The Role of Actor Capability in (Re)Defining Technology Affordances: The Case of Open Innovation Platform

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Abstract. Scholars have strived for more than two decades to understand and conceptualized technology affordances. While some claim that affordances should be at the core of the HCI discipline, there is limited consensus regarding how to define and operationalized this concept. In recent developments in the IS literature, perceived affordances are operationalized as the relationship between the actor's goal and the technology's features. In this research, we refine the concept of affordances by incorporating the new factor of 'actor capability' and test this claim by introducing and validating a three-way interaction between goal, capability, and feature in an open innovation context. Our contribution provides a more nuanced yet powerful way of understanding technology affordances from both theoretical and practical perspectives.

Keywords: Affordances · Actor capability · Open innovation platform

1 Introduction

The technology affordance lens has been broadly utilized to explore and understand technology use and its behavioral consequences. However, interpretations of the affordances are becoming increasingly incompatible with Norman's original definition. Norman defined affordances as "the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (Norman 1999). Thus, the affordances of an artifact are the actor's mental representation of the artifact potential utilities (Faraj and Azad 2012). This cognitive process has been interpreted in IS discipline as the interaction between goal-oriented actor and an technical artifact (Majchrzak and Markus 2013; Markus and Silver 2008). While this interpretation could arguably denote the existence of functional affordances, it has limited relevance to design because of differentiating actors' perception merely based on their goals (Kaptelinin and Nardi 2012)

Furthermore, IS researchers argued that affordances could exist whether they are (immediately) perceived or not; however, affordances may not be actualized if actors do not perceive the existence of such affordances (e.g. Volkoff and Strong 2013). That means affordances are only potentials for actions and need to be perceived and then

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actualized by goal-oriented actors to achieve an outcome (Pozzi et al. 2014). This interpretation has been successfully used to explain actor behavior (Dong et al. 2016; Strong et al. 2014). Nevertheless, a few studies as yet focused on its limitations to inform design (e.g. Davis and Chouinard 2017).

In this paper, we argue that the interactions between technological features (defined by required functions) and actors' goals (defined by expected outcomes) cannot fully explain why so many designs fail while so few succeed. This fact calls for redefining affordances to meet the conceptual needs of new technology design and development. To this end, we first introduced a new approach to operationalize affordances based on the Norman's original interpretation. This new approach accounts for actors' capabilities in perceiving the potential utilities of an artifact. Then, we empirically verified this claim in the context of open innovation platform design. We concluded with a discussion of theoretical and practical implications of the findings.

2 Background

Norman was a pioneer who applied Gibson's affordance theory to technology design (Norman 1999). In his opinion, while actors do not necessarily participate in defining the properties of an artifact (designed affordances), they need to perceive the affordances of a design in order to actualize them (Norman 2013). Perceived affordances, or 'signifiers' in Norman's words, must be recognized by actors, else they fail to function (Norman 2013). Hence, perceived affordances is equally important, if not more than designed affordances, to achieve the design's goals (Fayard and Weeks 2014). Since then, evaluating the perceived affordances has become a common methodology in capturing actors' perception of technology and its applications (Bærentsen and Trettvik 2002; Pucillo et al. 2014).

In the IS field, perceived affordance is defined as a relational construct that depends on the interaction between a technological artifact and an actor's perception[1] (Leonardi 2013; Malhotra and Majchrzak 2012; Volkoff and Strong 2013). IS literature limited the relationship between actor and artifact to the actor's perception of action possibilities to achieve a particular goal (e.g. Markus and Silver 2008). Unfortunately, studies used the affordance lens for the purpose of system design did not typically account for diverse actor-artifact relations (Davis and Chouinard 2017). As a result, in these studies, an artifact either affords or do not afford a goal-oriented action regardless of the actor's capability in discovering or actualizing the affordances. One possible explanation for this false dilemma is the oversimplification of Norman's affordance concept. Researchers conceptualize affordance as a relational construct without accounting for the role of actors' capability or past experience in perceiving the possibilities (Norman 1999; Norman and Nielsen 2010). Lack of quantitative methods to examine the relationship between actors and technology features also limits researchers to highlight the relative value of each contributing factor (Michell 2013).

