to leverage the opportunity, thus following the same pattern. This cyclical pattern in the innovation process provided our key sources of data on improvisation.

Figure 6. Key Area where High Levels of Improvisation occurred in the Conceptual Model of the Innovation Process



Improvisation occurred during the intense periods of innovation whereby leaders reflected on various technology affordances and associated user and environmental risks, opportunities, and outcomes in relation to one another. Among other considerations, improvisation involved perceptions of technology affordances and actions of decision-making. Trott and Simms (2017) and Sørensen (2011), among other scholars, placed decision-making as key events to be observed in innovation studies. Following Gibson (1986), Sørensen (2011) conceptualized service development as a process that involves the recombination of existing affordances and constraints. As an example from the data, the innovation leaders reflected on the potential impact of the mobile service network malfunctioning, which it did at times, and considered other technology affordances which might help mitigate the potential risks to the project.

Decisions were often made to alter the project to lessen the impact, such as through a change in technical approach or a revised project timeline.

We found that the cyclical pattern could be broken in various ways. One way was if innovation leaders found responsive affordances that could address the undesired issues to a satisfactory degree, which would lead to a desired outcome. A second way of breaking the cyclical pattern was if the innovation leaders simply gave up on finding satisfactory responsive affordances. In practice this resembles the act of *hitting a brick wall*. The reflection process is abandoned by the leaders in this scenario. Since our model only covers technology affordances, a third way the cyclical pattern could be broken is if the responsive affordances found by the leaders were non-technological in nature. Non-technology affordances could arise from environmental or human-only interactions. In an example from our data, IVR and SMS were reflected upon as possible ways to amend an error that occurred when sending out a particular IVR message but a decision was ultimately made to resolve the issue through in-person visitations by staff to the affected clients. In this example, the human-only interaction was perceived as affording the desired outcomes in a more satisfactory way than what could have been afforded by the IVR and SMS technologies.

When Affordance Enactment was Most Likely and Unlikely

Our analysis also examined the conditions for which the perceived affordances were used ("enacted") and not used by the innovation leaders. While it may come as no surprise, our findings showed that leaders closest to the technology, and with the most understanding of the pilot operations, had the most influence on affordance enactment. This could be due to the types of leaders who were situated closest to the innovation

since these leaders tended to carry more responsibility in the project. There were exceptions however. For instance, in cases when there were budget implications, the leaders closest to managing the budget tended to have the most influence.

When key decisions around affordance enactment were required, the innovation leaders called group meetings inviting innovation leaders representing the three organizations. For less important decisions, meetings might consist of representatives from only two of the organizations. Group dynamics in these meetings heavily influenced affordance enactment. A shared perception of affordances, or "shared affordances" (Leonardi 2013), among the senior leaders and across organizations was particularly important for affordance enactment. Leonardi (2013, 750) argues for the significance of shared affordances in stating that "group-level network change has its most profound implications at the organization level when individuals use the same subset of a new information technology's features." When an affordance is considered by a group that uses the technology in a similar way, an innovation process that is collaborative in nature can potentially become more efficient. In the leaders' reflections which we analyzed, for example, less effort was made to justify proposed uses of a technology when affordance perceptions were shared.

Another determinant of affordance enactment following affordance perception is drawn from Anderson and Robey's (2017, 110) meta-theory on affordance potency, which they defined as "the strength of the relationship between the abilities of the individual and the features of the systems at the time of actualization, conditioned by the characteristics of the work environment." In the innovation leaders' reflections, the contextual issues and their potency had varying degrees of influence on affordance

enactment which could help explain why certain affordances were enacted and others were not. For example, certain barriers and undesired outcomes presented more severe challenges than others, which meant that more severe challenges were possibly prioritized over other less severe ones. Other factors however played a role. For instance, human capabilities fluctuated which meant that leaders' perceptions of "easy-fixes" were more likely to result in affordance enactment than tasks which required more effort under seemingly comparable circumstances.

5.8 Discussion

This study sets out to answer the question of how technology affordances are perceived and used by digital innovation leaders. In our study, we used an affordance perspective to identify and subsequently conceptualize the role and dynamics of technology affordances in the innovation process. Our analysis of the reflections and actions of innovation leaders during an IVR pilot project in Ghana resulted in the conceptualization of the innovation process from the perspective of affordances, showing how five main underpinning logics guided leaders in their perceptions and use of technology affordances.

IT-Associated Change

Drawing from the information systems approach to affordances (Leonardi 2013; Markus and Silver 2008; Seidel, Recker and Brocke 2013; Volkoff and Strong 2013; Yoo et al. 2012; Anderson and Robey 2017), which followed Gibson's (1986) conceptualization of affordances as an interaction between users and their environments, our study aimed to understand the behaviors of innovation leaders in relation to environmental triggers

and conditions for those behaviors. With our interest in IT-associated change as it pertains to digital innovation, we focused on technology affordances as influencers of innovation-related actions and events. The findings from our study showed that leaders' interactions with technology affordances were guided by five main logics and often culminated in actionable decisions which had consequential outcomes for the innovation. We found that technology affordances were employed by innovation leaders to strengthen the alignment between an innovation and the organizational goals for that innovation, and secondly, to help the innovation address barriers and leverage emergent opportunities. While the degree to which innovation outcomes materialized was not the focus of our study, we sought to specify the nature of change as constituted by our five identified logics. In doing so, we uncovered new insights on the effects of technology affordances– perception and use– on innovation. As leaders enacted the innovation process through their interactions with technology affordances within their given contexts, as depicted in our conceptual model in Figure 5, the innovation was refined, shaped, and moved forward.

Proposed Framing for Innovation Affordances

Drawing from our findings, we offer a theoretical framing for understanding how certain design features of digital technologies can guide innovation practice and thereby shape innovation. We propose "innovation affordances" as a concept for shedding light on the action possibilities that emerge within the development or diffusion of innovation. From our analysis, we offer two main categories of innovation affordances which pertain to key underpinning logics of innovation that center around the driving forces, proactivity and reactivity. Proactivity corresponds to "intended affordances" which we

conceptualize as all possible actions that emerge within the development or diffusion of innovation which are connected to the organization's original goals for that innovation. Reactivity corresponds to "responsive affordances" which we conceptualize as all possible actions that emerge within the development or diffusion of innovation which are connected to any pre-existing or emergent barriers and/or opportunities posed by the organization, the socio-technical elements of the innovation, and/or the environment. As we described in our findings, intended and responsive affordances consisted of five subcategories: actualizing, optimizing, transforming, counteracting, and compensating affordances. These subcategories imply comprehensiveness and applicability, specifically in the way leaders innovated to enact organizational goals and improvised to respond to emergent barriers and opportunities.

Improvisation and a Logic of Responsiveness

As previously highlighted, improvisation in innovation involves the conception of action as it unfolds while drawing on available resources (Cunha, Cunha and Kamoche 1999). From the findings of our study, this conception of action can be underpinned by various logics of responsiveness. In understanding these logics, we can uncover how technology affordances are resources which guide cognitive perceptions based on the relationships between leaders and the affordances of the technology, as situated within particular contexts. These logics orchestrate the perception and employment of technology affordances in a way that is useful for the organization in harnessing complexity as innovation occurs (Nylén and Holmström 2015). In our data, innovation leaders perceived and employed responsive affordances to respond to barriers and opportunities. Leaders responded to emergent barriers by perceiving and employing

transforming, counteracting, and compensating affordances, all of which helped leaders mitigate and manage risk. Leaders responded to emergent opportunities by perceiving and employing optimizing affordances which helped the innovation fulfill its original goals and benefit from unplanned positive outcomes.

Digital Materiality

Such responses by leaders, particularly at the rapid speed at which they were given, were possible because of the malleable nature of the digital artifacts, IVR and SMS. The leaders in our study were able to rapidly respond to the outcomes of an IVR call, for instance, because the call data were nearly instantly available. If a call did not receive the expected results, the leaders could try another approach, such as sending the call at a different time of day or changing the format to send SMS instead of IVR messages. In this way, the method of engaging clients might change day-to-day or even minute-to-minute. Changes could occur based on leaders' improvised responses to the unfolding of actions which centered around the perception and enactment of technology affordances. Hence the nature of digital materiality played a significant role in enabling the leaders to respond rapidly to emergent challenges and opportunities, and thereby refine the innovation in a way that it became increasingly appropriate for its users and the given environment.

The role and dynamics of digital materiality and its perceived affordances became especially apparent through the analysis of the two technologies, IVR and SMS. Both IVR and SMS were perceived and used by the innovation leaders in the project but often to carry out different objectives and as a response to different stimuli. Based on their technical configurations in the project, IVR and SMS provided different affordances to

users, hence were perceived and used differently by the innovation leaders. IVR, for example, afforded customer interaction, whereas SMS did not[19]. IVR allowed a limited range of response, i.e., pressing 1, 2, or 3, and it also had the benefit of being less dependent on clients' levels of literacy. SMS messages were limited to 160 characters, whereas the voice-based messages were not limited in length, although shorter voice messages were recommended. A voice-based message was also perceived by the innovation leaders as more personable than a written message due to certain human elements such as variations in voice intonations and vocal expressions.

5.9 Conclusion

This study differs from previous studies on affordances by exploring how (non-IT) innovation leaders innovate using an empirical exploratory case study rather than a meta-analysis (see Tumbas, Schmiedel and Vom Brocke 2015). Through our study, we have offered new conceptualizations of technology affordances for how they are perceived and employed in the practice of digital innovation, and particularly in acts of improvisation. In our analysis, we have conceptualized the innovation process through the lens of technology affordances and have classified different types of affordances based on a set of logics underpinning the reflections and actions of innovation leaders. We conceptualize innovation affordances as the action possibilities that emerge within the development or diffusion of innovation and present one set of such affordances

[19] As demonstrated in other use cases, SMS can afford customer interaction but was not setup to do so in this project.

based on the underpinning logics we identified in our study which center around the forces of proactivity and reactivity.

Generalizability and Future Research Directions

While our findings may not be easily generalizable due to the selection of a single case and the interpretative nature of our study, we present two elements which we believe have broad implications for affordances and digital innovations, as follows.

First, we offer the structure of our proposed framing– centered around the forces of proactivity and reactivity– as applicable for digital innovations broadly. Innovations tend to be driven by organizational goals and they generally face emergent challenges and opportunities, hence the common practice of project risk analysis. Furthermore, our study is situated in a highly complex environment for innovation thus can offer implications for a range of settings.

Second, we believe the method we used to investigate technology affordances is generalizable within limits. We offer the systematic process we underwent as applicable to other innovation studies which intend to investigate technology affordances. To recap this process, first we observed the interactions between innovation leaders and the digital technologies with which they were innovating. Second, we identified any technology affordances that were perceived by the innovation leaders as they innovated. Additionally, we observed whether any of the perceived affordances were enacted and we analyzed the related circumstances, conditions, and effects. Lastly, we identified existing patterns based on the conceptualizations and uses of these affordances. We call

for other studies to test our process in other contexts and with other cases of digital innovation to improve our understanding of innovation affordances.

More research is needed to ascertain the degree to which our proposed concepts of intended and responsive affordances are generalizable. Future studies may uncover other categories or subcategories of innovation affordances and underpinning logics. They may also help shed light on whether differing environments (i.e., those posing different types and degrees of constraints and opportunities) can affect the extent to which responsive affordances may be applicable or useful. By identifying and examining the role and dynamics of technology affordances and their underpinning logics, future scholarship will help provide an improved understanding of the nature and direction of IT-associated change within organizations and specifically in innovation, and thereby contribute new insights to the literature.

Summary of Contributions

The study provides three primary contributions which are theoretical, methodological, and empirical in nature.

First, our introduction and proposed framing of innovation affordances extends the literature on technology affordances which is housed across various information related disciplines. These findings advance the current knowledge of technology affordances, providing new insights into affordance theory which enable more of its value to be accessed. A better understanding of technology affordances also offers valuable insights into areas of information science and technology management due to their focus on the interaction and interplay among technology artifacts, people, and their environments.

Second, our study provides a valuable methodological contribution to the literature on technology affordances and innovation management by offering a step by step process for identifying technology affordances within innovation.

Third, our findings offer practical implications for innovation. If applied, our proposed framing of innovation affordances can guide innovation leaders in building effective strategies for innovation management, especially for harnessing complexity during moments of improvisation. We follow Wright, Sturdy, and Wylie (2012) who challenged the notion that standardization impedes innovation. Our findings present a conceptual model which offers a logical framework of responsiveness which might be useful as a systematic approach in helping innovation leaders improvise. While many innovation leaders set detailed plans for implementing project components, setting detailed plans for leaders' responses to emergent constraints and opportunities is less common. Hence, in following a set of logics, we argue that organizations can respond more quickly and systematically to the rapid unfolding of innovation processes and outcomes within their given contexts, which is particularly relevant for digital innovation and pertinent for an improved, more efficient digital innovations process. Finally, through greater awareness of various types of responsive affordances, leaders can more easily distinguish the usefulness of digital technologies in relation to the broad range of outcomes they may wish to achieve.

Chapter 6: <Paper 2> A Technical Investigation into Strategic Customer Targeting: Digital Affordances as a Generative Mechanism

Abstract

Digital technologies and business intelligent methods are commonly used by banks and other businesses to strategically target customers. Strategic customer targeting helps businesses reach their intended customer base and adjust their products and services to better meet customer requirements. Despite the growing prominence of strategic customer targeting in business practice across industries, little is known about the role played by technologies and the contributions being made by digital materiality in this practice. To date, the information systems (IS) literature has been silent on these issues. In this study, we follow Volkoff and Strong (2013) and other IS scholars to decompose strategic customer targeting using affordance theory as a conceptual tool for investigating the role of digital technologies and explaining IT-associated change. Empirical evidence is drawn from an innovation project in Ghana involving an organization's efforts to use interactive voice response (IVR) to serve target customers. The findings show significant roles played by the technologies and their socio-technical relationships in generating changes to the innovation. The research extends the affordance literature by generating new insights into the patterning and shaping of digital innovation. It also offers theorization around the utility of affordances for understanding and optimizing innovations for target markets.

Keywords: Strategic Customer Targeting; Digital Innovation; Organizational Change; Technology Affordances; Interactive Voice Response; Financial Services

6.1 Introduction

This study employs affordances as a conceptual tool for examining digital technologies within innovation by focusing on the relationship between IT-associated change and the organization's goal of strategic customer targeting. We structure the paper as follows. We start by describing the phenomena of strategic customer targeting and present our research question. We then introduce our theoretical framework, outlining the relevant literature and describing how our methodology uses technology affordances with a critical realist ontology to examine and explain organizational change. We then discuss our findings, showing that when we decompose strategic customer targeting, we find that the technology and various socio-technical relationships play a substantive and critical role in generating change for the innovation. Our discussion focuses on how technology affordances serve as mechanisms that can generate a refinement of the innovation, making the innovation more fit for the market. We conclude with key contributions to scholarship and practice.

6.2 Strategic Customer Targeting

With the rise of digital technologies, new methods for strategic customer targeting have become prevalent across industries and are helping organizations stay relevant within a dynamic digital economy. An increasing number of companies are analyzing large data sets using techniques such as artificial intelligence, statistics, and data mining to develop and focus on target customer segments. These methods help organizations find the right customer and tailor their products, services, and outreach practices to these customers (see Smith 2012; Trusov, Ma, and Jamal 2016). Many businesses rely on

strategic customer targeting to bridge gaps between products and services and the intended customers for whom these products and services were designed. Strategic customer targeting can have positive effects for business outcomes such as improved customer retention, new customer acquisition, and increased customer demand (Hansotia 2009). Companies such as Google, Amazon, and Facebook have built profitable businesses centered around strategic customer targeting.

Digital technologies have considerable implications for how strategic customer targeting is applied and how the practices of customer targeting are evolving. Digital technologies are well-suited for carrying out strategic customer targeting due to their malleable and programmable nature and their ability to rapidly scale at relatively lower costs (Yoo et al. 2010; Kallinikos, Hasselbladh, and Marton 2013). Because of such characteristics, digital technologies are shaping organizational practices and outcomes in new and significant ways. Newer technologies, such as SMS messages, chatbots, and social media platforms, have fundamentally changed the customer-institution interface and the nature of interactions. These technologies capture vast amounts of data which can be useful for identifying target customers and gathering information on customers' preferences and requirements. Such developments in customer targeting can enable organizations to improve their businesses by making themselves more relevant and valuable to their target customers.

While the study of strategic customer targeting traditionally resides in the field of marketing and has largely focused on targeting techniques, applications, and

effectiveness[20] (Kannan and Hongshuang 2017), this paper positions strategic customer targeting as central to information systems (IS) by highlighting the technical aspects that underpin this phenomenon. We fill a gap in the IS literature through our investigation into the role of digital technologies in strategic customer targeting by addressing the question: *how do organizations innovate with digital technologies to strategically target their customers?* Following the work of Volkoff and Strong (2013), we employ affordance theory and a critical realist approach which enable the research to explain IT-associated change. Evidence is gathered from an empirical study on financial service innovation in the context of low-income markets in Ghana. This study sheds light on some of the most conceptually important issues of today's digital age which are located at the intersections of technology and organizations.

