Technology Affordances in Digital Innovation Research: Quo Vadis?

Completed Research

Yolande E. Chan
Smith School of Business
Queen’s University, Canada
ychan@queensu.ca

Suchit Ahuja
John Molson School of Business
Concordia University, Canada
suchit.ahuja@concordia.ca

Farzam Boroomand
Smith School of Business
Queen’s University, Canada
farzam.boroomand@queensu.ca

Arman Sadreddin
Smith School of Business
Queen’s University, Canada
arman.sadreddin@queensu.ca

Abstract

Technology affordance theory has been repeatedly mentioned as a viable lens to study implications of digital technologies for innovation processes and practices. In this research article, we highlight one of the challenges of applying technology affordance theory in its current form to digital innovation research. We address the relationships between individuals and organization within innovation ecosystems. Based on insights generated from the extant literature on technology affordances as well as on digital innovation, we seek to explore the challenges of studying digital innovation through the lens of technology affordance theory. Our research integrates and expands existing theoretical perspectives on affordances to better address the needs of research on complex, emergent socio-technical phenomena such as digital innovation.

Keywords


Introduction

There has been copious management research on the strategic role of information technology in organizational communications, information-based decision making, and innovation (Ciborra 1987; Hitt and Brynjolfsson 1996; Markus and Robey 1988). Initially, researchers focused on the impact of technology in organizations based on the features offered by the technology and the purpose of deployment, often using a top-down implementation approach involving structural and functional change in organizations (Delone and Mclean 1992; Perrow 1967). Subsequent researchers focused instead on the users within the organization who worked around the technology’s constraints and collaborated to design bottom-up innovations contingent on the material features of the technology (Leonardi and Barley 2010; Orlikowski and Scott 2008; Von Hippel 1976). Thus, the discussion about the strategic role of technology for innovation in organizations has moved beyond top-down, unidirectional deployment and adoption to complex technological interactions (among technological attributes and underlying materials) and social interactions (among users, internal and external actors, and the organizational environment) (Haefliger et al. 2011).
Recently, we have seen the emergence of various streams of literature that examine how innovation is fostered by affordances (Gibson 1977) that are created by digital technologies such as Social media, Mobile applications, Analytics, Cloud computing, and the Internet of Things (collectively called SMACIT) (Ross, 2014). An affordance is simply “the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relationship between an object and a goal-oriented actor or actors” (Strong et al. 2014; Volkoff and Strong 2013). Due to the affordability, accessibility, and availability (Harris et al. 2012; Weiß and Leimeister 2012) of digital technologies, they have become the default choice of entrepreneurs. More importantly, we have also seen a rise in the use of digital technologies and platforms (Sedera et al. 2016) not only for profitability but also for creating social innovation and environmental impact (Cui et al. 2017; Shan-ling and Sandeep 2018; Tim et al. 2018). Interestingly, many studies attribute the success and rapid adoption of innovative digital technologies and platforms to their underlying affordances (Denyer et al. 2011; Haefliger et al. 2011).

Some researchers focus on the attributes of digital technologies (openness, elasticity, etc.) that provide digital artifacts with important affordances (Yoo et al. 2012); others focus on socio-materiability from a critical realism perspective (Volkoff and Strong 2013); while still others (Majchrzak and Markus 2013) embrace a more tangible point of view by describing specific “digital affordances” that can be easily observed and manipulated. Despite the existence of a rich volume of literature on affordances that has helped us understand “what affordances are”, we lack a comprehensive understanding of “how to use and apply affordance theory” in the context of new and emergent forms of digital innovation (Nambisan et al. 2017). With the rapid adoption of SMACIT solutions and digital platforms, the traditional boundaries of the firm have changed and the locus of innovation has moved to innovation ecosystems (Nambisan et al. 2017). In the extant literature, several factors including digital technologies, contextual peculiarities, and the fusion of digital and physical realms within complex ecosystems lead to new types of innovations. However, there is limited extant literature on technology affordances that go beyond the individual level, and consequently limited explanation of the complexities of socio-technical interactions within organizations and their ecosystems. These complexities cannot be meaningfully captured using extant affordance theory. Supporting this view, Te’eni accentuates the necessity “to extend the mostly individual perspective of affordances to an organizational perspective, perhaps even a societal perspective of affordances” (Te’eni 2016, p. 474). To address this gap, this article seeks to contribute to the application of affordances theory within innovation ecosystems that are composed of heterogenous actors that have come together with common goals. Most of our discussion is rooted in the literature on digital innovation, but we also highlight emergent literature on social and environmental innovation.