[1] In this paper, the term 'actor' is limited to individual user to emphasize the user active and central role in perceiving affordances.

Researchers argued that affordances should capture more accurately how actors perceive the action possibilities based on their past experience and current capability in technology-enabled environments (Bærentsen and Trettvik 2002; Pucillo et al. 2014). Each actor has a unique set of capabilities that could potentially influence how they perceive and actualize affordances (Cormier and Lewis 2015). However, previous studies failed to distinguish between 'capability to perceive' and 'capability to actualize' (Michell 2013). While we acknowledge that affordances exist independent from actualization (Anderson and Robey 2017), we argue their quality (not their existence) depend on actors' perception shaped by actors' goals as well as their capability. Therefore, the main goal of this paper is to propose and verify a quantitative method to model affordances beyond the relationship between goals and technology features by including actor capability in perceiving the affordances.

3 Research Context

In order to generate and empirically test affordance propositions, researchers argue that definition of affordances should be contextualized before applying the concept to a specific technological context (Malhotra and Majchrzak 2012). We chose open innovation context to verify the new definition since platform design is crucial to open innovation productivity and sustainability. Additionally, the existing models of affordances –mainly draw form collaboration literature– have not been evaluated to determine their applicability to the open innovation context (e.g. Sutcliffe et al. 2011). Therefore, using existing models may not support the design process and the results of such evaluation may not be comprehensive and valid. In response to these limitations, this paper verified the new operationalization in the context of open innovation platform. Due to the increasing adoption of social technologies in open innovation, this paper focus on the affordances of social product development platforms.

Open innovation business models democratize innovation by opening R&D process to creative crowds all over the world (Nambisan et al. 2017; Ramírez-Montoya and García-Peñalvo 2018). These distributed models of innovation have transformational capacity in helping businesses to develop and market new products within a short period of time (Barrett et al. 2015; Lee et al. 2012; Leenders and Dolfsma 2016). Open innovation platform is the key vehicle to recruit, organize, engage and motivate co-innovation teams (Hossain and Islam 2015). The study of open innovation platform affordances is an effective way to explain how actors perceive the co-innovation possibilities and realized the potential of open innovation environments (Abhari et al. 2017). This paper proposed a new way to operationalize affordance in order to evaluate the relationship between platform design and actor co-innovation activities. Drawing from Gloor's co-innovation model (Gloor 2006), we conceptualized co-innovation act as an actor's participation in ideation, collaboration, and socialization (Brown and Wyatt 2010; Cullen 2007; Füller et al. 2014; Kahnert et al. 2012; Piller et al. 2012). Open innovation platforms offer a variety of technology features affording these activities (Abhari et al. 2017; Gloor 2006; Sawhney et al. 2005). Therefore, we investigated three main affordances, namely ideation affordances, collaboration affordances, and socialization affordances.

Ideation affordances include the broad range of possible actions from submitting a new product idea to suggesting a new product updates. The ideation affordance is enabled by a group of features such as idea submission, revision, and resubmission forms, and idea development tools. Collaboration affordances relate to interdependent activities that allow for a large range of collaborative tasks from product development to product commercialization. Collaboration affordances rely on platform features such as evaluation and ranking forms, product improvement tools, and brainstorming tools. Lastly, socialization affordances enable activities such as discussing opinions, sharing knowledge, and asking for help or votes. Socialization affordances require social networking features such as profile creation and management pages, sharing and posting messages, and connecting and networking tools.

4 Hypothesis

A technology affordance was traditionally modeled as the interaction between the actors' goals and technology features (Wang et al. 2015). This approach is a well-established practice in both HCI and IS fields for measuring task-technology fit (e.g. Belanger et al. 2001). Wang et al. (2015) argued that researchers only need to measure the interaction between technology characteristics and individuals' goals to understand the influence of technology affordances on the consequences of technology use. We discussed that measuring technology affordances in this way represents a challenge to researchers since the relationship between goals and features are insufficient to explain the potential use and thereby misleading the design. In reality, we need not only goal-oriented actors but also qualified actors who will be able to perceive the potentials. This study tried to tackle this limitation by suggesting a third interacting variable. We named the new variable 'actor capability' that define how capable the actor is in discovering the potential use of an artifact.