6.3 Theoretical Background and Framework

We use affordances theory for an improved understanding of strategic customer targeting from a socio-technical perspective. First coined by Gibson (1977) in ecological psychology, affordances refer to "action possibilities" that are latent in the environment. A chair, for instance, provides an affordance because of its capability to offer someone a seat. This affordance is "perceived" when a person recognizes the chair's ability to offer a seat and it is "actualized" when the person sits on the chair.

Affordances as a conceptual tool for understanding socio-environmental relationships has become popular. In various studies such as Markus and Silver (2008), Seidel,

[20] Examples include Ghose, Li, and Liu (2019), Mahdavimazdeh, Falkenberg, and Stackhouse (2020), and Huang, Zhong, and Yao (2014).

Recker, and Brocke (2013), Leonardi (2013), and Volkoff and Strong (2013), affordance theory has been used to examine and explain the consequences of technology uses in organizations and associated organizational changes. As constituted within the literature, affordance theory enables an in-depth study of the role and dynamics of technologies as they relate to users and the environment. Hence, affordance theory is the analytical approach most suited to addressing our query on how organizations innovate with digital technologies to strategically target their customers. Seminal works that employ affordances to explain IT-associated change are summarized in the following table.

Table 10. Affordance Scholarship Focused on IT-Associated Change

Technology Affordance Literature on IT-Associated Change	
Zammuto et al. (2007)	Identified five "affordances for organizing" which characterized emergent aspects of technology in organizations: visualizing entire work processes; real-time/flexible product and service innovation; virtual collaboration; mass collaboration; and simulation/synthetic reality. Explored how these affordances can result in IT-associated change, particularly new forms of organizing and how organizational boundaries form.
Volkoff and Strong (2013)	Studied two cases of manufacturing to conceptualize affordances as generative mechanisms through which action is enabled or constrained and potentially results in offered power and/or the threatened liabilities. Argued that this conceptualization enhances scholars' ability to explain IT-associated organizational change.
Strong et al. (2014)	Examined affordances in a study of the implementation of an electronic health records system in a multi-site medical group, pointing out the relationship between affordances and organizational goals. Conceptualized dependencies among affordances, specifically the relationship between organizational level actualization and individual level actualization.
Klecun, Hibberd, and Lichtner (2016)	Applied affordances to study IT-associated change programs in healthcare, particularly IT-associated change in relation to

	goals which require collaborative efforts across organizations. Introduced "organizational field level" as a new level for affordance researchers to study to span organizational boundaries.
Seidel, Recker, and Brocke (2013)	Studied the role of affordances in environmental sustainability transformations using the case study of a world-wide operating software solutions provider. Developed a theoretical framework that identifies four important functional affordances originating in information systems which are required in environmental sustainability transformations. Contributed to a better understanding of IT-associated change and the concept of functional affordances.
Leonardi (2011)	Examined the case of a computer simulation technology for automotive design to theorize the roles of affordances and constraints in organizational change. Argued that perceptions of constraint lead people to change their technologies while perceptions of affordance lead people to change their routines. Discussed how notions of agency– the imbricated nature of human and material agencies– help explain organizational change, i.e., how the infrastructures that people use to do their work is generated.
Leonardi (2013)	Examined a comparative, multimethod, longitudinal study of computer-based simulation technology use in automotive engineering to help explain organizational change. Found that group-level network change has its most profound implications when individuals use the same subset of a new information technology's features. Introduced "shared affordances" to help explain when technologies are likely to bring about network change within organization. Theorized shared affordances as users converging on a shared appropriation of the new technology's features such that the technology affordances are jointly realized.
Anderson and Robey (2017)	Studied changes in hospital work practices and developed the meta-theory "affordance potency," defined as "the strength of the relationship between the abilities of the individual and the features of the system at the time of actualization, conditioned by the characteristics of the work environment." Used "affordance potency" to help explain the relationship between IT's material properties and changing work practices, by focusing on individual affordance actualization and the social context.
Baiyere and Nieminen (2018)	Extended technology affordance theory by advancing a theoretical notion of digital affordance as a derived affordance. Proposed a distinction between the affordance of the technology (which is inherent in the agency of the

	technology) and the affordance of the application (which is unpacked by the interaction between the human agency and the technology agency, or other agency). Argued that the value of digital capability lies in the interaction between the human agency and the technology agency in the enactment of innovation agility.
Bernardi, Sarker, and Sahay (2019)	Studied the role of technology affordances in generating organizational consequences, specifically the maintaining or deinstitutionalizing of work routines and practices, using a case study on health management information systems (HMIS) in Kenya. Focused on the crucial role of identity work as a mechanism linking affordances to organizations and found four types of identity work (disruptive, legitimizing, reinforcing, and transformative) that, through different affordances, contributed to the maintaining or deinstitutionalizing of organizational routines and practices.

Affordances using a Critical Realist Ontology

To study IT-associated change, Volkoff and Strong (2013) and Bygstad, Munkvold, and Volkoff (2016) presented an approach for employing affordances using a critical realist ontology. They built on the foundations of Roy Bhaskar (1998) in the philosophy of science, arguing that affordances are generative mechanisms and refer to causal structures that explain a phenomenon. Mechanisms are not deterministic but probabilistic and contingent on other mechanisms within open systems (Bygstad, Munkvold, and Volkoff 2016). With this ontological grounding in critical realism, Volkoff and Strong (2013, 832), define technology affordances as arising "specifically from the relation between objects such as IT artifacts and goal-directed actors."

In addition to Volkoff and Strong (2013) and Bygstad, Munkvold, and Volkoff (2016), arguments for critical realism's use as an underpinning theory of IT-associated change have been made by other scholars (see Mingers, Mutch, and Willcocks 2013). According to Mingers, Mutch, and Willcocks (2013), critical realism as a framework for research is

especially useful for understanding the significance of technology in relation to change and for situations where relationships are complex and contingent on circumstances. While this ontological grounding is not widely established in the affordance literature, our empirical study tests the work of prior scholars and responds directly to Volkoff and Strong's (2013) call for more empirical research.

Critical realism's multidimensional approach to reality is particularly useful for this research given its intention to examine observable and unobservable phenomena. Bhaskar's three orders of reality consist of the "Empirical," the "Real," and the "Actual" (Bhaskar 1998; Archer et al. 1998; Mingers 2004). The Empirical is defined as the domain of experience; the Actual is the expressed manifestation of power and causal mechanisms that can come in the form of unobserved events and outcomes; and the Real is associated with the mechanisms that generate the domain of objects, structures and powers (Mingers 2004). Within this portrayal, reality consists of a "complex interaction between dynamic, open, stratified systems, both material and non-material, where particular structures give rise to certain causal powers, tendencies or ways of acting" (Mingers, Mutch, and Willcocks 2013). It is through these interactions that mechanisms generate the presence or absence of actual events (*ibid.*). Thus, critical realism goes beyond the interpretation of events to enable a deeper analysis of causal or generative mechanisms which can influence actual events and interact with multiple dimensions of reality (Mingers 2004). Hence, a critical realist ontological framework is particularly well-suited for this research for examining complex, causal relationships which generate change.

This research follows the blueprints left by Volkoff and Strong (2013) and Bygstad et al. (2016) by examining: (1) How the affordances arise in the strategies, structures and processes of strategic customer targeting; (2) How these technology affordances are actualized; and (3) How these actualizations lead to changes within the organization. We follow Strong et al.'s (2014) conceptualization of actualization 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 organizational goals."

6.4 Research Methodology

We investigated a pilot project involving the development and deployment of an interactive voice response (IVR) system in the context of financial services in Ghana. In our case, strategic customer targeting occurred through a reconfiguring of services and delivery channels to the customer. Following prior research (see Kannan and Hongshuang 2017), our study adhered to the conceptualization of strategic customer targeting as a process of organizational change whereby the business itself is adjusted to fit the market. The research focused on IT-associated changes to the innovation which related to the organization's goals of customer targeting.

6.4.1 Case Overview

Innovation

The research is primarily concerned with how an organization perceives and uses digital technology to refine its services to the target market. We therefore studied innovation because innovation is an important process for developing and operationalizing techniques of strategic customer targeting. Innovation is the relationship between the

technology and its surrounding context, whereby the context plays an active role in shaping the technology (Williams and Edge 1996). It is through this socio-technical interaction that an innovation is tailored for its target users, and by doing so, the organization enacts customer centricity. We follow Yoo et al.'s (2010) work which highlights digital innovation as generative and able to expand and refine products and services. This perspective closely aligns to the notion of "innofusion" introduced by Dutton et al. (1995) which conceptualizes innovation as a process that continues through implementation in the market. By employing a socio-technical perspective to investigating digital innovation, we uncover some of the most prominent and critical aspects of strategic customer targeting.

The Project

The IVR project took place over the course of 11 months in 2017-2018 and through multiple partnerships. The end customers were savings clients of a savings and loans company in Ghana called Opportunity International Savings and Loans Ltd. (Opportunity Ghana) and known by clients as Opportunity International. Other entities involved in the project include Opportunity Ghana's global affiliate, Opportunity International (Opportunity), an IVR technology supplier, a translation and recording firm, and two mobile network operators. The project team comprised of staff from the three main entities, Opportunity Ghana, Opportunity, and the IVR technology supplier.

The project was designed to test whether IVR was an appropriate channel for interacting with Opportunity Ghana's female clients through mobile phones. Opportunity Ghana, and in partnership with Opportunity, had made previous efforts to interact with female clients (as well as male clients) through mobile phones, starting in 2015 when

Opportunity Ghana launched its proprietary mobile banking service. Following its rollout of mobile banking, the institution found significantly lower rates of adoption among female clients. In late 2017, only 30% of active users were female, thus a gender gap of 35%, given the institution's female to male client ratio of 65:35. Various efforts were subsequently made by Opportunity Ghana and Opportunity to increase female clients' adoption of mobile banking. It was around this time when these partners developed their strategy for IVR, which among other objectives, aimed to engage female savings clients.

The project involved using IVR to engage 28,028 female and 18,643 male savings clients of Opportunity Ghana, which in total serves over half a million clients. A total of 23 IVR messages were sent to clients during the project and were generally sent on a weekly basis although some variation in the schedule occurred. The messages contained financial literacy education and aimed to promote positive savings behaviors (savings deposits and balance increases) among clients. This project was the first of its kind, as never before had a savings and loans company in Ghana deployed IVR with clients (according to the project team's collective knowledge).

The Technology

IVR is a computerized phone system that uses programmed algorithms to match a pre-recorded voice response to a person's communication input. This allows a two-way conversation between a person and a pre-recorded voice in an interactive manner. Because IVR leverages customers' possession of mobile phones, organizations can use IVR to interact with customers at a large scale and generally at lower costs when compared to in-person interactions. IVR enables organizations to collect and use large

amounts of data to provide tailored responses and often at rapid speed. Hence, an IVR system can be programmed to provide a set of customized messages to customer segments or individual customers. Through a combination of machine and human interventions, IVR can also offer substantial flexibility by allowing organizations to change programmed algorithms and outputs midstream.

In terms of its application, IVR has been used since the 1970s but the cost of deploying IVR has been a barrier for many organizations until recent decades. Since the 2000s, IVR has become more widely used especially by call centers to field calls and deliver automated information. Still today, IVR use is uncommon or nascent in many industries and regions globally, which is the context of our study.

In our case, the IVR system was configured to deliver pre-recorded voice messages to Opportunity Ghana clients. The messages were scripted by the project team in batches so that the project learnings could inform the message development as the project unfolded. In total, seven batches of messages were developed, and each batch contained between one and six messages for a total of 23 messages. Once written, the message scripts were translated and recorded into four languages by the translation and recording firm.

In addition to being developed into multiple languages, the messages were tailored to three client segments based on clients' savings activity. Clients with "less active," "inactive," and "low" savings balances received some messages that were unique to their segment, while most messages were common to all segments. Due to the flexibility of the IVR system, client segmentation could be changed at any point throughout the project. Changing segments involved actions such as scripting tailored messages,

relabeling client lists, and making alterations to the IVR system's messaging structure, known as "tree" structure.

The IVR system was configured to deliver messages following two main formats. Clients received "main messages" as push communications and "response messages" whenever they interacted with messages. Clients could interact with messages that contained "prompts," which were statements within a message that invited users to respond. For example, one of the messages included this prompt: "If you want to hear more facts about mobile banking, press 1. To re-listen to this message, press 0." Clients could respond to a prompt by pressing the corresponding numeric button on the keypad of their phone. Starting mid-project, clients could call a toll-free hotline to hear the messages and the calls could be transferred to a call center if the client wished to speak with a staff member.

The project team monitored and evaluated project performance using data from the IVR and core banking systems, client and staff interviews, and ad hoc client feedback collected by branch staff. These various sources of information ("feedback") heavily informed the project's development, including various refinements made to the IVR system to further tailor it to the target market.

6.4.2 Methods of Data Collection and Analysis

The study took place over a year and a half period which enabled the research to cover the project development, implementation, and closure phases. Influenced by Wynn and Williams' (2012) framework for critical realist case studies, this study adhered to the following methodology for data collection and analysis:

Step 1. Identify key events of the case which are the outcomes we wish to explain, namely changes to the innovation (strategies, structures, processes, etc.).

Step 2. Identify key entities (technologies, people, environments, etc.) and their relationships to the changes.

Step 3. Identify relevant technology affordances that help explain the changes. Examine how and why these technology affordances were or were not actualized, including any surrounding conditions.

Step 4. Use data collected from multiple sources along with possible alternative explanations to test the findings.

Step 5. Identify causal relationships (i.e., how technology affordances affect innovation) through a comprehensive exploration and examination.

Steps 1-2 of the methodology consisted of gathering data related to characteristics, relationships, interactions, and evolutions pertaining to the various entities involved directly and indirectly in the innovation process. Steps 3-5 consisted primarily of further analysis of the data that were collected in steps 1-2 along with theory testing and building.

6.4.3 Data Sources

The main methods of data collection consisted of internal documents and participant observations. These qualitative methods are particularly useful for understanding processes, structures, practices, and complexities of events.

Internal documents were gathered to provide evidence for steps 1 and 2 of the methodology. Documents included strategic plans, technology and programmatic reports, organizational structures, policies, processes, procedures, product data and manuals, quantitative bank and client records, performance analytics and reports, and transcribed mid-project and end-of-project user evaluations. These documents provided a basic understanding of the innovation along with details of any changes made to the innovation during the project period.

Observations were gathered through interactions which took place between the researcher and staff involved in the project. Throughout the research period, the researcher worked alongside the project team and recorded notes in the form of observational memos. The observations also included the project team's written communications (emails and instant messaging). All relevant observations were entered in NVivo software for analysis. Interactions with decision-makers and other key influencers of the innovation process enabled a granular understanding of the innovation and its evolutions. Sense-making was employed to direct the researcher's participation in the project and to help reduce researcher bias (Moore and Yager 2011).

Table 11. Links between Methodology and Data

Corresponding Step	Theory	Sources
1. Identify changes to the innovation (what this research aims to explain).	Changes to the innovation are key events of the case which are outcomes produced under particular conditions and by generative mechanisms.	Documents: strategic plans, technology and programmatic reports, organizational structures, policies, processes, procedures, product data and manuals, quantitative bank and client records, performance analytics and reports, and transcribed

Corresponding Step	Theory	Sources
		mid-project and end-of-project user evaluations. Observations: interactions with decision-makers and other key influencers of the innovation.
2. Identify relevant entities and their relationships to the changes.	Various entities, such as technologies, people and environments, and their characteristics, relationships, interactions, and evolutions are involved in shaping the innovation.	Same as above
3. Identify technology affordances that help explain the changes. Also identify conditions and affordance outcomes (whether the affordances are actualized or not).	Technology affordances, and relevant conditions and affordance outcomes, are identifiable through retroduction (Wynn and Williams 2012; Volkoff and Strong 2013) using the evidence gathered through steps 1 and 2. Secondly, the actualization of technology affordances can generate changes (identified in step 1), such as by the recombining of affordances and constraints following decisions made by humans (Sørensen 2011). Together, these affordances, conditions, and affordance outcomes, produce patterns which can be studied.	Findings from the analysis from steps 1 and 2: particularly the characteristics, relationships, interactions, and evolutions surrounding the innovation.
4. Test technology affordances as generative mechanisms (Volkoff and Strong 2013)	Theory testing helps ensure and strengthen the validity of the research.	Findings from the analysis of from steps 1-3: particularly plausible alternative explanations.

Corresponding Step	Theory	Sources
5. Identify causal relationships	Causal relationships between technology and innovation can be identified, or theorized, using logical inference through the retroduction process (Wynn and Williams 2012; Volkoff and Strong 2013).	Findings from the analysis from steps 1-4, particularly tested theory.