In our article, we address the following research questions: How can technology affordances be applied within an innovation ecosystem where the actor-object relationship moves beyond the interaction between a single individual (or organizational actor) and technical objects? We aim to contribute to the extant literature on technology affordances and digital innovation by highlighting how to use affordance theory to study evolving forms of digital innovation, specifically innovation that happens within innovation ecosystems that are composed of heterogeneous actors including individuals, organizations, and technology artifacts (Nambisan et al. 2017). Our insights stem from reviewing the extant literature that is at the intersection of affordance theory and digital innovation. We focus on the emerging interactions among goal-oriented actors, the IT artifact, and the environment in digital innovation contexts where these entities often overlap in their functions and are perceived as loosely coupled. We also provide a real-life example to illustrate our theoretical insights in a real-life setting.

The rest of the paper is organized as follows: First, we discuss the origins and application of affordance theory in traditional as well as digital innovation studies. Next, we present in detail a typology of affordances
in the digital innovation context. This is followed by an illustrative example. Finally, we present concluding remarks and outline future research directions.

**Theoretical Background**

**Affordance Theory**

Gibson (1977) defined affordances as ‘action possibilities’ that arise in the interaction between an animal 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 1977, p. 127). After Gibson’s definition, the literature on affordances split into two major streams. One stream focused on design and argued that an affordance exists independent of the user but has an impact only if the user perceives and actualizes it. Another relation-based stream argued that affordances emerge in practice in a particular context (Andriani and Cattani 2016; Thapa and Hatakka 2017). In the 1980s, a major focus of affordance research was at the individual level where an affordance was often described as a way of perception by the “individual user” of an object (Gibson 1977; Norman 1999).

Over time, the meaning of “affordances” was formulated differently in various literature streams, although a well-established link to socio-cultural contexts remained. Specifically, within the information systems literature, the term was reformulated to the extent that it was used to refer to objects on a screen, thus purely focusing on the features of technology and not on the socio-cultural aspects (Norman 1999). However, recent IS literature has moved away from defining affordances as purely feature-based and includes the socio-techno-cultural as well as action-oriented perspectives (Markus and Silver 2008; Robey et al. 2013; Volkoff and Strong 2013). This is in line with the view held by other streams of literature where the effectiveness of technology depends on more than technical issues (Denyer et al. 2011).

Three major components of affordances that must be examined are the actors, objects, and interactions among them. One of the first instances of unpacking the complexities involved in these components of affordances in an organizational setting was provided by Zammuto et al. (2007, p. 749). This study moved beyond the individual level of affordances and offered five affordances of information technology at the organizational level “that can result from the intersection of technology and organizational features”. Similarly, Majchrzak and Markus (2013) focused specifically on studying organizations and technology affordances that were related to hardware, software, electronic communications, media, and people. This stream of research gained further momentum due to the wide adoption of newer technologies such as SMACIT, AI, blockchain, and augmented reality in organizations. There has also been significant evolution of digital innovation including digital platforms, digital transformation, UI/UX research, and digital entrepreneurship (Kallinikos et al. 2013; Nambisan et al. 2017; Ross 2014; Yoo et al. 2012).

**Affordances and Digital Innovation**

One of the challenges of applying the affordance lens to study digital innovation arises because a technical object is a complex assemblage of many parts, and an actor may be an individual, group, organization, ecosystem, or society (Te’eni 2016). Thus, the relation between technology and an actor will be associated with a variety of affordances at various levels. This is particularly true in newer contexts where digital innovation is investigated. While a social or business ecosystem stems from ecological and sociological origins (El Sawy and Pereira 2013; Elliot 2011), a digital ecosystem is a “self-organizing, scalable and sustainable system composed of heterogeneous digital entities and their interrelations focusing on interactions among entities” (Li et al. 2012, p. 119). Even when these complex forms of organization are investigated in order to study the various levels and types of affordances they have to offer, generally the research focus is on affordances that are related to the actor (Strong et al. 2014). As a result, other
affordances within the ecosystem remain underexplored. Such gaps are also manifested in various streams of management literature. For example, Sussan and Acs (2017, p. 56) highlight an important gap that exists in the entrepreneurship literature, stating that “entrepreneurship research has ignored both the role that digital technologies play in entrepreneurship and the role that users and agents play in digital entrepreneurship.” This can also be attributed to the fact that strategic entrepreneurship research has for a long time focused on the role of the individual entrepreneur and underplayed the role of supportive technologies, the ecosystem, and the social context in which the entrepreneur is embedded (Dimov 2007).