The term capability is commonly referred to capacity to perform a task (e.g. Blomqvist and Levy 2006; Mathiesen et al. 2013; Michell 2013). From affordance perspective, actors should perceive a technology's potentials according to their goals and capabilities in order to create value (Michell 2013; Michell 2013; Ortmann and Kuhn 2010). Actor capability is defined by actors' past experience or prior knowledge about the environment or artifact affecting their perception (Norman 2013). Capability is different from 'goal' but it affects perceive affordances in the same way. This claim could be validated if the interaction between actors' goals, actors' capability and a particular group of features has a positive effect on the behavioral intention associated with those features. This three-way interaction suggests that the interplay between goals and technology features varies across different levels of the third variable, actor capability. In other words, the effect of technology features on actor behavior differs across various levels of goals as well as capability. From this perspective, affordance is still a relational construct between actor and artifact; however, actor can be conceptualized as an agent with different sets of goals and levels capabilities. For example, we can claim a platform affords ideation if the interaction between an actor's goals, her ideation capability, and platform ideation features perceived by actors has a positive effect on the ideation activity. At the same time, we do not expect the ideation

affordances has a significant effect on other behavioral domains such as collaboration and socialization. Thus, we hypothesize the following three-way interactions (Fig. 1):

H_1: *Actor Capability* positively moderates the relationship between *Goals* × *Ideation Features* and *Continuous Intention to Ideate* (but not Continuous Intention to Collaborate or Socialize).
H_2: *Actor Capability* positively moderates the relationship between *Goals* × *Collaboration Features* and *Continuous Intention to Collaborate* (but not Continuous Intention to Ideate or Socialize).
H_3: *Actor Capability* positively moderates the relationship between *Goals* × *Socialization Features* and *Continuous Intention to Socialize* (but not Continuous Intention to Ideate or Collaborate).

5 Methods

We tested the proposed three-way interaction using a social product development platform through a survey study. The survey items derived from the literature were adapted and modified in the context for this study. The Partial Least Squares Modeling approach was used to test the effects and statistical significance of the hypothesized pathways in the structural mode.

5.1 Sample

The data for the field survey were collected from a random sample of Quirky members. Quirky is an open innovation platform soliciting new product ideas and sharing a portion of the sales revenue with the community of innovators who contribute to product ideation as well as product selection, design, development, and promotion. Quirky is one of the first companies to implement such a model on a social media platform (Piller et al. 2012; Roser 2013). Quirky compensates the individual contributors involved in the product's innovation process by paying community 50% of royalty revenue for each product. As of 2018, more than 1.2 million members had collaboratively developed 150 consumer products and collectively received about $11 million in royalties. This case demonstrated a prototypical and, at the same time, comprehensive model of open innovation due to the high levels of actor involvement and the variety of co-innovation processes and tools (Abhari et al. 2016).

5.2 Measurements

Goal construct was measured using a second-order construct with five dimensions: Financial gain, Recognition, Learning, Networking, Enjoyment, and Altruism. The items for these three dimensions were adopted from previous studies on open innovation networks (Abhari et al. 2018; Antikainen et al. 2010; Antikainen and Vaataja 2010; Battistella and Nonino 2012, 2013; Kahnert et al. 2012). Platform *features* were measured by three constructs developed especially for this study, in reference to the

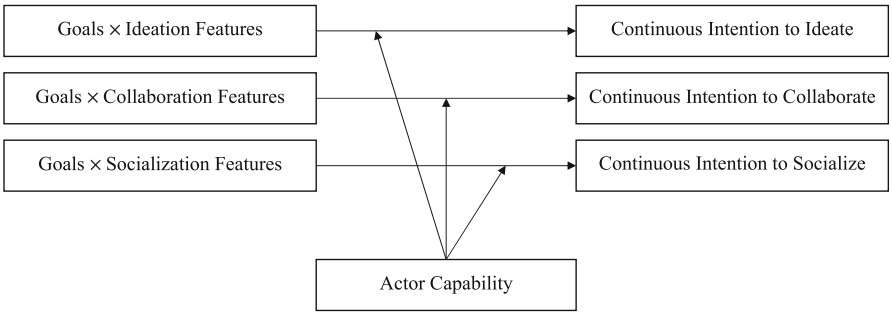

Fig. 1. Research model with three-way interactions between goals, features and capability (Other relationships are not presented for the sake of simplicity)