6.4.4 Data Analysis

The data were analyzed thematically and iteratively throughout the data collection process. These methods provided an in-depth exploration of the research topic by enabling the research to actively shape the research inquiry process as new findings emerged. Following Miles and Huberman's (1994) guide to coding, we applied descriptive and interpretive codes for each of our key themes (elements): changes to the innovation, target customer and contextual characteristics (including perceptions held by staff), and perceived and actualized technology affordances. Mid-analysis, we revised our coding schematic to include a new theme “feedback” which we will describe in upcoming sections. After coding our documents, we examined these codes to identify patterns that provided insights into how various factors and relationships played a role in shaping the innovation. In doing so, we categorized the codes into meta-codes (i.e., human-only changes, positive client feedback, technical challenges). The evidence from the various sources was reviewed together to help triangulate the findings and enhance accuracy and depth (Yin 2003).

This section summarizes our analysis for each step of the methodology.

Step 1. Identify changes to the innovation. The analysis focused on identifying changes to the innovation which took place to improve, or with the intention to improve, call performance among target customers (female clients). Our data provided evidence of decisions that were made in relation to this target group, as illustrated by the following example.

> Excerpt from a Project Communications Log:[21]
>
> *Steve (innovations leader, Opportunity): This is the message asking customers to change their language or hang up to keep their existing language?*
>
> *Leanne (innovations leader, Opportunity): So I think <the IVR supplier> said not to use that idea in the end because the clients we're targeting wouldn't understand that message (giving them options).*

We identified 28 changes to the innovation. 21 of the changes were coded "IT-associated changes" because they involved actions by humans and machines (which related to our constitution of "IT-associated change"). The other 7 changes did not involve actions by machines hence we coded these "human-only changes." Examples of IT-associated changes included: introducing a call-back feature, changing the call schedule, and adding branch staff as call recipients. Human-only changes included: changes to in-person communications, changes in the voice actors used for the recordings, and project staff changes.

Step 2. Identify relevant entities and their relationships to the changes. We analyzed various entities that related to the IT-associated changes identified in step 1. We

[21] Pseudonyms have been used.

identified 22 categories of characteristics, which substantively comprised of customer constraints pertaining to various socio-economic and environmental factors, and technical challenges. 15 codes were generated which classified customer and/or environmental characteristics (i.e., unfamiliarity with IVR, price-sensitive, multiple languages spoken). 7 codes classified technical challenges (i.e., network down, calls repeating, call delays).

Step 3. Identify technology affordances, along with conditions and affordance outcomes. For each IT-associated change identified in step 1, we employed the process of retroduction (Wynn and Williams 2012; Volkoff and Strong 2013) to identify technology affordances that helped to explain these changes. Retroduction involved starting with observable actions and events (i.e., changes made to the innovation) and working backward to identify the unobservable objects involved (i.e., the technology systems and features) and underlying mechanisms (causes of change). We identified technology affordances for each instance of IT-associated change. Examples of identified affordances include the IVR system's capacity to integrate with mobile network systems, recombine audio clips, and deliver automated messages.

Step 4. Test technology affordances as generative mechanisms. We examined data from our case that presented plausible alternatives and triangulated our findings using various sources (documents and observations). We examined if organizations innovating with digital technologies could strategically target customers without the presence of various elements identified in step 3. While our test data comprised of a limited sample from our case, the process was useful for helping constitute and validate our findings. For further testing and investigation, we call for future researchers to

examine similar studies, given that mechanisms, enable some degree of generalization (Bygstad et al. 2016).

Step 5. Identify causal relationships. The analysis from steps 3-4 laid the foundations for identifying causal relationships between various technology affordances and the changes that were made to the innovation. Like earlier steps, we used retroduction for this analysis. In agreement with the literature, the causal relationships we identified were probabilistic rather than deterministic, as we will show in our findings.

6.5 Findings

It is useful to establish whether IVR, as employed in our case, engaged the target customers (female clients) before we elaborate on the key technical aspects of our analysis and explain how these aspects generated changes to the innovation.

6.5.1 The Innovation's Ability to Engage the Target Market

This analysis (using frequencies) involved comparing the performance of female clients (n=28,028) to the male clients (n=18,643), who served as a comparison group. IVR engagement was measured based on the number of seconds that the customers listened to each IVR message. "Listening" was defined by the project team as 20 or more seconds since this cutoff was roughly the amount of time required to cover the main content of a message.

The findings revealed that 79% of female clients listened to at least one message and 44% listened to at least six messages. Rates of call engagement were slightly lower for female clients compared to male clients, but only by roughly five percentage points. This gender gap was lower than expected for the project team since other digital gender

divides in Ghana were higher: 16% for mobile phone ownership, 17% for mobile money usage (Muhura 2018), and 30-35% for the organization's mobile banking service (in 2018). Furthermore, the female clients accounted for nearly half of all time spent listening to the messages, indicating that the IVR messages were as relevant for female clients as for male clients. These findings were important because they addressed a core assumption of the research, namely that IVR could and did engage the target market.

6.5.2 Key Technical Aspects that Enabled Strategic Customer Targeting

We found that changes to the innovation, identified in step 1, involved four main elements: feedback, customer and/or environmental characteristics, perceived (and actualized) technology affordances, and human and machine actions (or "inputs"). These elements contained intricate and interdependent relationships, many of which unfolded in our analysis. This section provides an overview of the process we observed and describes the key findings for each unit of analysis.

Process Overview

When new feedback was received by the project team, the team considered this feedback in relation to other factors, such as characteristics of the target customers and the environment, and the potentialities of the technology within this context (technology affordances). After considering these factors jointly, and in relation to the project and its objectives, decisions were made by the project team on a case-by-case basis on if and how to change the IVR technology or system. The following excerpt from the data provides an example.

Excerpt from a Project Communications Log:[22]

Leanne: ...Would it be worth exploring every other week?...

Steve: yes, I think that's right, given the customers preference for Saturdays (was it?), we send out every other Saturday?

Leanne: Can we group the client list into 2 so that 1 group receives it Saturday afternoon + evening, then Sunday (for remaining); then group 2 receives it the following weekend. Trying to figure out a way to get it all completed within weekends.

Steve: hmm, not sure. perhaps we can ask Kisi whether they can really strive to complete it during the weekend, and therefore why some calls take longer than others?

Changes to the Innovation

Changes to the innovation were operationalized through two main types of inputs: human and machine. Our analysis found that implementing IT-associated changes was done through human and machine inputs such as programming code, altering technical structures, and sending communications. There was a complementary and interdependent relationship between human and machine inputs. While humans carried out manual inputs, such as writing algorithms, machine input took some form of response to human input. The IVR system, for example, was preprogrammed by software engineers to run code at specific times and retrieve available information when queried by clients. Human willingness and ability to make the proposed changes were other pertinent components in the process although our analysis did not focus on such

[22] Pseudonyms have been used.

elements (as these would be better explored using tools from psychology and behavioral science).

Feedback

In our data, we found two main types of feedback: positive and negative feedback, which we grouped as customer/staff complaints, positive client feedback and positive staff feedback (see Table 13). We grouped customer and staff complaints because we found that these complaints among clients and staff were of a similar nature.

The project team received feedback about the project in three main ways. First, clients provided feedback about the IVR calls especially when there were problems, i.e., the messages came in the wrong language. This type of feedback was collected in person or over the phone by branch staff and was subsequently channeled to the project team. The second channel for obtaining feedback was from interviews that were conducted by the project team at two intervals during the project. These interviews sought to evaluate the project using a sample of 102 clients and 52 branch staff. The third channel for obtaining feedback was from the project analytics. The data generated from the IVR calls were collated and displayed onto a live dashboard provided by the IVR technology supplier to the project team. Additional data from the IVR system and Opportunity Ghana's core banking system were provided in spreadsheets for manual processing. These sources allowed the team to track various aspects of the project such as call performance and any correlations between calls and changes in savings account balances. If performance was found to be better or worse than average, the project team could examine the message scripts, the timing of delivery, and other aspects of the calls to derive ideas on how to improve future call and savings performance.

Customer and/or Environmental Characteristics

Customer and environmental characteristics played a key role in influencing the decisions made by the project team members to configure the innovation to the target customers. Customer constraints and technical problems were two categories of characteristics that arose in our analysis.

Customer constraints played a prominent role in influencing changes to the innovation. They also offered to the project team directional guidance for making the changes in a way that would increase relevancy and appropriateness for the customer. As an example, as shown in the excerpt above, the timing of the calls changed midway through the project from weekdays to weekends. Several target customers (female clients) had provided feedback to staff that they were too busy to listen to IVR messages during weekdays and would prefer receiving the calls on weekends. Upon receiving this feedback, project team members discussed the feedback. Team members commented that, during weekdays, many female clients tended to be busy with their businesses during the day and with housework in the evening (based on both professional observations and personal experiences). Subsequently, a decision was made to revise the call schedule. This change to sending calls on weekends aimed to work with the existing time constraints faced by female clients and provide them a more convenient time for receiving the calls.

Various technical challenges arose throughout the project which influenced reconfigurations of the IVR system. For example, near the start of the project, clients complained about receiving repeated messages. After an investigation, adjustments were made to the IVR system to try to fix the problem. The project team adjusted the

number of times the system would attempt call retries for undelivered calls. They also removed the language selection menu from being played at the front of calls, which was used for clients without an assigned language. These changes to the innovation presented implications for future call performance.

Technology Affordances

In our case, we identified technology affordances, as described under the Data Analysis section. The technology affordances in our study were found to have consequential outcomes for if and/or how certain changes to the IVR technology and system took place. Various technology affordances, alongside other elements such as the presence of feedback, were found play a significant role in generating various changes to the innovation. These were IT-associated changes which would have not been possible without such elements. Our findings, backed by our testing, provide evidence in support of Volkoff and Strong's (2013) theory that technology affordances are generative mechanisms. The following sections provide further discussion on these findings.

The following table provides an example from the analysis, showcasing changes made to the innovation that relate to various key target customer characteristics (female, low-income, low literacy, etc.).

Table 12. Example from the Analysis

Target Customer Characteristics	**Implemented Change to the Innovation**	**Excerpt from the Data**[23]	**Relevant Technology Affordances**
Female	The continued primary use of a female voice	*"<there were> multiple cases where females*	• Capability to record audio clips

[23] Pseudonyms have been used.

	instead of alternating between male and female voices	*were suspicious of male partner receiving calls from Alice."*	• Capability to deliver automated messages
Low-income/ few resources/ price sensitive	A new ending to all messages "any response is free of charge"	*"Clients expressed concerns that engaging with IVR – responding with a number – may incur a fee."*	• Capability to record audio clips • Capability to deliver automated messages
Low levels of literacy	The continued use of SMS messages for clients with low literacy instead of discontinuing these messages	*"I think we can keep doing the SMS though. Based on what I've heard in the past, clients who are illiterate will simply have their child or friend read the SMS to them."*	• Capability to integrate with SMS technology to send text messages • Capability to deliver automated SMS messages
Unfamiliarity with IVR	Revisions to scripts to the make message instructions clearer for clients who were unfamiliar with IVR surveys	*"People don't know what to do after listening to the message. We could say: 'Use your phone to tell us. Press 1 on your keypad.' Also, 'Hello this is Alice. I want you to do .... And this is how to do it…'"*	• Capability to record and rerecord audio clips • Capability to deliver automated messages
Busy and with constrained mobility due to business and domestic work	Introduction of a callback feature for clients to listen to messages on-demand	*"This allowed clients who were busy to avoid being interrupted by a call in the middle of their day. They could hear the messages on their own time at their convenience."*	• Capability to integrate with mobile network systems • Capability to automate call message responses following user input • Capability to deliver automated messages

Concerned about security/ fraud	A new ending to messages to encourage clients to contact their branch or relationship officer	*"<According to feedback> some clients thought the calls might be advertising or from a fraudster."*	• Capability to record and rerecord audio clips • Capability to deliver automated messages

A sample list of codes for the four main elements has been provided in the following table. As described in Section 2.6, the relevant technology affordances we identified were retrospectively derived (i.e., through retroduction).

Table 13. Sample List of Codes by Element

Changes to the Innovation (Activated by Human/Machine Inputs)	**Triggers of these IT-Associated Changes (Feedback)**	**Relevant Target Customer and Contextual Characteristics**	**Relevant Technology Affordances**
IT-Associated Changes • Added call-back feature • Added tollfree hotline • Resent calls • Revised timing of language selection menu • Revised default language • Tweaked reports • Added phase for pre-testing • New option of default language • Revised call delivery time • Revised list of call recipients • Altered project schedules • Use of alternative delivery channels *Human-only changes* • Writing/ rewriting message scripts (i.e., to increase clarity, appropriateness, relevancy, emotional connection) • Writing stylistic revisions • Project staff/ voice actor changes • Service supplier changes • Writing communications • Communicating in-person as follow-up	*Addressed Customer/ Staff Complaints* • Calls too frequent • Repeat messages • Confusion about survey prompts • Wrong language • Confusion about message content • Message too long • Calls as a nuisance/ interruption • Unknown caller/ potential fraud *Addressed Positive Client Feedback* • Feeling of emotional/ relational connection • Prompted to save • Prompted to go to the branch or contact staff • Useful/ educational messages *Addressed Positive Staff Feedback* • Applicable for low-literate clients • Applicable for "market women" • Helps engage with difficult-to-reach clients	*Considered Customer Characteristics* • Female • Low income/ few resources • Price sensitive • Low levels of literacy/ numeracy • Unfamiliarity with IVR • Concerned about security/ fraud • Busy with constrained mobility due to business and domestic work *Considered Environmental Characteristics* • Multiple local languages • Geographical spread • Non-private work/home locations • Noisy locations *Considered Technical Challenges* • Network down/ limited mobile connectivity • Repeat messages • Call delays • Systems constraints/ inflexibilities • Limited call volume capacity	*Considered and Enacted* • Capability to automate call message responses following user input • Capability to collect information/ survey clients • Capability to preprogram the timing of message delivery • Capability to record and rerecord audio clips • Capability to slice and (re)combine audio clips • Capability to integrate with SMS technology to send text messages *Considered but not Enacted* • Capability to forward the call to another person • Capability for speech synthesis • Capability to setup a hotline module for a specific subsegment • Capability to rerun messages if there are any errors • Capability to personalize messages (i.e., client's names/ account details) • Capability to link to mobile accounts to provide airtime incentive

6.5.3 Results of Theory Testing

In examining plausible alternative explanations, the analysis followed Gaver (1991) who distinguished among perceived, hidden, and false affordances. Only perceived affordances are real and can be actualized, while false affordances are non-existent, and hidden affordances are not actualized because they are not perceived (*ibid.*). These variations of affordances– perceived, false, and hidden– were observed in our data and provided the sample for testing our proposed mechanisms.

Our analysis showed that changes to the innovation occurred when technology affordances were both perceived and actualized. False or hidden affordances, on the other hand, did not correspond to changes taking place. As an example, there were various instances when the project team considered a technology affordance which was believed to unlock a desired outcome (i.e., improved call performance among target customers). At times, this considered affordance presented a perceived affordance that could be actualized. At other times, the affordance presented a false or hidden affordance. Such discoveries were evidenced in some of the interactions among technical and non-technical members of the project team. At times, non-technical members would query how the technologies might be reconfigured to meet organizational goals. They queried, for instance, about possible changes to the messaging structure and schedule to improve call performance and about changes to reporting systems to add various indicators.

Example of a Query: Excerpt from a Project Communications Log:[24]

Leanne: Hi Kisi and Brian, I have a question about the callback feature. Now that the hotline is up, I am wondering if we could sequence it so that the client first hears the message of the week and then at the end of that message is asked if they'd like to listen to information- if yes, to press 1, which would lead them to the hotline menu.

At times, these lines of questioning introduced novel ideas which prompted further exploration by the project team. In such discussions, the technical team members would help the non-technical members distinguish between perceived affordances and false affordances before decisions were made.

Example of a False Affordance: Excerpt from a Project Communications Log:[25]

Leanne: Hi Kisi, … I am looking at the dashboard for the Ghana project and a few things are unclear. I know one of the trees a few weeks ago was mislabeled (6-M4 is really 6-M3). What would be really helpful is if you could rename the tree titles to be consistent with the past. (For example, is the tree "Tracks" the messages from 6-M4? And the Thankyou message is 7-M1?) Thanks

Kisi (innovations leader, IVR vendor): Hello Leanne, I am unable to change the names of the trees since this is locked in the system. Sorry for the inconvenience.

We found that if the affordances were found to be false or hidden, the outcome was either inaction or an implementation of some type of workaround, which often enacted different sets of technology affordances.

Example of a Proposed Workaround: Excerpt from a Project Communications Log:[26]

Leanne: Hi Kisi, related to my last question, Steve and I were just chatting about the message schedule. It seems messages are taking longer than a day or two to get to the full list of recipients. We are wanting to have the messages go

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[24] Pseudonyms have been used.