More recent literature in strategy and entrepreneurship has addressed this issue (Autio et al. 2014, 2018) by introducing both digital affordances and ecosystem-based, spatial affordances that are conceptualized in the context of digital innovation. Digital affordances are embedded within IT artifacts, IT infrastructures, and digital platforms. Users, organizations, and ecosystems derive digital affordances from the technical architecture of digital infrastructures, and they support an economy-wide process redesign of value creation, delivery, and capture (Autio et al. 2018). In contrast, spatial affordances are derived from the locus and positioning of innovation within and outside the boundaries of an organization (Autio et al. 2018). Spatial affordances are characterized by the predominance of business model innovation, voluntary horizontal knowledge spillovers, and the locus of entrepreneurial opportunities outside the traditional boundaries of the firm (Autio et al. 2018). Nonetheless, the existence and intersection of both digital and spatial affordances are necessary conditions to execute digital strategy and innovate. The extant literature is limited in providing a comprehensive theoretical framework that captures this interaction among digital affordances, spatial affordances, and the various actors within an ecosystem. Further, there is limited practitioner-oriented literature that emphasizes how firms and managers can strategize to take advantage of affordances within their unique contexts (Autio et al. 2018).

One of the ways in which the literature is beginning to address the applicability gap of technology affordances is by discussing “affordance actualization” (Tan et al. 2016; Tim et al. 2018). Affordance actualization is the process of realizing the potential that is offered by technology affordances and is usually conducted by an actor, group of actors, an organization, an ecosystem, and sometimes even by society (Te’eni 2016). According to the extant literature, prior to actualization, it does not matter who the specific actor is, just that some actor who could actualize it does exist (Chemero 2003; Hutchby 2001). However, in the context of digital innovation, especially innovation at the ecosystem level as well as the societal level, it is important to consider both the individual and collective interactions of several entities that “orchestrate” the actualization process collectively by sharing or collaborating in a synchronized manner, for example, through digital platforms, across various locations and time zones (Ahuja and Chan 2017; Vaast et al. 2017). The above discussion shows how the extant literature on affordances may need to be updated to address challenges arising from technological change. Next, we address one of these challenges by extending existing typologies of affordances to heterogeneous actors within an ecosystem.

**Typology of Affordances: Multiple Types of Actors**

As outlined earlier, the concept of affordance was first introduced by Gibson (1977) in ecological psychology as an “action possibility” arising from the interaction between an animal and an object within an environment. Management scholars adopted affordance theory to study the impact of artifacts in general, and technological artifacts in particular, on the fabric of organizations (Zammuto et al. 2007), and to focus on affordances as an approach to studying the relationship between artifacts and organizational actors (Markus and Silver 2008). As previously discussed, the management literature defines affordances as the potential for behaviors that arise from the relation between an artifact and a goal-oriented actor or actors (Strong et al. 2014; Volkoff and Strong 2013). While preserving the main elements of the original conceptualization of affordances (i.e., artifact and goal-oriented actor or actors), this definition neither limits the “actor” to an individual-level user nor puts extra emphasis on the psychological origin of the
theory (e.g., the individual’s perception or cognitive abilities). Thus, organizational researchers expand the original definition of affordances from an individual-level construct to a construct that can be applied to multiple levels of analysis. This expanded definition supports a stream of research in which actors go beyond the individual level. In this stream, researchers apply affordances as a theoretical lens to study the development of organizational capabilities, and affordance theory emerges as a viable lens to study organizational-level phenomena (e.g., Majchrzak and Markus 2013; Rehm and Goel 2017; Zammuto et al. 2007). Such studies focus on goal-oriented organizational actors looking to realize organizational goals (Argyris and Ransbotham 2016) without examining micro-level (i.e., individual) granularity as was required by affordance theory in its original form. Although this research stream does not conceptually limit the number of actors that interact with an artifact, our review of empirical research reveals that currently researchers do not leverage the power of technology affordances theory to study phenomena in which multiple micro and/or macro-level actors (e.g., multiple organizations) interact with an artifact.