three key processes of social product development (i.e., ideation, collaboration, and socialization). Three constructs of *ideation features*, *collaboration features*, and *socialization features* were developed based on recent studies on sociotechnical features of collaborative virtual environments (Kreijns 2004; Sutcliffe et al. 2011; Wellman et al. 2003; Zebrowitz 2011). To emphasize the contextual nature of affordances, we slightly modified some items. The measurement items for three behavioral intention, were adapted from the studies on continuous behavioral intention in virtual collaborative communities (Bhattacherjee 2001; Chen 2007; Zhang et al. 2010). To model *actor capability*, we used actors' open innovation accumulated experience (self-report) as a proxy for their capability to perceive the potential uses of features. Actor goals, platform features, and continuous intention constructs were measured using seven-point scales using "strongly disagree" to "strongly agree" as the anchors.

5.3 Analysis

We used SmartPLS to test the effects and statistical significance of the hypothesized pathways in the structural model (Ringle et al. 2015). For estimating the second order construct (goal), we followed two-step process suggested by Anderson and Gerbing (1988) to estimate the latent variable and used these aggregate measures as indicators for the second order construct in the second step. To estimate the three-way interaction effects, we also estimated and saved the latent variable scores of the two-way effects, and then entered them as indicators of the associated two-way constructs in the model estimated. This analysis explained how affordances –as defined in this study– affect the behavioral intention by showing how the moderated relationships between goals and features behave under different scores of the second moderator (actor capability).

6 Findings

From 1000 randomly invited Quirky members, 261 members participated in this study. Demographic data analysis shows that respondents varying in gender, age, education, and employment were included in the sample. The comparison of sample's

co-innovation experience and contributions with the population's indicated no nonresponse bias. Most respondents had participated in Quirky ideation (82%), collaboration (100%), and socialization (85%) activities. More women (59%) participated in the survey compared to men (41%). Most the respondents were between 26 and 65 years old (84%), and over 70% had at least some college education. Nearly 60% of the respondents were employed outside of their participation in open innovation network.

6.1 Measurement Model

The evaluation of measurement items was conducted first. All the loadings of measurement items on their latent constructs exceed 0.7, indicating acceptable item reliability (Hair et al. 2013). In addition, the Cronbach's alpha and composite reliability of all the constructs are higher than 0.7, indicating good internal consistency among the items measuring each construct (Hair et al. 2013). Three tests were conducted to determine convergent validity and discriminant validity: (1) all Average Variance Extracted (AVE) is higher than 0.50 (Hair et al. 2013); (2) the square root of the AVE of each constructs is larger than the correlations of this construct with the other constructs (Fornell and Larcker 1981); and (3) the correlations among all constructs (i.e., inter-construct correlations) are all well below the 0.90 threshold (Hair et al. 2013). The results of these tests suggest adequate convergent and discriminant validity. Because common method bias is a concern when utilizing a survey instrument to measure both independent and dependent variables, Harman's one-factor test was used to assess this potential problem. These results suggested common method bias was not a problem.

6.2 Structural Model

We focused on the comparisons between the current definition of affordances (Goals × Features) and the proposed definition (Goals × Features × Capability). Our results supported the baseline model as actors' goals and perception of platform feature positively influence the degree to which the actor intent to continuously ideate, collaborate, and socialize. However, explaining the variations in other relationships is not the main purpose of this paper.