[25] Pseudonyms have been used.

[26] Pseudonyms have been used.

out only on the weekend from now on. We also don't want clients to hear messages more frequently than 1 week (there needs to be a break of at least 6 days between messages). Perhaps you can help us understand if messages going out on the weekend will be quicker or if we can continue to expect delays.

The following table presents a sample of our analysis on perceived, false, and hidden technology affordances. The table also shows links between key elements in the study and change outcomes.

Table 14. Links between Key Elements and Change Outcomes, Categorized by Affordance Type

Examples of Feedback	**Considered Customer and/or Environmental Characteristics**	**Considered Technology Affordances**	**Change Implemented?**
Perceived Affordances			
Clients voiced that they sometimes missed messages because they were busy.	Clients may be less likely to pick up the phone and listen to an unknown caller or unfamiliar message format.	Capability to automate call responses following user input.	Yes. A call back feature was introduced so that clients could receive a free call back from the system to relisten to a message (without being charged for an out-going call).
Clients expressed concern that they might incur hidden fees if they engaged with the calls.	The target customers are small-scale entrepreneurs with fewer resources and may be price sensitive. Mobile phone services in Ghana tend to place charges on outgoing calls while in-coming calls are free.	Capability to record and rerecord audio clips. Capability to slice and (re)combine audio clips.	Yes. Audio clips were sliced and reconfigured to add the phrase: “any response is free of charge” at the end of each message.

The analytics dashboard lacked information on the number of clients who relistened to messages.	The work locations of the target customers tended to be noisy, busy marketplaces where hearing IVR messages might be difficult or infeasible. To hear a full message without interruption, clients may have selected the "relisten" option. Evaluation data showed that some clients replayed the messages to share them with others.	Capability to collect and store data. Capability to disaggregate and collate data. Capability to customize the analytics dashboard.	No. While these affordances were deemed feasible, the level of effort required to make the changes exceeded the team's willingness. Resource limitations were the main challenge hence the proposed changes were not realized.
False or Hidden Affordances			
Clients expressed concern that the calls might be from fraudsters.	Many microfinance and savings and loans companies in Ghana lost their licenses to operate around the time of this project. This, along with news and rumors about instances of fraud, may have heightened clients' concern about this issue.	Capability of speech synthesis to auto-generate audio files that contain the names of clients and/or staff members. Capability to slice and (re)combine audio clips to add individual names that could help personalize the messages.	No. This considered affordance was found to be a false affordance. The IVR system being used for the project did not offer the capability of speech synthesis (especially synthesis of local Ghanaian languages, hence a risk of severely hindering the correct pronunciation of names).

The analytics dashboard showed that few clients interacted with a response message after it was sent to clients. While clients received the main message, an investigation revealed that the response messages had not been properly configured in the system so they were not received by clients.	The target customers were inexperienced with IVR and many of them had low digital literacy. Testing an IVR system that was reliable was therefore of utmost important to establish positive first impressions.	Capability to send messages to a system-defined subsegment of clients.	No. This affordance was found to be hidden because the project team was unsure if the IVR system had the capability to resend the response message to only the established subsegment of clients. Time constraints led the team to decide on a workaround. They sent an SMS message as a replacement.

6.6 Theorizing Technology Affordances as Mechanisms behind Strategic Customer Targeting

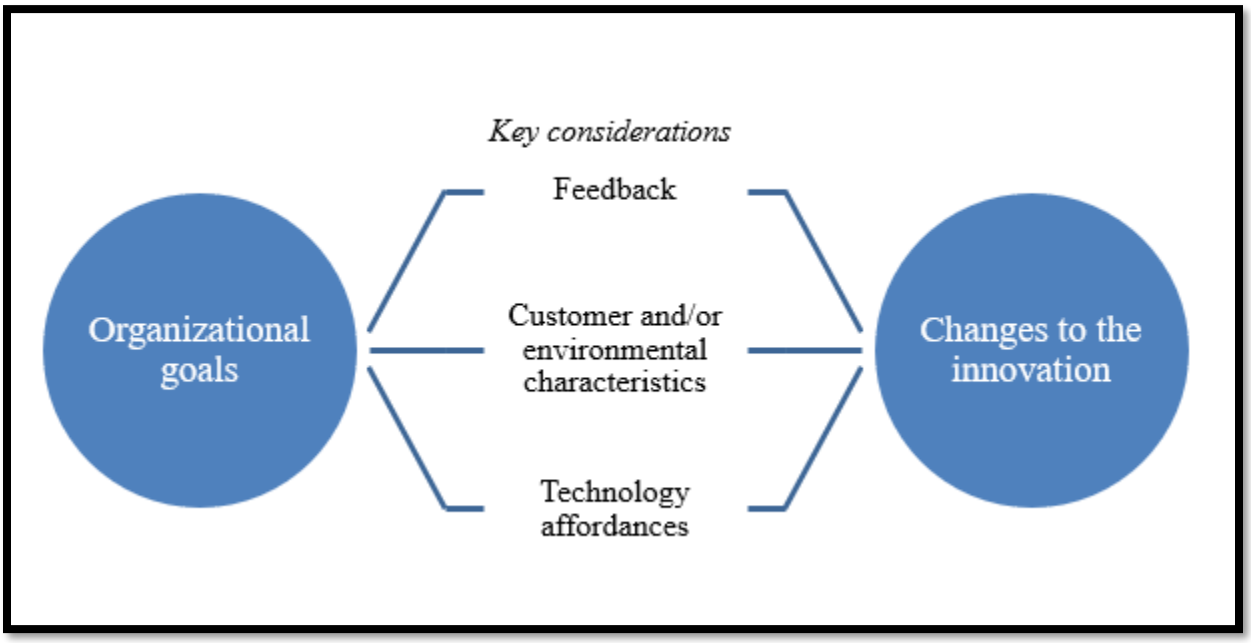
Through our study, we have shown how an affordance lens can be used to examine and explain change. Our findings reveal ways in which the relationships among technologies, humans and their environments were generating effects within an organizational context and in relation to market-based approaches to digital innovation. In our analysis, we highlight the roles of organizational learning processes (feedback loops), interdependencies between humans, technologies, and their environments, and a complementarity between human and machine inputs for generating changes to the innovation. In this discussion, we consider strategic customer targeting as the outcome of change.

Strategic customer targeting, as we defined earlier, is a process of organizational change whereby the business itself is adjusted to fit the market. Strategic customer targeting is evident when a causal link can be established between the organizational goals of customer targeting and the changes enacted. For increased clarity on terminology, it is important to differentiate between "strategic customer targeting" and "customer targeting." Based on our usage in this research, which follows prior affordance research (Strong et al. 2014), "strategic customer targeting" involves some form of intentionality or goal-orientation, whereas "customer targeting" may not, thus falling outside the scope of this study.

6.6.1 Mechanisms and Conditions behind Strategic Customer Targeting

To establish the causal link between organizational goals of customer targeting and changes to the innovation, we consider the mechanisms and conditions that were present in our data. Our analysis showed that strategic customer targeting occurred when technology affordances, feedback, and one or more of the customer and/or environmental characteristics were present. Strategic customer targeting, as an IT-associated change, took place when feedback was received by the innovation leaders and considered in light of customer and/or environmental characteristics alongside organizational and technical features and capabilities (technology affordances).

Figure 7. Schematic of Link between Organizational Goals and Changes to the Innovation



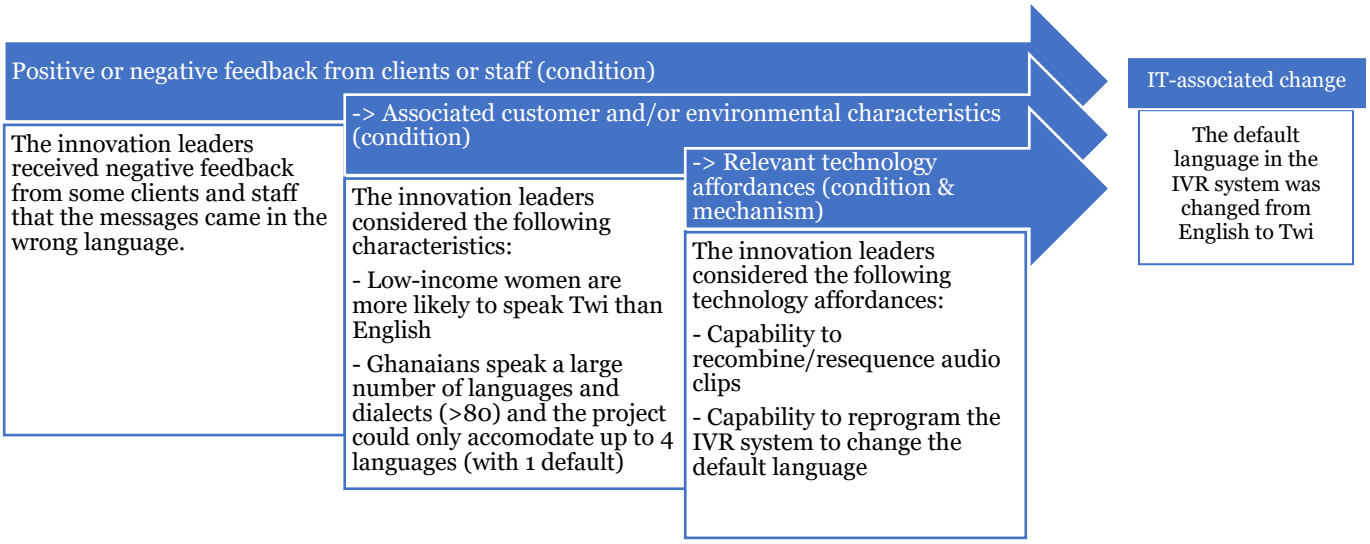
Feedback was present in our data for all types of changes we identified, including human-only changes. The feedback raised by clients and staff led to consequential outcomes. When positive feedback and complaints were associated with customer and/or environmental characteristics, the innovation leaders considered the barriers and opportunities that were specific to the market segment. They also considered what was technically feasible for removing the barriers and exploiting the opportunities. We provide the following example to illustrate how the codes we derived in our analysis (examples provided in Table 13) related across these elements (feedback, customer and/or environmental characteristics, technology affordances, and IT-associated change).

Example from the data: When some clients complained that the messages had been delivered in the wrong language, the innovation leaders discussed the situation and how they might fix this problem by tailoring the IVR system. Clients who had not selected a preferred language using the language menu were receiving the messages in English as the default language. This is because English had been identified at the start of the project as the language that most clients would be familiar with, especially compared to the regional local languages. During the decision-making process, the innovation leaders discussed how their target market (low-income women) generally had low levels of formal education and were therefore less likely to speak English than Twi, especially compared to other customer segments (i.e., middle-income women and male customers). The leaders also discussed that an environmental challenge for the project was that Ghana was a country of many languages[27] and most of these languages could not be accommodated in the project due to resource constraints. Since the project could only accommodate the top four commonly spoken languages by clients (English, Twi, Ga, and Dagbani), a decision was made by the innovation leaders between the two most commonly spoken languages: English and Twi. Twi was believed to be more appropriate for the target market thus the IVR system was reconfigured to make Twi the default language instead of English.

[27] There are 80 native languages in Ghana, according to WorldAtlas.com (https://www.worldatlas.com/articles/what-languages-are-spoken-in-ghana.html, accessed January 21, 2019). When including local dialects, the number of spoken languages and dialects in Ghana is 250, according to the Ghana Embassy (http://www.ghanaembassy.nl/index.php/faqs-mainmenu-25/121-what-is-the-official-language-of-ghana.html, accessed January 21, 2019).

In this example, the feedback and customer and/or environmental characteristics played key influencing roles in generating the change to the IVR system. By providing informational substance, the feedback served as the trigger and the characteristics served as consequential input within the decision-making process which led to the change. Hence, we identify these elements as conditions in this particular context. The technology affordances also served as conditions as well as mechanisms behind the change that occurred because of the roles they played in generating the change. Without these affordances, which were derived from technical and organizational features (i.e., resources), the change would have not been perceived nor would it have been technically possible. The figure below illustrates the interrelations among these conditions and mechanisms in generating the change.

Figure 8. Conditions and Mechanisms of Change: An Example from the Data



While feedback was always present in our data as a condition for generating IT-enabled strategic customer targeting, we did not find that this was generalizable. In our testing, we considered and identified various plausible alternatives that could have filled the role

of feedback in our data. For instance, alternative sources of information such as external reports might have provided the project team with new valuable insights on IVR which could have replaced the role of feedback. In our testing, the research concluded that some form of informational input would be required for each of the changes that we analyzed.

Unlike our findings on feedback, we did not find the presence of customer and/or environmental characteristics for each of the changes we analyzed. We identified some changes that did not involve customer and/or environmental characteristics. When we examined these changes closely, we found that they were not directly related to strategic customer targeting and that these changes were more infrastructural in nature (i.e., a switch in mobile network operator, an SMS sent to clients to remedy a programming error, and a change in reporting format). No evidence was found that these changes involved any association to the organization's goals around customer targeting (although this does not preclude the possibility of an indirect association). Based on our evidence, we conclude that there is a direct association between strategic customer targeting and the presence of one or more customer and/or environmental characteristics in strategic customer targeting. In extending this logic, we exert that the presence of one or more customer and/or environmental characteristics is a condition for generating (IT-enabled) strategic customer targeting.

Finally, given our conceptualization of technology affordances as action possibilities that are latent in the environment (emergent within a socio-technical relationship), we conclude that there is a direct association between any IT-associated change and the presence of one or more technology affordances. Technology affordances may not be

present when the changes do not involve IT (i.e., "Human-only changes" as listed in the first column in Table 13).

The following table summarizes the associations we found in our data between the key elements and outcomes, which we described above.

Table 15. Summary of Associations between Key Elements and Change Outcomes

Elements	**Outcomes**		
	A change to the innovation	**An IT-associated change to the innovation**	**An IT-associated change to the innovation involving strategic customer targeting**
Feedback or other informational input	*Always present*	*Always present*	*Always present*
Customer and/or environmental characteristic(s)	*Sometimes present*	*Sometimes present*	*Always present*
(Actualized) technology affordance(s)	*Sometimes present*	*Always present*	*Always present*

6.6.2 A Refined Constitution of Affordances

In addition to decomposing strategic customer targeting for an improved understanding of various elements, our research offers significant insights into technology affordances. In our investigation on if and how technology affordances generates strategic customer targeting, our analysis queried the data for a better understanding what constitutes a technology affordance. We found that an ontological distinction between a digital

technology artifact and a technology affordance was useful for understanding the differing roles of these entities in the changes we analyzed.

Digital technologies, or artifacts, comprise of a compilation of physical and non-physical properties and are inherently incomplete (Kallinikos, Aaltonen, and Marton 2013). They constantly evolve as a result of ongoing organizational practices (Orlikowski and Iacono 2001). Our case showed that the technology artifacts which constituted the IVR system were constantly evolving. It was through these evolutions that the technologies served as conduits of the changes that we identified in Step 1 of the methodology.

The technology affordances in our study were found to be substantively and functionally different from the technology artifacts. The technology affordances arose within the relationships between digital technologies and "goal-directed" humans (Volkoff and Strong 2013, 832) and were informational in nature. The affordances presented manifestations of information about the technology's capabilities and potentialities. In our evidence, this information would bring forth elements of the nature of digital technologies for consideration and deliberation. This information was useful because it informed decision-making on if and how the innovation could be changed. Our research showed that these affordances were mechanisms of change that served as a generative force. We can extend these conclusions to state that these affordances, in generating change, were also generating the very existence of the technology artifacts for which the affordances belonged. This follows the critical realist argument that the realms of the Real and Actual interact, and that in doing so, mechanisms generate the domain of objects, structures, and powers (Mingers 2004).

6.7 Contributions

The findings from this research shed light on some of the most important and conceptually significant features of the conditions of digital innovation that would not have been possible through other theories. The research contributes to the literature on strategic customer targeting in three main ways. First, it generates new insights into the patterning and shaping of digital innovation for target markets. Second, it highlights the role of technology affordances in generating strategic customer targeting. Lastly, it demonstrates how digital technologies can have consequential outcomes for meeting business objectives. It explains organizational change by decomposing the relationship between organizational objectives and strategic customer targeting to show how strategic customer targeting was generated by technology affordances and contingent on other factors.

For the affordance literature, this research provides an empirical study that tests and builds on the theories presented by Volkoff and Strong (2013) and Bygstad et al. (2016). It also offers new theoretical insights into the concept of affordances. First, it improves our understanding of technology affordances and their relationships to market-based approaches to digital innovation. Second, it improves our understanding of the role of technologies and technology affordances in organizational change. This increased understanding of affordances carries implications for the utility of affordances. Through an improved understanding, scholars can potentially extract greater value from affordances as a conceptual tool for understanding change and other phenomena. Finally, in analyzing various differences between technology artifacts and affordances, the research shows how technology artifacts are generated by their affordances.