A second stream of research that also bridges the gap between individual-level affordance theory and macro-level phenomena is the extension of individualized affordances to collective and shared affordances (Leonardi 2013). An individualized affordance is an “affordance that someone enacts when using a technology’s features, but that affordance is not common to his or her workgroup or department” (Leonardi 2013, p. 752). An individualized affordance solely benefits the person who realizes it, but may not be available to social entities beyond the enacting individual (Leonardi 2013). To extend affordances beyond individuals, Leonardi (2013) introduces collective and shared affordances. A collective affordance is “an affordance that is collectively created by members of a group, in the aggregate, which allows the group to do something that it could not otherwise accomplish” (Leonardi 2013, p. 752). Similarly, a shared affordance is defined as “an affordance that is shared by all members of a group” (Leonardi 2013, p. 752). A shared affordance is different from a collective affordance as the shared affordance implies similar use of an artifact by all members of a group while the collective affordance represents different usage of the same artifact to accomplish a collective goal (Leonardi 2013, p. 752). This approach has been applied to study macro-level phenomena at the societal level (e.g., Gaskin et al. 2014; Tim et al. 2018; Vaast et al. 2017; Zheng and Yu 2014), where individual members of a society collectively used a technology to achieve a common goal.

While both research streams provide powerful foundations to study the relationships between an artifact and macro-level social actors, we see the opportunity to combine the two research streams and introduce a new typology of affordances that can help researchers to study the relationship between an artifact and actors within complex social entities such as innovation ecosystems. These are “composed of interconnected and interdependent networked actors, which includes the focal firm, customers, suppliers, complementary innovators and other agents as regulators” for value co-creation (Gomes et al. 2018, p. 45). Such ecosystems have goals that reach beyond individuals or organizations such as “the goal of enhanced and sustained performance to all the various actors” within the ecosystem or lowering unemployment rate in a region (Acs et al. 2017, p. 4). Entrepreneurial ecosystems⁠¹ as a type of innovation ecosystems are also highly reliant on digital technologies (Autio et al. 2018; von Briel et al. 2018; Nambisan et al. 2017) to achieve their ecosystem-level goals. As a result, technology affordance theory provides an opportunity to study the relationship between a technological artifact and a goal-oriented social actor.

In response to recent calls to study technology affordances from a multi-level perspective (Savoli and Barki 2016), we focus on extending the existing typology of individualized, collective, and shared affordances

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⁠¹Entrepreneurial ecosystems are industry clusters composed of multiple social entities such as individual entrepreneurs, startups, incubators, universities, industry partners, government-supported centres of excellence, venture capitalists, and policy makers (Jackson 2011) at multiple levels of granularity that are connected together by spatial proximity and digital connectivity (Autio et al. 2018; von Briel et al. 2018).
beyond individual-level actors. The existing typology of affordances (i.e., individualized, collective, and shared) provides a theoretical foundation for studying group-level phenomena in which a group of individuals collectively use an artifact to achieve a common goal. However, such a theoretical foundation does not exist for a group of meso or macro-level actors (e.g., organizations) interacting with an artifact to achieve a common goal (e.g., multiple organizations using GitHub for the purpose of open innovation, Lee 2015). We propose to extend the definition of individualized affordance from an “affordance that someone enacts when using a technology” to an “affordance that a social actor enacts when using a technology” in which a social actor may be either an individual or an organization (Leonardi 2013, p. 752). Similarly, we suggest extending the definition of collective and shared affordances to macro-level social actors. Thus, we suggest defining a collective affordance as an affordance that is collectively created by a group of social actors (rather than members of a group) in the aggregate by using an artifact collectively but in a different manner. We also suggest reconceptualizing shared affordance as an affordance that is common to a group of social actors, in which a social actor can be either an individual or an organization. We therefore introduce a 2x3 typology of affordances by combining the two existing streams of affordance research as shown in Table 1.

<table>
<thead>
<tr>
<th>Actor's goal &amp; technology usage</th>
<th>Individualized goal &amp; individual use of technology</th>
<th>Common goal &amp; shared use of technology</th>
<th>Common goal &amp; collective use of technology</th>
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<tr>
<td>Actor</td>
<td>Individual actor</td>
<td>Individualized affordance</td>
<td>Shared affordance</td>
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<tr>
<td>Example from extant literature</td>
<td>(Benbunan-Fich 2018)</td>
<td>(Leonardi 2013; Vaast et al. 2017)</td>
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<tr>
<td>Organization as an actor</td>
<td>Individualized-organizational affordance</td>
<td>Shared-organizational affordance</td>
<td>Collective-organizational affordance</td>
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<tr>
<td>Example from extant literature</td>
<td>(Zammuto et al. 2007)</td>
<td>(Rehm and Goel 2017)</td>
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Table 1 - Extended multi-level typology of affordances

To elaborate on the previous discussion, we present an illustrative example and expand on our conceptualizations. The example is written based on a real-life series of events that happened when Uber was introduced to ACity, a semi-urban city in North America. We demonstrate how the introduction of Uber App as a digital artifact created new affordances for different actors in an ecosystem and how this introduction changed the dynamics and interaction among the actors within the ecosystem.