H_1 proposed a three-way interaction of Goals, Ideation Features, and Capability on Continuous Intention to Ideate. As expected the empirical data show that this three-way interaction is positive and significant ($b = 0.15$, $p < 0.05$), thus supporting this hypothesis. The relationships between this three-way interaction and other two intention constructs (collaboration and socialization) were not supported. The results did not support the positive relationship between the two-way interaction of Goals and Ideation Features –as suggested by previous studies– on Continuous Intention to Ideate. Therefore, we conclude that Platform Ideation Affordances is a function of actors' goals, actor capability, and platform ideation features predicating actors' intention to ideate.

H_2 proposed a three-way interaction of Goals, Collaboration Features and Capability on Continuous Intention to Collaborate. As expected, the three-way interaction is positive and significant ($b = 0.22$, $p < 0.001$), thus supporting H2. However, the relationships between this three-way interaction and other two intention constructs

were not supported. The results also did not support the positive relationship between the two-way interaction of Goals and Collaboration Features on Continuous Intention to Collaborate. Therefore, we conclude that Platform Collaboration Affordances is a function of actors' goals, actor capability, and platform collaboration features predicating actors' intention to collaborate.

H_3 proposed a three-way interaction of Goals, Socialization Features and Capability on Continuous Intention to Socialize. As expected, the three-way interaction is positive and significant ($b = 0.20$, $p < 0.01$), thus supporting H3. However, the relationships between this three-way interaction and other two intention constructs were not supported. The results did not support the positive relationship between the two-way interaction of Goals and Socialization Features on Continuous Intention to Socialize. Therefore, we conclude that Platform Socialization Affordances is a function of actors' goals, actor capability, and platform socialization features predicating actors' intention to socialize.

7 Discussion and Conclusion

We conducted an empirical investigation to theorize affordances in open innovation context. The review of the common approaches to modeling perceived affordances revealed that actor capability was typically overlooked in the operationalization of this concept. Nonetheless, capability is the major contributing factor to the perception of action possibility. We compared the predictive validity of a prototypical operationalization of affordances (interaction between goals and features) with our new model that includes the interaction between goal, capability, and features. Our results supported that the new operationalization could better capture the actor's perception of platform affordances and thereby predict their behavioral intention. The findings also provide a better understanding of platform design in the context of open innovation.

7.1 Theoretical Implications

We have introduced a new way to operationalize perceived affordances in order to explain regularities in actor behavior in the context of open innovation platforms. The results show that these effects are more complex than anticipated given the different results for two-way (Goal × Features) and three-way (Goal × Features × Capability) interactions. We found no support for a positive effect of affordances as traditionally defined (Goal × Features) on behavioral intention. A closer inspection reveals that capability affects the relationship between Goal × Features and behavioral intention constructs associated with the key features (i.e. ideation, collaboration, and socialization). A possible explanation for this result is that the goal-oriented actors with higher capabilities respond to the platform features with higher intention than their counterparts with lower capabilities because of ability to perceive the possibilities. This might imply that mere alignment between a platform's features and actor's goal would result in a platform full of features satisfying different goals rather than more participation. This is consistent with our argumentation that including actors' capabilities in defining

a platform's affordances would ensure a better design by making right adjustments and customization of features.

In the context of this study, our results suggest that open innovation design strategy should entail a better understanding of the alignment between actors' goals and actors' capabilities in terms of knowledge, skills, qualifications and past experience. As open innovation platforms increasingly adopt social technologies to engage more actors, we call for further research drawing on affordance theory. This should result in a more user-centered design of the platforms and thereby the effectiveness of open innovation practices.

7.2 Practical Implications

Our use of capability to operationalize affordances represents a design perspective which argues designing features for satisfying goals is likely to result in superficial adoption and thus lower long-term application. This would benefit the practitioners towards a better understanding of platform design. We propose six-step process for platform design evaluation based on the findings of this study: (a) Identify existing system key features, (b) Identify actors' goals and capabilities, (c) Determine the two-way and three-way interactions between features, actors' goals and capabilities (d) Determine the associations between the interacting factors and behavioral intention constructs, and (e) Interpret the results using the following guide. We argue that positive two-way and three-way interaction coefficients demonstrate a proper alignment between the platform features and actors' goals and capability. No significant relationship suggests inconclusive results or inconsequential effect of affordances on user behavioral intention. In case of a negative coefficient, the platform owner may want to A/B testing the platform with new features or a new reward system depending on the coefficient of two-way interactions. A negative coefficient for Goals $\times$ Features suggests misalignment between goals and platform features. A negative coefficient for Goals $\times$ Capability suggests the necessity of improvement in the reward system. A negative coefficient for Capability $\times$ Features suggests misalignment between actors' capabilities and platform features. This approach would help platform owners to engage either the current actors with offering new features or new actors with a different set of goals and capabilities.