The research also offers significant implications for practice. It provides practitioners an improved understanding of the processes and practices of strategic customer targeting. It offers organizations increased insights into how they might leverage digital technologies to further their business objectives (Kannan and Hongshuang 2017). Lastly, it offers affordances as a (potentially) useful tool for organizations to decompose strategic customer targeting to help them adjust their innovations to better fit the market. This research therefore provides substantive insights into how organizations can enact customer centricity.

Our investigation into how organizations innovate with digital technologies to strategically target their customers provides strong evidence that technology plays a critical and generative role in the innovation process. Our findings generate novel insights and present a new line of inquiry for scholars examining technology and organizational change.

Chapter 7: <Paper 3> Human or Machine? A Study of Anthropomorphism through an Affordance Lens

Abstract

Anthropomorphism– the tendency of humans to apply human-like attributes to non-human objects– has received growing attention by scholars across multiple disciplines. With increasing popularity of service and personal robotics and conversational agents, scholars of information systems have begun to shed light on some of the technology features and processes related to anthropomorphism. This study applies a socio-technical approach using affordance theory to examine the relationship between technology and anthropomorphic perceptions among users. Evidence is gathered from an empirical study involving the introduction of interactive voice response (IVR) with savings clients of a savings and loans company in Ghana. The findings highlight four main ways that the IVR technology exhibited human-like qualities within the user-technology interaction (as perceived by users). This paper illustrates how a study on the relationship between technology and anthropomorphism might be conducted through an affordance perspective. It also offers implications for technology development.

Keywords: Technical Anthropomorphism; Technology Affordances; Digital Innovation; Interactive Voice Response; Financial Services

7.1 Introduction

This study employs affordances as a conceptual tool for examining digital technologies within innovation by focusing on how the innovation outcome of anthropomorphic perceptions (found among users) was generated. We structure the paper as follows. We start by describing the phenomena of anthropomorphism and present our research question. We then present the theoretical underpinnings of the research on technology affordances and summarize the existing affordance literature in IS. Next, we outline our research methodology, describing our case study and research methods. We then present our findings, showing how and in what ways IVR exhibited human-like qualities as perceived by users from a socio-technical perspective. Lastly, we discuss the findings and their implications for scholarship and practice. We argue that affordances as a conceptual framework offers an improved understanding of the socio-technical relationship related to anthropomorphic outcomes.

7.2 Anthropomorphism

Anthropomorphism refers to the tendencies of humans to apply human-like attributes to non-human objects. Anthropomorphism as a psychological concept is becoming increasingly relevant in the field of information systems (IS) with the rise of human-like robots (often referred to as "humanoids") and conversational agents such as voice assistants and chatbots. As more organizations digitize the customer-institution interface, human-to-human interactions are being replaced by human-computer interactions which use natural learning processing, artificial intelligence, and machine learning to mimic human-to-human communication (Schuetzler et al. 2018).

Until now, anthropomorphism has largely been studied as psychophysiological processes (Freud 1930; Epley, Waytz, and Cacioppo 2007; Urquiza-Haas and Kotrschal 2015) but the literature outside of psychology and behavioral studies is growing and is shedding light on other related processes. In IS and especially the field of robotics, the literature has begun to shed light on the technological processes involved in anthropomorphism and anthropomorphism's implications for technology design and diffusion (Pfeuffer et al. 2019). Key examples include Tondu (2012), Iossifidis et al. (2004), Schuetzler et al. (2018), Taddeucci et al. (2002), and Hashimoto et al. (2002). In 2012, Tondu (p. 612) introduced the term "technical anthropomorphism" to refer to the technological artifact which results from the human-machine mimicking process.

In IS literature, anthropomorphism has been recognized for playing a key role in helping technologies adapt to human society, which in turn helps humans adopt these technologies as users (Tondu 2012; Sims et al. 2005). By developing technologies to mimic human-like attributes, these technologies afford increased familiarity for humans which helps facilitate the user adoption process. This paper builds on the existing IS literature and examines anthropomorphism in the adoption of a new technology by users in the context of financial services in Ghana. Using an empirical study, we employ an affordance lens to examine aspects of the technology and the socio-technical relationships which help facilitate anthropomorphic perceptions among users. We address the research question: *how does an IVR technology exhibit human-like qualities within the user-technology interaction?* By addressing this question, we shed light on some of the most conceptually important issues of today's digital age which are located at the core of technology design, diffusion, and adoption.

7.3 Affordances as a Conceptual Framework

Affordances, or "potentials for action" (Pozzi et al. 2014), can be employed as a conceptual tool for examining the link between technology and anthropomorphic perceptions among users. Affordance theory originated from James J. Gibson's work (1977, 1986) in the field of ecological psychology. Gibson conceptualized an affordance as a link between an organism and its environment. "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" (Gibson 1986, 127). Gibson conceptualized affordances as phenomenal in nature and not as physical properties. Affordances are not properties of the organism nor the environment. Instead, they are relational and are situated within an interaction. They are a direct link between perception and action and can be conceptualized as "action possibilities" (*ibid*.).

The affordance literature in IS has grown substantially in the last decade (i.e., Anderson and Robey 2017; Leonardi 2011, 2013; Majchrzak and Markus 2012; Markus and Silver 2008; Robey, Anderson, and Raymond 2013; Seidel, Recker, and Brocke 2013; Strong et al. 2014; Volkoff and Strong 2013; Yoo et al. 2012). Within IS, the term affordance has become a concept that broadly encapsulates the relationship between technology and its users but no single conceptualization of affordances dominates the literature. While IS scholars tend to agree that the concept of affordances is useful for examining socio-technical phenomena, Stendal, Thapa, and Lanamaki (2016) highlight the lack of consistency among scholars around whether affordances are intended or emergent, functional or non-functional, and potential or actual.

In addition to IS, various disciplines including psychology and design fields, human-computer interaction (HCI), organizational studies, and communications and media studies have used (and expanded) upon affordance theory, making the conceptualization of affordances suit various research needs and contexts. In communications and media studies, Nagy and Neff (2015) introduced the term "imagined affordances" to underscore the importance of the imagination in affordances, which they state are located somewhere between the technology and human actors amongst expectations, intentions, perceptions, attitudes, and actions. Nagy and Neff (2015) argue that imagined affordances provide users with agency.

Following Gibson, Nagy and Neff, and the work of many other scholars, this research applies affordances as a multi-faceted concept that highlights the critical role of user perception within the socio-technical relationship. User perception is critical to technology development and technology-related outcomes. According to Kardes, Cronley, and Cline (2015, 100), "understanding perception and how it influences consumers' attention to the environment, their interpretation and comprehension of stimuli, and ultimately their behavior, are essential to developing successful products and marketing messages." Hence, an affordance lens– which focuses on the socio-technical relationship and user perceptions– provides a particularly suitable tool for carrying out research on technology and anthropomorphism.

7.4 Methodology

This research uses an empirical case involving a pilot project that introduced interactive voice response (IVR) with financial savings clients of a large savings and loans company in Ghana, Opportunity International (Opportunity). The research examines ways in

which the IVR technology exhibits human-like qualities for the user-technology interaction. IVR is a computerized phone system that enables organizations to send pre-recorded voice messages via mobile phone and to receive responses from listeners typically through voice applications or by typed commands on a phone keypad.

The pilot project took place over an 11-month period in 2017-2018 and targeted 46,671 clients of the institution (nearly 10% of the institutions' existing clientele). In total, 23 IVR messages were sent to clients ("users") during the project period, at a rate of one message per week on average. While most messages were focused on the topic of savings, five of the messages contained other content such as information about the project and holiday greetings. The messages that were savings-related gave basic information on savings such as tips on how and when to save, how to develop positive savings habits, and the importance of savings and goalsetting. Some messages provided information about the institutions' savings products, such as types of savings accounts and channels for making savings deposits. The content aimed to associate savings with positive outcomes for people's wellbeing by framing savings as a safety net for times of emergency, a good way to cover familial expenses such as school fees and retirement, and an aid for fulfilling life ambitions.

Some of the messages responded to recent activity in the users' savings accounts. For example, if balances increased, these users received a congratulatory message and were encouraged to continue saving regularly. If balances declined, these users received a message that encouraged them to make small yet regular efforts to increase their balances.

Some of the calls were used to collect information from clients through IVR surveys known as *prompts*. The following provides an example of a prompt:

> *Hello valued customer, this is Alice again, from Opportunity International. We have noticed that your savings account at Opportunity has stayed at a low balance. Can you tell me why you haven't been saving?*
> *Press 1 if you save somewhere else.*
> *Press 2 if you save at home.*
> *Press 3 if you have no excess money to save.*
> *(A different voice: Once you press 1, 2 or 3, listen again to hear what Alice wants to tell you. Would you like to re-listen to this message? If yes, press 0.)*

As illustrated by this example, users were able to interact with the institution through IVR in two main ways. First, users could respond to a message using the keypad on their mobile phone handset. Around 30% of the calls requested a response such as, "press 1 if..., press 2 if...." and every call allowed the user to relisten to the message by pressing 0. The IVR system was limited to typed commands and lacked the voice capability which some other IVR systems offer. The second way users could interact with the institution was by calling the IVR system back using the same number that been used to call them. This elicited a callback feature so that the users would be automatically called by the system, allowing users to hear the IVR messages at no-cost (as opposed to being charged for the cost of sending a call).

Nearly all the messages were scripted as being delivered by the same character with the name "Alice." Throughout the project, the same voice actors were used for the voice recordings so that users receiving the messages would become familiar with the same voice for "Alice." Multiple voice actors were employed since the messages were recorded into four commonly spoken languages in Ghana (Ga, Twi, Dagbani, and English)

following a translation process. An audio menu was used during some of the calls to allow listeners to select their preferred language for future calls.

7.5 Methods of Data Collection and Analysis

Data was collected using participant observations and key informant interviews. Participant observations were gathered by the lead researcher who worked alongside the project team for a period of over one year to gain a deep understanding of the IVR system. Observations of the technology artifact, design, and processes were recorded in observation memos throughout the project period. Interviews were conducted at two intervals, mid-project and end-of-project, to collect user perceptions. The interviews were conducted with 154 key informants consisting of 102 users (clients) and 52 branch staff. The methods included staff interviews because staff also listened to the IVR messages and were responsible for collecting client feedback. To ensure proportional representation of various savings and call behaviors, cluster sampling was used to select the users for interviews, while random sampling was used to select the branch staff. The interviews enabled the researchers to collect perceptions related to the IVR calls and to understand if and how users experienced human-like qualities through the IVR system. The interviews were conducted by phone and in the local languages of the informants. The interview responses were translated and recorded in English. The interview guides have been provided in *Appendix E*.

The observation memos and transcribed interviews were analyzed using NVivo software. Thematic analysis following Miles and Huberman (1994) was applied to identify human-like factors perceived by users. In total, human-like factors of the technology were identified using 24 unique codes which were descriptive and interpretive in nature (i.e.,

Alice as memorable, Alice as monitor of past behavior, Alice doesn't listen). Based on patterns among the codes, we categorized these codes into seven meta-codes (such as Alice as caller, Alice as staff member, etc.). These meta-codes were inferential in nature and sought to explain how and in what ways IVR exhibited human-like qualities as perceived by the users. The code hierarchy was established through an iterative process and evolved over time following periods of reflection.

Following this coding process, we applied the analytical tools of pattern matching and explanation building (Yin 2003) to understand the roles of technology as they related to the codes (the human-like factors). From this analysis, we identified patterns in the relationship between the human-like factors and the technology artifact, design, and processes. Once identified, these patterns helped explain how various affordances of the technology played a role in enabling anthropomorphism as identified in our case.

7.6 Findings: The Alice Effect and the Technology Behind It

It is useful to summarize the anthropomorphic perceptions which we found in our dataset before we elaborate on the key technical aspects of our analysis to explain how the IVR technology exhibited human-like qualities for the user-technology interaction.

7.6.1 Anthropomorphic Perceptions

The IVR system was designed to deliver a series of pre-recorded phone calls from a voice self-identified as "Alice." While the name "Alice" was created by the IVR project team as a fictitious character who delivered the IVR messages, evidence in our data showed that "Alice" was perceived and talked about by both clients and staff as if "Alice" were a real person. Various types of anthropomorphic perceptions of "Alice" were found in the data.

We categorized the anthropomorphic perceptions into seven main classifications based on inferred identities being attributed to "Alice," which are: 1. caller, 2. staff member, 3. monitor, 4. conversationalist, 5. talker, 6. instigator of action, and 7. gendered (i.e., mysterious female caller, homewrecker, etc.). Jointly, we call these seven classifications of anthropomorphism the "Alice effect."

Table 16. The Alice Effect: Classifications of Anthropomorphism

Meta-Codes and Descriptions	**Codes**	**Examples from the Data**
1. Alice as (Regular) Caller *Alice was referred to by clients and staff as the deliverer of the messages. Alice made it easy for people to differentiate the IVR calls from other calls that they may have received from the organization.*	• Message deliverer • Familiar • Recognizable • Memorable • Distinct part of the call	• "The client said she didn't remember the message but when I mentioned Alice's name, she said she remembered." - Staff • "There were times I didn't pick [up] Alice's call." - Client
2. Alice as (Mysterious) Staff Member *Clients and staff asked who Alice was and where she was located. Clients came to the branch looking for Alice. Clients and staff would describe the calls as being sent from a staff member and typically from someone based at the head office.*	• Looking for Alice • Who is Alice • Where is Alice • Someone from the head office • A staff member	• "People asked, 'who is Alice?'" – Staff • "I went to the branch looking for Alice. I was told Alice was in the head office." – Client • "There's a teller at Tamale named Alice so the clients thought it was her." - Staff
3. Alice as Monitor *Clients talked about Alice as someone who could observe their financial behavior and would check in on them.*	• Monitor of past behavior • Monitor of future behavior	• "Alice said it's been a long time since I visited the bank to deposit savings." – Client • "I have finished paying for the car so now Alice will see me saving more." – Client

4. Alice as Conversationalist *Clients talked about Alice as someone who engaged in a conversation with them. Some clients described the conversations as two-way, as if Alice asked them questions (including questions not scripted in the IVR messages).*	• Asks how the client was doing • Greets • Informs • Advises • Joins in a conversation	• "One of my clients…her account was dormant. Her daughter had passed away so she had stopped saving. Alice asked her what is happening, how is her business, said that she should come back." – Staff • "Whenever Alice calls, she greets me." – Client • "He said it <the call> was questions about his business, how he was doing, an advice to him." – Staff
5. Alice as Talker *According to staff, clients talked about Alice as talking and not listening to them nor engaging in a two-way conversation.*	• Doesn't listen • Client unable to respond	• "The client wanted to know who Alice was and complained that they wanted to talk back. It means they didn't know it was a recording." – Staff • "Clients want to interact with Alice. A common complaint is that she just talks and talks and won't listen." - Staff
6. Alice as Instigator of Action *According to staff, clients talked about Alice as asking them to do certain actions (save), including actions not scripted in the IVR messages (borrow a loan).*	• Save • Borrow a loan	• "She remembers the calls, that Alice would say you should save" – Staff • "Most of the clients come to the branch saying that Sister Alice said they should come for a loan. It puts us, the officers, under pressure to explain." – Staff
7. Alice as Gendered (Mysterious Female Caller/ Homewrecker, etc.) *Clients and staff used gendered language (i.e., "she," "her") when speaking about the IVR calls. In some cases, the gendered aspect of Alice generated consequential effects. According to staff, clients mentioned cases of household conflict related to Alice: women confronted their*	• Husband accused of cheating on wife • Wife curious • "Sister Alice"	• "The wife was suspecting him of cheating because someone called Alice has been calling him." – Staff • "One client commented that the wife picked [up] the call and was curious who Alice is." – Staff

male partner out of curiosity or with the belief that their partner was romantically involved with "Alice."		

7.6.2 Technical Aspects

The *Alice effect* was made possible by various sociopsychological and physical elements. Within the scope of our study, we focused on the role of technology within the human-machine interaction which gave rise to anthropomorphic perceptions of "Alice." Hence our analysis presents technical explanations for how the "Alice effect" was made possible.

Based on our investigation of the socio-technical relationship between users and the IVR system, we found that the *Alice effect* was enabled through various features and configurations of the technology. Through an analytical interweaving of interview and observational data, we drew connections among various technological aspects and anthropomorphic perceptions of "Alice." By applying affordances as a conceptual lens, we identified several technology affordances which we found to culminate in four main ways that helped explained how the IVR system helped facilitate anthropomorphic perceptions among users. The following table presents a summary of our findings.