Uber started its services in ACity in 2015. Within the transportation ecosystem of ACity and before the introduction of UberTaxi, the city had two local taxi companies, which we refer to as ATaxi and BTaxi. Both ATaxi and BTaxi had been operating for decades and were regulated by ACity’s taxi commission. The operations of the taxi companies had been relatively unchanged for many years: taxi drivers traveled around the city looking for potential customers or waited for calls from a dispatcher who gave them addresses to go to in order to pick up clients. Both companies had introduced 2-way radio dispatch in the early 1950’s and had not transformed their operations significantly since then.

Upon the introduction of Uber to the city, residents started signing up as Uber drivers. Thus, Uber created an individualized affordance that enabled any individual resident with the individual goal of making some

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2 Pseudonyms are used in this illustrative example.
extra cash to be able to earn some money at their convenience without worrying about the city’s regulations or paying fees to the local taxi businesses. At the same time, Uber enabled customers to have a taxi service at their fingertips. Uber also provided customers with the affordance to write reviews about drivers with the collective goal of maintaining service quality. Thus, the interaction between the reviewing feature of Uber and individual residents created a shared affordance that enabled the residents, who were all using the reviewing feature similarly, to access a high-quality transportation service. Uber also created a collective affordance that allowed drivers and customers to review each other with the goal of maximizing their incentives but by using different features of the mobile application as an artifact.

Not to be left behind, the local government of BCity, which is a neighbor of ACity, replicated the innovation model of Uber and developed an application with which residents could request the city’s night bus to stop at a particular bus stop. This created an individualized-organizational affordance which enabled the local government of BCity to serve the residents better and get close to the goal of being a smart city. Further, the introduction of UberTaxi was perceived as a threat by the two taxi companies in ACity. Since ACity was a college town, a majority of the population were young students who appreciated the convenience of a mobile application. To compete against UberTaxi, ATaxi and BTaxi turned to Google and Apple platforms. Both companies leveraged the Google maps technology in an identical way to develop a mobile app that would allow them to compete against UberTaxi. Thus, the shared usage of Google maps by the two organizational actors created a shared-organizational affordance that enabled ATaxi and BTaxi to compete against UberTaxi. While the taxi companies used Google maps technology in a similar way, they used the other features of Google and Apple platforms quite differently and developed very distinct mobile applications. These mobile applications created a collective-organizational affordance that allowed the taxi companies to compete against UberTaxi.

Conclusion and Future Research Direction

In this conceptual research, we highlighted one of the challenges in applying technology affordance theory in its current form to digital innovation studies. We derived insights from the extant literature at the intersection of affordance theory and digital innovation. We described how to address a challenge in emergent research that examines affordances in the digital innovation area. Also, we explained how technology affordances are actualized through interactions between social entities, at different levels of granularity, and technology artifacts. Accordingly, we integrated and extended the existing conceptualizations of affordances and introduced a new typology of technology affordances that suits complex sociotechnical problems such as digital innovation. Finally, we also provided a real-life example to practically illustrate our 2x3 affordance typology. Our study not only addresses a theoretical gap and complexities involved in applying current affordance theory to newer forms of digital innovation but also presents new theoretical insights to provide fertile ground for future research.

In summary, in our study, we propose a typology of different technology affordances for individuals and organizations. In addition, we capture the relationships among technical objects, individual actors, and organizational actors within an ecosystem along with their individual, shared, and collective goals. In a future study, we propose to look within ecosystems to examine different types of potential interactions between individuals and organizations in ecosystems. Interactions between different individual and organizational entities of an ecosystem and the tensions among their collective goals and shared activities can be considered as a novel way to uncover other relationships within these ecosystems. Another future research opportunity will be to examine the ecosystem as an actor – “new structures of economic relationships” that acts collectively - by looking at its characteristics and relationships with digital technologies (Jacobides et al. 2018, p. 2258).
REFERENCES