In the context of this study, our findings suggest that affordance lens can still contribute to our understanding of the effectiveness of platform design. However, our study shows that limiting affordances to the relationship between goal-directed actors and platform features can reduce open innovation platforms' ability to fully engage the actors in ideation, collaboration, and socialization. Open innovation platform designers, therefore, need to pay more attention to the actors' capabilities for evaluation of platform features. Misalignment between actors' goals and capabilities and platform features may jeopardize reaping benefits from open innovation platforms. That is why a significant number of platforms, even those with meticulously designed features, tend to gain less in co-innovation when they engage an inexperienced group of actors.

References

Abhari, K., Davidson, E.J., Xiao, B.: Taking open innovation to the next level: a conceptual model of social product development (SPD). In: The 22nd Americas Conference on Information Systems, San Diego (2016)

Abhari, K., Davidson, E.J., Xiao, B.: Co-innovation platform affordances: developing a conceptual model and measurement instrument. Ind. Manag. Data Syst. **117**(5), 873–895 (2017)

Abhari, K., Davidson, E.J. Xiao, B.: Classifying motivations in social product development networks : a discriminant analysis of actor profiles. In: The 51st Hawaii International Conference on System Sciences (2018)

Anderson, C., Robey, D.: Affordance potency: explaining the actualization of technology affordances (2017)

Anderson, J.C., Gerbing, D.W.: Structural equation modeling in practice: A review and recommended two-step approach. Psychol. Bull. **103**(3), 411–423 (1988)

Antikainen, M.J., Mäkipää, M., Ahonen, M.: Motivating and supporting collaboration in open innovation. Eur. J. Innov. Manag. **13**(1), 100–119 (2010)

Antikainen, M.J., Vaataja, H.K.: Rewarding in open innovation communities–how to motivate members. Int. J. Entrep. Innov. Manag. **11**(4), 440–456 (2010)

Bærentsen, K.B. Trettvik, J.: An activity theory approach to affordance. In: Proceedings of the Second Nordic Conference on Human-Computer Interaction, pp. 51–60 (2002)

Barrett, M., Davidson, E.J., Vargo, S.L.: Service innovation in the digital age: key contributions and future directions. MIS Q. **39**(1), 135–154 (2015)

Battistella, C., Nonino, F.: What drives collective innovation? exploring the system of drivers for motivations in open innovation, web-based platforms. Inf. Res. **17**(1), 1–33 (2012)

Battistella, C., Nonino, F.: Exploring the impact of motivations on the attraction of innovation roles in open innovation web-based platforms. Prod. Plann. Control **24**(2–3), 226–245 (2013)

Belanger, F., Collins, R.W., Cheney, P.H.: Technology requirements and work group communication for telecommuters. Inf. Syst. Res. **12**(2), 155–176 (2001)

Bhattacherjee, A.: Understanding information systems continuance: an expectation-confirmation model. MIS Q. **25**(3), 351–370 (2001)

Blomqvist, K., Levy, J.: Collaboration capability–a focal concept in knowledge creation and collaborative innovation in networks. Int. J. Manag. Concepts Philos. **2**(1), 31–48 (2006)

Brown, B.T., Wyatt, J.: Design thinking for social innovation. Stanf. Soc. Innov. Rev. **12**(1), 30–35 (2010)

Cormier, P., Lewis, K.: An affordance-based approach for generating user-specific design specifications. Artif. Intell. Eng. Des. Anal. Manufact. **29**(3), 281–295 (2015)

Chen, I.Y.L.: The factors influencing members' continuance intentions in professional virtual communities a longitudinal study. J. Inf. Sci. **33**(4), 451–467 (2007)