Table 17. Summary of Technical Aspects that Contributed to the Alice Effect

	Underpinning affordances	Embedded human-like elements
1. Capture, Storage and Renderings of Voice Recordings	Capability to capture and store human voice as audio clips Capability to integrate and combine audio clips	Human voice messages Tailored messages Two-way conversation format

	Capability to rapidly introduce, combine, and rearrange audio clips	
2. Mimicry of Human-like Conversation Methods	Capability to integrate IVR and mobile network operator systems to deliver phone calls Capability to transfer patterns of sound waves from human speech into electronic impulses (Liebenau and Backhouse 1990)	Phone calls
3. Mimicry of Human-like Conversational Elements	Capability to capture, store, and integrate human voice	Prosodic features of human speech (intonation, stress, tone, and rhythm) Gendered
4. Presentation of Human-like Message Content	Capability to send calls on a preprogrammed schedule Capability to preprogram audio responses following customer input Capability to capture, store, and apply customer call data Capability to integrate customer savings data from core banking system Capability to solicit customer input and interaction via mobile phone connectivity	Informational, interactive, culturally relevant, and affect-laden message content

Capture, Storage and Renderings of Voice Recordings. The IVR system used pre-recorded voice messages which were stored on hundreds of short audio clips. The audio clips could be manipulated and edited by the project team to configure the messages to the intended users (call recipients). The IVR technology possessed the capacity to rapidly introduce, combine, and rearrange audio clips. The audio clips could be sliced and rearranged to render variations in the sequencing of the audio clips and to develop pre-made voice-loops. The ability to rapidly manipulate the recordings enabled

the project team to develop messages in an iterative fashion, while the ability to set pre-made voice-loops enabled clients to re-listen to messages and to select alternative messages from a menu of options. These technology affordances can therefore be summarized as enabling the common human-like elements: human voice messages, tailored messages, and the format of a two-way conversation.

Mimicry of Human-like Conversation Methods. For IVR messages to be delivered by phone to users, the technology was integrated with the system of one of the largest mobile network operators in the country. The seamless integration made the IVR calls indistinguishable from human-delivered calls based on the calls' method of delivery. Phone calls are human-machine interactions which rely on telephone systems that transfer patterns of sound waves from human speech into electronic impulses (Liebenau and Backhouse 1990). With over a hundred years in existence, telephony has become readily available and is easily understood (*ibid.*). In our case, phone calls were already a familiar medium of human-to-human communication for users hence receiving the IVR messages as a phone call presented a human-like element.

Mimicry of Human-like Conversational Elements. Mimicking human-like conversation was enacted through various conversational elements such as style and approach. The voice recordings contained human patterns of speech. By using voice actors for the recordings instead of machine-generated voice synthesis, the IVR system was able to model human speech without various limitations faced by some text-to-speech systems. For instance, the voice actors naturally conveyed prosodic features of human speech such as intonation, stress, tone, and rhythm. The message scripts included instructions for the voice actors through punctuation (i.e., question and

exclamation marks) and special notations (i.e., a "<pause>" to signal when a longer break between sentences was necessary).

Another characteristic of human-like conversation found in the data was the gendered nature of the technology due of the use of a female voice and the named character "Alice." In the interview data, clients and staff referred to the caller as "Alice" and "she" as opposed to "the machine" or "it." This provided additional evidence for the phenomenon of anthropomorphism.

These technology affordances– from the voice recordings and the integration of these recordings– can therefore be summarized as enabling the human-like elements of gender and various prosodic features of human speech.

Presentation of Human-like Message Content. The IVR system also modeled human-like conversation through the message content which was substantively informational, interactive, culturally relevant, and affect-laden.

The IVR messages provided various types of information which by nature would typically be provided to clients by bank staff. Some of the information came as push communications, meaning that the content was programmed to provide information according to a predetermined call schedule. Other information was availed by the users through their interaction with the system. Users could use the keypad of their mobile phone to interact with the system such as by dialing a number that corresponded to a number on a menu. For instance, "Alice" might pose a question such as, "Use your mobile handset to tell us if you have set a savings goal for you or your family. Press 1 if you have a savings goal. Press 2 if you don't have a savings goal and want some help

with setting one." Responses from "Alice" could take into consideration user-generated content or other sourced information (i.e., bank account information from the core banking system). This question and answer format might feel familiar and human-like to the user, while the input method for responses might feel unfamiliar and machine-like. It is the familiar elements which help the user adapt to the unfamiliar aspects of the technology (Pfeuffer et al. 2019).

The voice messages were designed to contain cultural and emotional relevancy. Because the IVR messages were typically short – less than 1 minute per message – the language used in each message was carefully selected and often relied on short soundbites commonly known or associated with local knowledge. "Alice" started each call with an introduction and greeting which modeled human phone conversation etiquette. One client commented, "Whenever Alice calls, she greets me." Furthermore, some of the messages contained cultural expressions and idioms which helped convey specific meanings using a concise format.

Additional evidence for anthropomorphism came from user language which attributed "Alice" as having carried out certain actions, such as calling, talking, asking questions, and watching them save. Some clients even reported that "Alice" behaved in ways that went beyond the limitations of the IVR system. For instance, some clients described "Alice" as responding to their individual needs, such as calling to follow-up on specific challenges they faced and to ask questions about their specific businesses. Although such personalized interactions were technically infeasible, these findings suggest that an emotional connection with "Alice" was present in some of the users' experiences of anthropomorphism. "Alice" represented a staff member of Opportunity for which

human relationships between clients and bank staff had been the norm (Liebenau and Backhouse 1990).

7.7 Discussion and Implications

In addressing our research question on how an IVR technology exhibits human-like qualities within the user-technology interaction, our findings highlight various technical aspects that contributed to anthropomorphism in the case of Opportunity. Using an affordance lens, we identified four main ways that the IVR system helped facilitate anthropomorphic perceptions among users. In this section, we consider the significance of anthropomorphism for IS scholarship and practice based on our findings.

7.7.1 Contributions to the IS Affordance Literature

Anthropomorphism, a phenomenon that has historically involved attributing human-like qualities to a vast array of living and non-living subjects, has become increasingly relevant for IS especially due to the growing popularity of robotics and conversational agents. As more cases of anthropomorphism are situated in socio-technical relationships, the field of IS becomes particularly important for shedding light on the technological processes which underpin anthropomorphism. As demonstrated by our research, an affordance lens enables a rigorous methodological study of various technical aspects which underpin anthropomorphic perceptions. This conceptual lens, as we have shown, offers an improved understanding of the role of technology in anthropomorphism.

The IS affordance literature has focused largely on cognitive perceptions, particularly actor intentions, to explain the relationship between technology and affordance

actualization (action). This research expands the ways of theorizing affordance perception by highlighting the roles of imagination and affect (emotion) for triggering affordance actualization. As demonstrated by our research, technology affordances can work together to evoke users' imaginations and emotions, fostering anthropomorphic perceptions and outcomes. Building on the work of Nagy and Neff (2015), who underscored the importance of the imagination in affordances, this research highlights how the development of *technical anthropomorphism* (Tondu 2012) occurs within a socio-technical relationship between technologies and user perceptions, imagination, and affect.

7.7.2 Anthropomorphism's Role in Technology Adoption and Diffusion

Anthropomorphism is important for IS because of the significant role it can play in the adoption and diffusion of technology. According to Pfeuffer et al. (2019) and Sims et al. (2005), anthropomorphism helps users in their adoption of technology. This is because machines can be designed to provide contextually sensitive and seemingly accurate responses which makes the interactions seem more natural and human-like (Pfeuffer et al. 2019). As found in our analysis, the IVR system contained human-like components which were familiar to users and helped users in their adoption of IVR as a new communications channel at Opportunity.

Understanding the technical aspects underpinning anthropomorphism is important because it can lead to improved business practices. Anthropomorphic design of technologies can help facilitate ease of use in the user experience by bridging the gap between human familiarity and technological unfamiliarity. The phenomenon of anthropomorphism is situated within the socio-technical relationship and can be co-

produced by users and systems managers. Anthropomorphic perceptions, imaginations, and affect among users can be cultivated by systems managers through the configuring and reconfiguring of anthropomorphic design. Through our affordance study, we offer practical implications for identifying and developing anthropomorphic design features which can positively impact technology diffusion by helping facilitate user adoption.

7.7.3 The Anthropomorphic Outcome of Relationship Building

Along with helping users bridge a technical knowledge gap, anthropomorphic design can help bridge relational gaps through human affect. Technology companies such as Apple and Google have found that anthropomorphic design features have helped foster social connections and built trust among users (Pfeuffer et al. 2019). Evidence was found in our case that the human-like elements of the IVR calls helped build the client-institution relationship. When asked how clients felt about Opportunity after getting the IVR messages, many clients expressed a sense of feeling closer to the organization. One client responded, “Good. I feel well connected. Anytime I saw the call, I will <be> like 'eei my people.'” Another client responded, “I realized that you think about your customers and that really touched my heart.” Based on our analysis, client-institution relationship building took place directly (i.e., with clients perceiving “Alice” as a person with whom they form a relationship) and indirectly (i.e., with clients prompted by the IVR calls to connect with the institution such as by visiting a bank branch). These findings provide implications for how relational value might be generated, cultivated, or otherwise affected by technology artifacts when these artifacts are configured to embed human-like qualities.

7.8 Conclusion

Through this case study on anthropomorphism and an enfolding of the literature (Eisenhardt 1989), we have demonstrated how technologies can have consequential outcomes. By decomposing anthropomorphism from an affordance perspective, we have demonstrated how affordance theory can help shed light on the technological processes that underpin anthropomorphism. By bringing to the forefront various technical aspects which helped generate (perceivable) human-like elements, we have provided an improved understanding of the role of technology in anthropomorphism.

This research generates new insights into the utility of affordance theory and expands the IS affordance literature by highlighting the roles of imagination and affect for triggering affordance actualization. It also provides a methodological roadmap for other scholars wishing to investigate the relationship between technology affordances and anthropomorphism. These contributions to the IS affordance literature provide an entry point for the topic of anthropomorphism. It is our hope that future research will uncover many more insights on the relationship between technology affordances and anthropomorphism.

PART III. FINAL REMARKS

Chapter 8: Conclusion

The goal of this final chapter is to connect the ideas and themes presented in chapters 5-7 by summarizing the key findings in relation to chapters 1-3, which present the introduction and theoretical foundations of this thesis. This research was influenced by the IS literature which applies affordance theory for an improved understanding of IT-enabled change in organizations. This chapter discusses the main arguments which have been empirically substantiated in this thesis. After recapitulating and elaborating upon the research highlights, this chapter connects the key findings to the underlying links which connect the three papers (chapters 5-7). We also elaborate on the role of the ICT artifact in digital innovation, highlighting key digital affordances. Our aggregated findings present broader implications for scholarly theory, methodology and practice. This chapter concludes with a summary of the limitations of the research and a list of possible directions for future research.

8.1 Research Recapitulation

For organizations globally, the client-institution interface is being reconfigured as digital technologies are introduced and adapted to meet customer and service requirements. These new technologies introduced by and within organizations are playing critical roles in the reconfiguration of organizational practices, yet little is known about these technologies and how they are impacting practices of innovation.

This research was designed to further our understanding of some of these issues. It employed case study research along with affordance theory to examine if and how digital technologies, particularly their affordances, played a role in the strategy and practice of innovation for low-income markets. It used empirical methods and the context of digital financial services for low-income markets to explore a few aspects of innovation. The unifying research question we addressed was as follows: *What are the roles and dynamics of technology affordances in digital innovation?*

Through an embedded case study– a one-year innovation project that involved the design and deployment of IVR messaging for microfinance clients– the three papers of this thesis (chapters 5-7) explored three main facets of the relationship between digital innovation and technology affordances. Paper 1 focused on the role and dynamics of technology affordances in digital innovation as it relates to innovation strategy for improvising. Paper 2 focused on the role and dynamics of technology affordances in relation to organizational strategy and market-oriented approaches to innovation. Paper 3 focused on the role and dynamics of technology affordances in generating outcomes among users, which for our case were anthropomorphic perceptions found among users. These aspects have been probed through the analysis and have generated new insights with direct applications for scholarship and practice.

8.2 Findings Recapitulation and Links among the Three Papers

This thesis was partly motivated by the problem of whether and how the concept of technology affordances can be employed for an improved understanding of digital innovation. The research demonstrated how various challenges and opportunities of innovating, brought by digital technologies, can be better understood through an

affordance lens. Our three studies demonstrate how technology affordances as a theoretical lens can provide deep insights into the relationship among technologies, humans, and their environments within innovation practice. The findings from our three papers showed how the technology plays a critical and generative role in the innovation process. This improved understanding has significant implications for innovation strategy and practice.

In addressing our main research question, the research revealed patterns for how technology affordances have been perceived by innovation leaders and other project stakeholders and at times been enacted and generated effects. These patterns have provided evidence for theory building, particularly some of the ways that technology affordances are used by an organization to innovate and strategize around innovation. Through a better understanding of these issues, this study contributes to the bodies of literature on digital innovation and technology affordances by extending the theory of affordances to various strategic and practical aspects of digital innovation. It offers fresh conceptualizations around digital innovation and technology affordances as elaborated in our three papers.

In **Paper 1** (Chapter 5), the key findings extend the literature by introducing new concepts and providing new theoretical insights on the application of affordances to innovation strategy. We theorize the meta-affordance "innovation affordance"– a new term we define as all possible actions that emerge within the development or diffusion of innovation. We present a theoretical framing in introducing two main categories of innovation affordances: intended and responsive. These new conceptualizations of affordances follow the ways in which the decision-makers in the study conceptualized

and applied affordances as guided by certain logics during moments of improvisation within innovation practice. Intended affordances refer to all possible actions that emerge within the development or diffusion of innovation which are connected to the original goals of the organization for that innovation. Responsive affordances refer to all possible actions that emerge within the development or diffusion of innovation which are connected to any emergent constraints and/or opportunities posed by the organization, the socio-technical elements of the innovation, and/or the environment. From the analysis, intended and responsive affordances have been further classified into five sub-categories: actualizing, optimizing, transforming, counteracting, and compensating affordances. Their definitions, as derived from the data, are as follows:

- *Actualizing Affordances*: All possible actions that emerge within the development or diffusion of innovation which are connected to fulfilling the original organizational goals of the innovation.
- *Optimizing Affordances*: All possible actions that emerge within the development or diffusion of innovation which are connected to reinforcing or enhancing a desired outcome or existing condition.
- *Transforming Affordances:* All possible actions that emerge within the development or diffusion of innovation which are connected to changing an undesired outcome or existing condition.
- *Counteracting Affordances:* All possible actions that emerge within the development or diffusion of innovation which are connected to counteracting or offsetting an undesired situation or outcome.

- *Compensating Affordances:* All possible actions that emerge within the development or diffusion of innovation which are connected to compensating or making up for an undesired outcome or existing condition.

This theoretical framing introduced by the research showcases how technology affordances were employed by innovation leaders to strengthen the alignment between an innovation and the organizational goals for that innovation, and secondly, to help the innovation address barriers and leverage emergent opportunities.

Paper 2 (Chapter 6) demonstrates how the concept of "actualizing affordances," introduced in Paper 1, is grounded in the relationship between organizational goals and digital innovation. This was done through an examination of how organizational strategy was enacted through relationships among technology affordances, users, and their environments. The analysis showed how technology affordances which underpin the innovation dynamic of strategic customer targeting were derived from the data. These affordances were enabled by technical and organizational features and came in the form of capabilities which organizational actors could enact. These findings showed that technology affordances generated outcomes for the innovation which reinforced the objective of the organization which was to target low-income female customers. In highlighting the role of technology affordances in generating strategic customer targeting, the research generated new insights into the patterning and shaping of digital innovation for low-income markets. The analysis revealed that the presence of one or more of these elements– technology affordances, feedback, and one or more of the customer and/or environmental characteristics– was a condition for generating IT-enabled strategic customer targeting. This paper also furthered the conceptualization of

technology affordances, which in our study were found to be informational in nature. The affordances presented manifestations of information about the technology's capabilities and potentialities which helped inform decision-making in the innovation process. Our research showed that these informational affordances were mechanisms of change that served as a generative force. They played a role in changing the innovation and the technology artifacts for which the affordances belonged. Hence, the research showed how IT-associated change and the ICT artifact were generated in part by technology affordances.

Paper 2 builds on the work of Paper 1 by elaborating upon various relationships among intended and responsive affordances. The research identified intended and responsive affordances in the analysis that, when enacted, helped the organization fulfill its objectives for the innovation. Intended affordances are connected to the original goals of the organization for that innovation, hence their enactment would presumably help the organization fulfill its goals. Responsive affordances are connected to any emergent constraints and/or opportunities posed by the organization or outside elements. The analysis showed that responsive affordances also played a key role in helping the organization fulfill its original goals for the innovation. When feedback on the IVR system came in the form of customer complaints, the identified barriers offered directional guidance to the project team and helped them make changes to the innovation that would increase relevancy and/or appropriateness for the customer. This example shows how responsive affordances (using affordances to address barriers) were useful in assisting the enactment of intended affordances (using affordances to fulfill the organization's goal of reaching the target market). In other instances, responsive

affordances functionally served as a backstop to help remove or otherwise address barriers that were hindering the effectiveness of the intended affordances. These findings demonstrate how relationships among intended and responsive affordances may exist and play a prominent role in influencing changes to the innovation. This has implications for how managers of innovation might strategically leverage responsive affordances alongside actualizing affordances in developing digital innovation.

Paper 3 (Chapter 7) reveals new insights into how the technology had consequential outcomes in the form of anthropomorphic perceptions and technical anthropomorphism (Tondu 2012) in the context of digital innovation. The research highlighted various features and configurations of the technology that helped generate anthropomorphic perceptions among users. As demonstrated by the evidence, technology affordances can work together to evoke users' imaginations and emotions, fostering anthropomorphic perceptions and outcomes. The analysis showed how technology affordances which underpin this innovation dynamic of anthropomorphism were derived from the data. These affordances were enabled by technical and organizational features and came in the form of capabilities which organizational actors could enact. The analysis then categorized these affordances to identify four main ways that the affordances helped facilitate anthropomorphic perceptions among users, which are: (1) the capturing, storing and rendering of voice recordings, (2) mimicry of human-like conversation methods, (3) mimicry of human-like conversational elements, and (4) presentation of human-like message content. In decomposing anthropomorphism from an affordance perspective, the research demonstrated how technical anthropomorphism

can occur within a socio-technical relationship involving technologies and user perceptions, imagination, and affect (emotion).

Like Paper 2, Paper 3 builds on the work of Paper 1 by elaborating on the concepts of intended and responsive affordances in the context of anthropomorphism. It offers implications for how technical anthropomorphism can be generated through a strategic configuration of technology affordances to facilitate anthropomorphic design. Intended affordances would pertain to the perception and/or enactment of technology affordances for delivering the organization's original objective of targeting low-income women. This study demonstrates how responsive affordances, namely optimizing affordances, may be identified and leveraged to reinforce desired outcomes that emerge from the innovation, such as anthropomorphic perceptions among users, which according to other studies (i.e., Pfeuffer et al. 2019) can help facilitate user adoption. Thus, the use of optimizing affordances to facilitate user adoption, particularly among low-income women, can help reinforce the role of intended affordances in fulfilling the organization's original objectives.

The links between papers 1-3 can be summarized as follows.

- Paper 1 introduces the conceptual framing of innovation affordances which is elaborated upon through deeper analyses in papers 2 and 3.
- Paper 2 demonstrates a relationship between intended and responsive affordances in relation to the organizational practice of strategic customer targeting. Through the analysis, it conceptualizes the role of responsive affordances in addressing emergent constraints and barriers that inhibit the organization in fulfilling its original objectives for the innovation (i.e., targeting

low-income women). By addressing the constraints and barriers, the intended affordances can be used more effectively in fulfilling the organization's original objectives.

- Paper 3 demonstrates a relationship between intended and responsive affordances in relation to an emergent outcome (anthropomorphism) which is identified as an opportunity to reinforce the role of intended affordances in fulfilling the organization's original objectives. It focuses on conceptualizing responsive affordances, namely optimizing affordances, to reinforce anthropomorphic perceptions among users, which can improve user adoption and thereby aid the organization in targeting low-income women.

8.3 An Improved Understanding of the ICT in Digital Innovation

Applying the concept of digital affordance (Autio et al. 2018; Baiyere and Nieminen 2018), we theorize the role and dynamics of the ICT in digital innovation. Following Autio et al. (2018) and Baiyere and Nieminen (2018), we define digital affordance as an affordance that is derived from a digital technology (i.e., digital infrastructure) or from a technology affordance. Applying digital affordance as a concept in our research enables us to identify technology affordances which are distinctly digital in nature. While our meta-affordance, innovation affordance, may be applicable to innovation at the broadest level, our case study on digital innovation enabled the research to further our understanding of the role and dynamics of specifically digital affordances. We make this claim by enfolding the digital innovation literature (described in Section 3.3.1).

In our three studies (papers 1-3), our data showed that the technology affordances we identified were distinctly digital based on the technology and various technological

processes and characteristics in our case study (i.e., phone calling and messaging, audio recording, the electronic transmission of data, etc.). By identifying distinct properties of digital materiality based on our technology affordances, as we have done in the following table, we will demonstrate how our data is linked to the theory of digital affordances.

Table 18. Technology Affordances and Related Properties of Digital Materiality

	Technology Affordances (Identified in Papers 1-3)	**Link to Digital Materiality**	**Related Digital Properties**
1	*Identified dimensions of the meta-affordance "innovation affordance" (Paper 1):*		
	• Actualizing Affordances • Optimizing Affordances • Transforming Affordances • Counteracting Affordances • Compensating Affordances	The innovation leaders can rapidly make changes to the digital innovation, proactively to fulfill organizational goals and reactively to address emergent barriers and opportunities. The digital innovation embraces such actions because it is programmable and editable.	Programmability Editability
2	*Identified underpinning affordances of strategic customer targeting (Paper 2):*		
	• Capability to automate call message responses following user input • Capability to collect information/ survey clients • Capability to setup a hotline module for a specific subsegment • Capability to personalize messages (i.e., client's name/ account details)	The IVR system can be programmed to provide and collect tailored information through automated phone calls. This is possible because the digital innovation is (1) programmable and editable to enable such actions, and (2) addressable and traceable to relate to clients at an individual or group level.	Programmability Editability Addressability Traceability
	• Capability to preprogram the timing of message delivery	The IVR system can be programmed to deliver automated phone calls with a variety of delivery-related specifications. This is possible because the digital innovation is programmable and editable to enable such actions.	Programmability Editability

	• Capability to rerun messages if there are any errors		
	• Capability to record and rerecord audio clips • Capability to slice and (re)combine audio clips • Capability for speech synthesis	The IVR system can record and store information and enable digitized messaging. This is possible because the digital innovation is (1) programmable and editable to enable such actions, (2) contains memorability to enable such handing of data, and (3) communicable by enabling the digitization of messages.	Programmability Editability Memorability Communicability
	• Capability to integrate with SMS technology to send text messages • Capability to forward the call to another person • Capability to link to mobile accounts to provide airtime incentive	The IVR system can interact with other systems and protocols. This is possible because the digital innovation is (1) programmable and editable to enable such actions, and (2) communicable by being potentially open to integration with other systems/protocols and by being interactive with the ability to send and receive digital messages.	Programmability Editability Communicability
3	*Identified underpinning affordances of anthropomorphism (Paper 3):*		
	• Capability to capture and store human voice as audio clips	The IVR system can record and store information. This is possible because the digital innovation is (1) editable to enable such actions, and (2) contains memorability to enable such handling of data.	Editability Memorability
	• Capability to capture, store, and apply customer call data	The IVR system can record, store, and integrate data/information. This is possible because the digital innovation is (1) programmable and editable to enable such actions, and (2) contains memorability and communicability to	Programmability Editability Memorability Communicability

	• Capability to integrate customer savings data from core banking system	enable such handling of data, including the transfer of data from one system to another.	
	• Capability to integrate IVR and mobile network operator systems to deliver phone calls • Capability to transfer patterns of sound waves from human speech into electronic impulses (Liebenau and Backhouse 1990)	The IVR system can interact with other systems and protocols. This is possible because the digital innovation is (1) programmable and editable to enable such actions, and (2) communicable by being potentially open to integration with other systems/protocols and by being interactive with the ability to send and receive digital messages.	Programmability Editability Communicability
	• Capability to preprogram audio responses following customer input • Capability to solicit customer input and interaction via mobile phone connectivity	The IVR system can be programmed to provide and collect tailored information through automated phone calls. This is possible because the digital innovation is (1) programmable and editable to enable such actions, (2) communicable by being interactive with the ability to send and receive digital messages, and (3) addressable and traceable to relate to clients at an individual or group level.	Programmability Editability Communicability Addressability Traceability
	• Capability to send calls on a preprogrammed schedule	The IVR system can be programmed to deliver automated phone calls with delivery-related specifications. This is possible because the digital innovation is programmable and editable to enable such actions.	Programmability Editability

	• Capability to rapidly introduce, combine, and rearrange audio clips • Capability to integrate and combine audio clips	The IVR system can handle stored information, including modifying this information and transferring it to another system/protocol. This is possible because the digital innovation is (1) programmable and editable to enable such actions, (2) communicable by being potentially open to integration with other systems/protocols, and (3) contains memorability to enable such handling of stored data.	Programmability Editability Communicability Memorability

As shown in Table 18, digital properties are associated with the technology affordances that we identified in our research. Similar to the roles of the affordances, these digital properties underpin the innovation dynamics we have studied (improvisation when innovating, the strategic targeting of customers, and anthropomorphism). In identifying these underpinning digital properties, we find that it is multiple digital properties that underpin each technology affordance. Hence, by way of extension, our multi-level study of affordances enables the research to identify digital properties that are associated with the dynamics of digital innovation in our research. These digital properties by nature are emergent, bringing forth new opportunities to the innovation and creating the means to generate innovation. They enable the research to understand digital affordances as generative and enabling dynamism. These notions of digital affordances and their underpinning properties provide an improved understanding of the role of digital materiality in digital innovation.

In summary, the digital innovation in our research exhibited the following digital properties which were derived from the technology affordances that we identified in papers 1-3.

- ***Editability.*** The IVR system's capability of being rapidly altered (i.e., through revisions to the code) is illustrative of the digital property, editability (Kallinikos, Aaltonen, and Marton 2010).
- ***Programmability.*** The IVR system's capability of being able to accept new sets of instructions and become modified is illustrative of the digital property, programmability (Yoo et al. 2010).

- ***Memorability.*** The IVR system's capability of recording and storing information is illustrative of the digital property, memorability (*ibid.*).
- ***Communicability***. The IVR system's capability of interacting with other elements or entities, including its capability of sending and receiving digitized messages, is illustrative of the digital property, communicability (*ibid.*).
- ***Traceability.*** The IVR system's capability of tracing clients based on their interactions with the calls, "making them newly visible across time and space," is illustrative of the digital property, traceability (*ibid.*).
- ***Addressability.*** The IVR system's capability of uniquely identifying and addressing the digital artifact (mobile phone) belonging to each client is illustrative of the digital property, addressability (*ibid.*).

Following Autio et al.'s (2018) concept of digital affordance as derived from a digital technology, we can position the technology affordances identified in our research as digital affordances, as illustrated by the digital properties that underpin these affordances. Furthermore, we can follow Baiyere and Nieminen's (2018) notion of digital affordance as a derivative of a technology affordance to position these digital properties as digital affordances and thereby extend the theory we derived in our research. In doing so, we highlight key digital affordances within the technology affordances in our case, namely, capabilities to edit, program, trace, be communicable, be addressable, and exhibit memorability. This enables the research to tie theoretical links from the concept of innovation affordance to technology affordance to digital affordance. These theoretical linkages are made possible through our multi-level approach to affordances and they complete our thesis in addressing our research

question. Specifically, this arrangement of associated affordances reveals how affordances can be applied to explicate the relationship between digital materiality and digital innovation. This improves our understanding of the role of the ICT artifact in digital innovation.

8.4 Summary of Contributions and Implications

The thesis' theorizations have implications for theory, methodology and practice as described in this section.

8.4.1 Theoretical Contributions and Implications

The research has extended the literature on digital innovation and technology affordances by drawing on empirical evidence. It has been able to theorize the role and nature of technology affordances in digital innovation by building on the work of scholars including Tumbas, Schmiedel, and Vom Brocke (2015), Baiyere and Nieminen (2018), Yoo et al. (2012), Volkoff and Strong (2013), Bygstad, Munkvold, and Volkoff (2016), and Tondu (2012). We extend affordance theory in IS to conceptualize technology affordances as being particularly generative within the innovation development and diffusion processes. In doing so, we provide an improved understanding of how affordances, and technological design features by way of extension, relate to innovation strategy and practice, which is the main issue that our research sought to address.

This research advances the current knowledge of technology affordances, providing new insights into affordance theory which enable more of its value to be accessed. A better understanding of technology affordances also offers valuable insights into areas of

information science and technology management due to their focus on the interaction and interplay among technology artifacts, people, and their environments. The research also fills various gaps in the affordance literature. First, the existing literature does not address the logic of responsiveness within the innovation process, which our analysis contributes. Second, it highlights the understudied topics of strategic customer targeting and anthropomorphism as critical contemporary issues that are areas ripe for investigation in the affordance literature. The following table summarizes the key theoretical contributions and implications of this thesis.

Table 19. Summary of Theoretical Contributions & Implications

Contribution/ Implication	**Thesis Paper**	**Relevant Literature being Built upon**
Identified the role of technology affordances in digital innovation drawing upon thick, empirical evidence to examine understudied innovation dynamics, particularly: moments of improvisation, innovation leader mindsets, strategic customer targeting, and anthropomorphism.	Papers 1, 2, and 3	Yoo et al. 2010; Nylén and Holmström 2015; Tumbas, Schmiedel, and Vom Brocke 2015; Tondu 2012; Baiyere and Nieminen 2018
Applied a multi-level approach to studying affordances and the concept of meta-affordance to explicate the relationship between digital materiality and digital innovation.	Papers 1, 2, and 3	Baiyere and Nieminen 2018
Introduced new concepts into the literature by identifying and structuring technology affordances in digital innovation based on five main logics that underpinned the perceptions and actions of innovation leaders and often culminated in actionable decisions which had	Paper 1	Zammuto et al. 2007; Dijk et al. 2011; Abrishami, Boer and Horstman 2014; Tumbas, Schmiedel and Vom Brocke 2015; Endrissat and Noppeney 2016; Zhao and Zhu 2016; Abhari, Davidson and Xiao 2017

consequential outcomes for the innovation.		
Applied and tested theories and methods to explore technology affordances as a generative mechanism underpinning organizational change.	Paper 2	Volkoff and Strong 2013; Bygstad, Munkvold, and Volkoff 2016
Identified technology affordances and contingent factors that underpinned digital innovation and helped fulfill organizational goals.	Paper 2	Strong et al. 2014; Klecun, Hibberd and Lichtner 2016; Anderson and Robey 2017
Demonstrated how technical anthropomorphism can be generated through a strategic configuration of technology affordances to facilitate anthropomorphic design.	Paper 3	Tondu 2012
Revealed how the contextual and relational nature of affordances, particularly digital affordances, allowed this research to address the generativity and malleability of digital innovation.	Papers 1, 2, and 3	Tumbas, Schmiedel and Vom Brocke 2015; Autio et al. 2018; Baiyere and Nieminen 2018

8.4.2 Methodological Contributions and Implications

This research provides valuable methodological contributions to the literature on technology affordances and innovation management. It has shown how an affordance lens, particularly a multi-level approach to studying affordances, enables a rigorous methodological study of various technical aspects that underpin innovation dynamics and phenomena. The research has demonstrated how affordance theory can help shed light on technological processes and dynamics for an improved understanding of the role of technology in digital innovation.

The research also offers a step-by-step process for identifying technology affordances within digital innovation. Through a decomposition of innovation dynamics and phenomena in our three studies– namely, improvisation when innovating, the strategic targeting of customers, and anthropomorphism– the research showcases how technology affordances and their roles in IT-associated change may be identified. Through this work, the research offers a methodological roadmap for other scholars wishing to investigate the relationship between technology affordances and digital innovation. These contributions to the IS affordance literature provide an entry point for exploring understudied topics such as strategic customer targeting, anthropomorphism, and the role of human imagination and affect within socio-technical relationships.

8.4.3 Practice-Oriented Contributions and Implications

Finally, this research provides significant implications for industry practice by specifically addressing how the development of digital innovation for low-income markets may be further optimized. The research offers implications for identifying and utilizing technology affordances in ways that positively impact technology adoption and diffusion. The findings can guide innovation leaders in building effective strategies for digital innovation, especially for (1) harnessing complexity during moments of improvisation, (2) targeting specific customer segments, especially low-income markets, and (3) eliciting anthropomorphic perceptions among users and configuring anthropomorphic design in information systems development.

As demonstrated by our three studies, affordances provide an actionable construct for innovation practice. The five subcategories of affordances that we found in Paper 1 (actualizing, optimizing, transforming, counteracting, and compensating), for example,

have implications for strategy development. The conceptual model introduced by the research offers a logical framework of responsiveness which might be useful as a systematic approach in helping innovation leaders harness complexity during moments of improvisation. When identifying barriers and opportunities while innovating, for instance, these categories may help innovation leaders identify a broad range of possible responses using digital technologies to address barriers and exploit emergent opportunities. Similarly, our decomposition of strategic customer targeting and anthropomorphism in papers 2 and 3 may provide innovation leaders a method for uncovering and optimizing technical aspects which can help contribute to such outcomes. An improved understanding and utilization of technology affordances, and interrelated socio-technical aspects, can help innovation leaders configure and reconfigure technological artifacts and systems to achieve better outcomes. Our research has also shown how various technology affordances and affordance types (i.e., intended and responsive) can be used jointly to obtain desired goals. Such findings present novel insights into the utility of affordance theory.

8.5 Limitations

This research on technology affordances in innovation for low-income markets is hindered by various theoretical and empirical limitations, such as:

- There are limitations as to the extent these findings are generalizable to other technologies and contexts. First, the empirical evidence was collected from an IVR pilot project in Ghana during Ghana's banking crisis of 2017-2018 and at a time when IVR in Ghana was nascent. Second, our research context presents unique environmental conditions (elaborated in section 4.2.5) which may not be

found in higher-income contexts. Lastly, every organization is unique and carries out digital innovation processes differently (Nylén and Holmström 2015).

- Other aspects, in addition to those mentioned above, may make our research difficult to replicate. For instance, as a participant observer, the researcher was able to connect dots which someone from the outside may not be able to do. For example, there were multiple communications logs being used simultaneously for different purposes. There was one log internal to Opportunity staff, while another log contained communication between Opportunity staff and the IVR technology vendor. Questions may have been asked on the first channel and discussed on the second channel before a response was provided back to the first channel. Following multiple trails of conversations in various channels, including Skype chat, emails, WhatsApp, and calls, presented a complexity for the research which might be difficult for a replication study.
- The research followed specific conceptualizations of affordances which appeared most relevant to the research context and objective. Alternative conceptualizations, such as affordances as exclusive properties of the technology artifacts, may have provided some interesting findings but were not explored.
- In addition to narrowing our conceptualization of affordances, we also had to narrow the scope of our data collection and analysis. For instance, given the complexity of our case study, this research does not claim to be comprehensive in our examination of technology affordances. There were elements within the research that were not prioritized due to decisions made based on the research design and motivations. For example, because the digital innovation landscape is rapidly changing (Nylén and Holmström 2015), we focused the research on

elements which were presumed to have a longer duration of relevancy. Out of necessity, we also narrowed the scope of the research, such as in Paper 3 (Chapter 7), when we focused on some of the human aspects of the socio-technical relationship affordances, leaving other human and environmental aspects of our case relatively unexplored. Conclusively, there were many alternative paths that the research could have taken which we leave to future research. Such paths include affordance studies focused on the various stakeholders or other topical areas such as innovation design and affordance evolution.

8.6 Further Research

This research offers various directions for future research. It recognizes that Yoo et al.'s (2010, 3) call for more thick, empirically grounded qualitative research to explore the dimensions and dynamics of digital innovation is as applicable today as it was in 2010. We call for IS researchers to further investigate technology affordances in the context of digital innovation for an improved understanding of affordances and innovation.

To build on this research, more work is needed to:

1) Ascertain the degree to which our findings are generalizable, such as by testing the conceptual model on innovation affordances (developed in Paper 1) in other cases and contexts;
2) Build on this model from Paper 1 using new evidence, especially to uncover other categories or subcategories of innovation affordances and underpinning logics;

3) Study the co-existence of affordance types (intended and responsive) and possible relationships among them in generating outcomes;

4) Examine the potency (Anderson and Robey 2017) of innovation affordances (i.e., intended and responsive) and the degrees to which innovation outcomes are materialized;

5) Study technology affordances in other cases of improvisation, strategic customer targeting, and anthropomorphism for an improved understanding of the role of technology and its dynamics within these phenomena;

6) Explore the roles and dynamics of human imagination and affect in triggering the perception and actualization of technology affordances; and

7) Examine the degree to which technology affordances help achieve various outcomes, such as IT-associated change, the improvement of innovations for target markets, and advances in user adoption.

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APPENDICES

Appendix A: Seminal IS Literature on Technology Affordances

Table 20. Seminal IS Literature on Technology Affordances

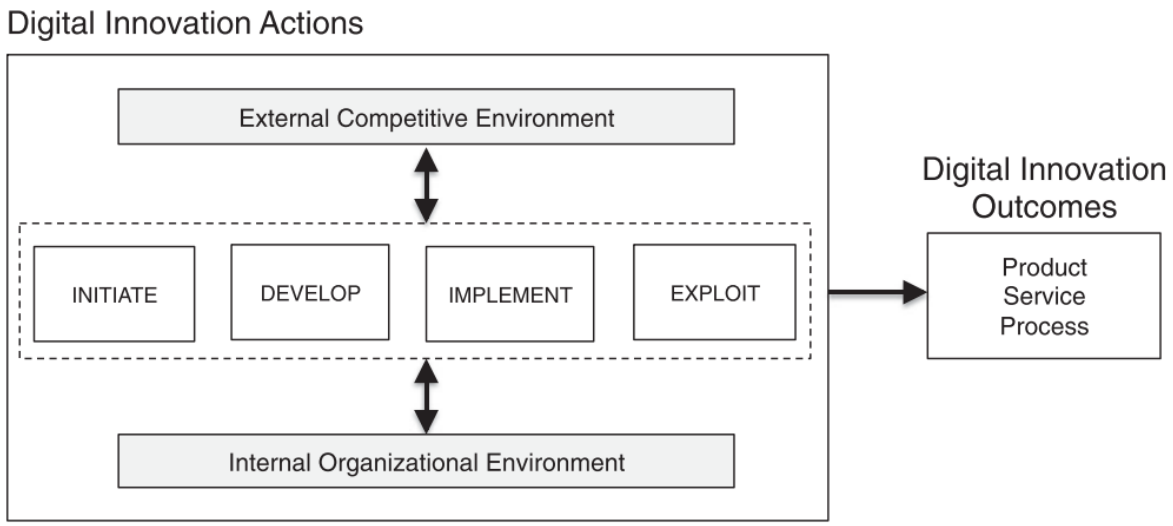
Key Technology Affordance Literature	
Zammuto et al. (2007)	Identified five "affordances for organizing" which characterized emergent aspects of technology in organizations: visualizing entire work processes; real-time/flexible product and service innovation; virtual collaboration; mass collaboration; and simulation/synthetic reality. Explored how these affordances can result in IT-associated change, particularly new forms of organizing and how organizational boundaries form.
Markus and Silver (2008)	Introduced the term "functional affordances" which are defined as the possibilities for goal-oriented action afforded to specified user groups by technical objects. Argued that functional affordances can be used to conduct a more holistic analysis of IT artifacts by enabling scholars to examine potential uses alongside actual use, which gets at the social structures surrounding the IT artifact. Acknowledged the limitation of this term, that it does not capture values, hence proposed the concept of symbolic expressions to assist in the analysis of IT artifacts. Extended DeSanctis and Poole's original concepts of structural features and spirit.
Leonardi (2011)	Examined the case of a computer simulation technology for automotive design to theorize the roles of affordances and constraints in organizational change. Argued that perceptions of constraint lead people to change their technologies while perceptions of affordance lead people to change their routines. Discussed how notions of agency– the imbricated nature of human and material agencies– help explain organizational change, i.e., how the infrastructures that people use to do their work is generated.

Yoo et al. (2012)	Drew themes from six articles to explore the implications of three innovation traits that are associated with pervasive digital technology: (1) the importance of digital technology platforms, (2) the emergence of distributed innovations, and (3) the prevalence of combinatorial innovation. Argued that the affordances of pervasive digital technologies create innovations characterized by convergence and generativity, and that these digital affordances are fundamentally shifting the nature of innovation processes and outcomes. Highlighted the nature of digital innovation as distributed, heterogeneous, accidental, serendipitous, and as having emerging complexity.
Leonardi (2013)	Examined a comparative, multimethod, longitudinal study of computer-based simulation technology use in automotive engineering to help explain organizational change. Found that group-level network change has its most profound implications when individuals use the same subset of a new information technology's features. Introduced "shared affordances" to help explain when technologies are likely to bring about network change within organizations. Theorized shared affordances as users converging on a shared appropriation of the new technology's features, such that the technology affordances are jointly realized.
Robey, Anderson, and Raymond (2013)	Argued that the material aspects of organizations can disappear into the backdrop of theory development and highlighted the importance of the IT's materiality in explaining organizational change. Offered theoretical options– applying affordances and organizational routines theory (Feldman and Pentland 2003)– to explain organizational persistence and change.
Seidel, Recker, and Brocke (2013)	Studied the role of affordances in environmental sustainability transformations using the case study of a worldwide operating software solutions provider. Developed a theoretical framework that identifies four important functional affordances originating in information systems which are required in environmental sustainability transformations. Contributed to a better understanding of IT-associated change and the concept of functional affordances.
Volkoff and Strong (2013)	Studied two cases of manufacturing to conceptualize affordances as generative mechanisms through which action is enabled or constrained and potentially results in offered power and/or threatened liabilities. Argued that

	this conceptualization enhances scholars' ability to explain IT-associated organizational change.
Strong et al. (2014)	Examined affordances in a study of the implementation of an electronic health records system in a multi-site medical group, pointing out the relationship between affordances and organizational goals. Conceptualized dependencies among affordances, specifically the relationship between organizational level actualization and individual level actualization.
Anderson and Robey (2017)	Studied changes in hospital work practices and developed the meta-theory "affordance potency," defined as "the strength of the relationship between the abilities of the individual and the features of the system at the time of actualization, conditioned by the characteristics of the work environment." Used this concept to help explain the relationship between IT's material properties and changing work practices by focusing on individual affordance actualization and the social context.
Baiyere and Nieminen (2018)	Extended technology affordance theory by advancing a theoretical notion of digital affordance as a derived affordance. Proposed a distinction between the affordance of the technology (which is inherent in the agency of the technology) and the affordance of the application (which is unpacked by the interaction between the human agency and the technology agency, or other agency). Argued that the value of digital capability lies in the interaction between the human agency and the technology agency in the enactment of innovation agility.
Bernardi, Sarker, and Sahay (2019)	Studied the role of technology affordances in generating organizational consequences, specifically the maintaining or deinstitutionalizing of work routines and practices, using a case study on health management information systems (HMIS) in Kenya. Focused on the crucial role of identity work as a mechanism linking affordances to organizations and found four types of identity work (disruptive, legitimizing, reinforcing, and trans-formative) that, through different affordances, contributed to the maintaining or deinstitutionalizing of organizational routines and practices.

Appendix B: Theoretical Framework of Digital Innovation

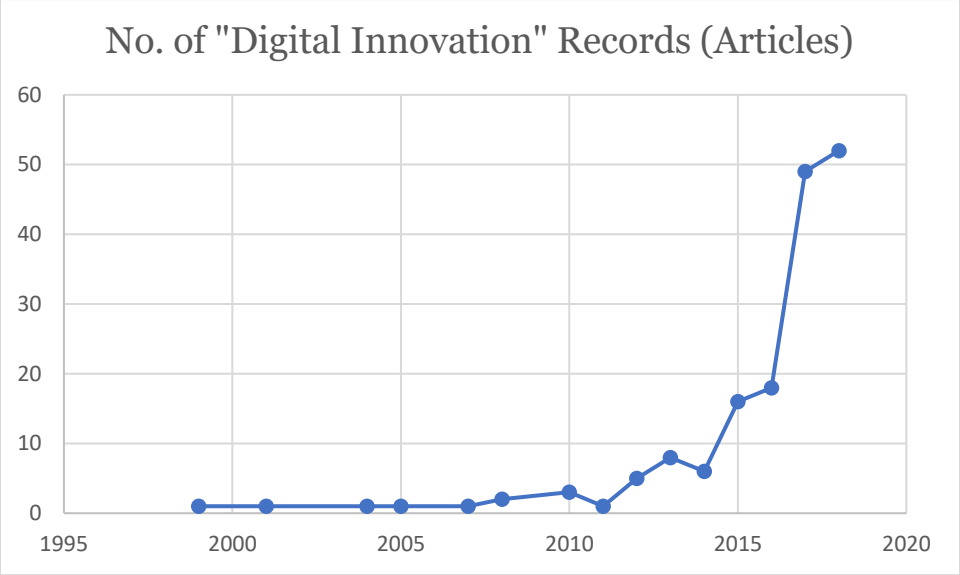
From Kohli and Melville (2018, 3)



Appendix C: Growth of Digital Innovation Literature

The literature on digital innovation is in its infancy but is growing at a rapid pace. While a simple search on “innovation” of the Web of Science database revealed over 193,500 records of articles starting from the year 1943, a search on “digital innovation” revealed 166 records of articles starting in 1999. The vast majority (82%) of these 166 articles were published in just three years, 2015-2018.

Figure 9. Number of Records of Articles containing "Digital Innovation" on the Web of Science Database (as of January 12, 2019)



Appendix D: Examples from the Data (Sub-Codes) from Paper 1

Table 21. Examples from the Data from Paper 1

Meta-Code	Examples from the Data by Code		
Actualizing Affordance	*Target clients* • Female clients • Low income • Low literate • Segment A: active savers with low balances • Segment B: less active savers • Segment C: inactive savers *Deliver scale* • Multiple local languages at once • Large-scale consistency • Geographical spread *Deliver information* • Push communications • Pull communications • Savings tips • Savings methods	• Product information • Mobile banking benefits • Mobile banking instructions • Project-related information *Prompt behavior change* • Savings increase • Savings frequency • Savings goals • Mobile banking registration • Mobile banking use • Digital savings channels • Listen to messages Respond to messages	*Connect to client relationally* • Interactive communication style • Emotional connection • Seasonal greetings • Conversational approach • Encouraging / praise-giving • Engaging experience ("fun," "humorous") • Cultural connection • Expressing gratitude • Tailored messages
Optimizing Affordance	*Reinforce existing work practices* • Financial education • Product information and promotion • Encourage savings • Mobile banking training and promotion • Delivery channel information • Institution information • Pricing information • Communications-related information	• Relationship building *Reinforce key messages* • SMS to reinforce IVR • SMS to provide numeric details • Phone calls from staff • SMS messages from staff *Strengthen relationships*	• Human-like communication methods • Human-like conversational style • Familiar message content • Relevant message content • Personalization • Emotionally connected content

Transforming Affordance	*Educate and inform* • New information not previously disseminated • Information not commonly delivered • Complex information often not understood • Policy changes • Process changes • Environmental change	• Revised instructions *Change behaviors* • Patterns of action • Methods of action • Frequency of action • Capacity to act *Change attitudes* • Increased trust in digital channels	• Increased comfortability with digital channels • Sense of commitment • Sense of accountability • Desire/ willingness to act
Counteracting Affordance	*System delay response* • Schedule changes • Service provider changes • Removed inactive call recipients • Revised to batch-method for sending calls *Poor performance / miscommunications response* • Removed messages • Relabeled terms	• Restructured message trees • Repeated language section menu *Banking crisis response* • Calls/ messages to increase trust in institution • Calls/ messages to increase assurance	*Dormant account response (savings/mobile banking)* • Increased relational connection • Reminders • Prompts to act • System credibility • Updates
Compensating Affordance	*Adjustments* • Call retries • Revised call delivery time • Revised call frequency • Process adjustments • Project schedule adjustments • Added staff as call recipients • Shared audio clips • Repeated language selection menu	• Unlimited access to weekly message *New elements* • Callback option • Automated call retries • Call center • Message resends *Workarounds* • Reconfigured messages • Resequencing of messages	• Resequencing of clips • SMS messages • Phone calls from staff • SMS messages from staff • Added reporting • Added contact method alternatives

Appendix E: Interview Guides used in Papers 2 and 3

Mid-Project Interview Guide for Clients

Greetings/ Introduction
Prompts regarding recent movements in savings balances: • Why have you made savings / not made savings in recent months?
Why/ for what purpose do you save?
Do you remember any calls from Opportunity International (from Alice)?
What did you think of the messages?
Would you like to receive more messages in the future? • If yes, what types of messages would you like to hear?

End of Project Interview Guide for Clients

Greetings/ Introduction
Do you remember the messages from Opportunity International (from Alice)?
What do you remember about the messages?
Please, what was your impression of the messages you received from Alice (or from Opportunity International?' • Were any of the messages helpful to you? If yes, in what way? • Is there anything in particular that you liked about the messages? Yes/No (Why?)

Is there anything in particular that you disliked about the messages? Yes/No (Why?) • Have you faced any challenges in listening to the messages? Yes/No (If yes, allow the client to mention the challenges) • Were you always able to pick the call and listen to the end? Yes/No (Why?)
Did the messages influence you in any way? • If Yes, how? • If No, why? (why didn't the calls influence client behavior? Ascertain if it's about design, tone, timing, frequency, etc.).
Would you like to receive (more) messages in the future? If yes, on what topic?
How did you feel about Opportunity International after getting these messages?
Have you been able to make any savings? • If Yes, what are you saving for? • If No, why haven't you been saving?

End of Project Interview Guide for Branch Staff

Greetings/ Introduction
Have you heard about this project?
Did you receive any of the calls yourself? How many?
Did you receive any feedback about the messages from clients? • What negative things did clients say? • What positive things did clients say?
Do you think sending voice messages to clients is a good idea or bad idea (and why)?
Which message topics would be most useful to clients?

Do you think such messages to clients make your job easier or harder? How?
If we were to design another project like this in the future, what advice would you give? • How would you do it differently?