Cullen, J.: Information work and the opportunity of innovation: from corporate to social product development. Bus. Inf. Rev. **24**(3), 156–160 (2007)

Davis, J.L., Chouinard, J.B.: Theorizing affordances: from request to refuse. Bull. Sci. Technol. Soc. **36**(4), 27046761771494 (2017)

Dong, X., Wang, T., Benbasat, I.: IT affordances in online social commerce : conceptualization validation and scale development full papers. In: AMCIS 2016 Proceedings, pp. 1–10 (2016)

Faraj, S., Azad, B.: The materiality of technology: an affordance perspective. In: Leonardi, P.M., Nardi, B.A., Kallinikos, J. (eds.) Materiality and Organizing: Social Interaction in a Technological World, pp. 237–258. Oxford University Press, Oxford (2012)

Fayard, A.L., Weeks, J.: Affordances for practice. Inf. Organ. **24**(4), 236–249 (2014)

Fornell, C., Larcker, D.F.: Structural equation models with unobservable variables and measurement error: algebra and statistics. J. Mark. Res. **18**(3), 382 (1981)
Füller, J., Hutter, K., Hautz, J., Matzler, K.: User roles and contributions in innovation-contest communities. J. Manag. Inf. Syst. **31**(1), 273–308 (2014)
Gloor, P.A.: Swarm Creativity: Competitive Advantage Through Collaborative Innovation Networks. Oxford University Press, New York (2006)
Hair, J.F., Hult, G.T.M., Ringle, C., Sarstedt, M.: A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM). SAGE Publications, Thousand Oaks (2013)
Hossain, M., Islam, K.M.Z.: Ideation through online open innovation platform: dell ideastorm. J. Knowl. Econ. **6**(3), 611–624 (2015)
Kahnert, D., Menez, R., Blättel-Mink, B.: Coordination and motivation of customer contribution as social innovation: the case of crytek. In: Franz, H.W., Hochgerner, J., Howaldt, J. (eds.) Challenge Social Innovation: Potentials for Business, Social Entrepreneurship, Welfare and Civil Society, pp. 293–306. Springer, New York (2012). https://doi.org/10.1007/978-3-642-32879-4_18
Kaptelinin, V., Nardi, B.: Affordances in HCI: toward a mediated action perspective. In: Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems, pp. 967–976 (2012)
Kreijns, K.: Sociable CSCL Environments: Social Affordances, Sociability, and Social Presence. Datawyse Boek-Grafische producties, Maastricht (2004)
Lee, S.M., Olson, D.L., Trimi, S.: Co-innovation: convergenomics, collaboration, and co-creation for organizational values. Manag. Decis. **50**(5), 817–831 (2012)
Leenders, R.T.A.J., Dolfsma, W.A.: Social networks for innovation and new product development. J. Prod. Innov. Manag. **33**(2), 123–131 (2016)
Leonardi, P.M.: When does technology use enable network change in organizations? a comparative study of feature use and shared affordances. MIS Q. **37**(3), 749–776 (2013)
Majchrzak, A., Markus, M.L.: Technology affordances and constraint theory of MIS. In: Kessler, E. (ed.) Encyclopedia of Management Theory, pp. 832–835. Sage, Thousand Oaks (2013)
Malhotra, A., Majchrzak, A.: Use of collaborative technology affordances to innovate virtually. In: European Conference on Information Systems (ECIS), Barcelona (2012)
Markus, M.L., Silver, M.S.: A foundation for the study of IT effects: a new look at DeSanctis and Poole's concepts of structural features and spirit. J. Assoc. Inf. Syst. **9**(10/11), 609–632 (2008)
Mathiesen, P., Bandara, W., Watson, J.: The affordances of social technology: a BPM perspective. In: International Conference on Information Systems (ICIS 2013), pp. 3709–3719 (2013)
Michell, V.: The capability affordance model: comparing medical capabilities. In: Shishkov, B. (ed.) BMSD 2012. LNBIP, vol. 142, pp. 102–124. Springer, Heidelberg (2013). https://doi.org/10.1007/978-3-642-37478-4_6
Nambisan, S., Lyytinen, K., Majchrzak, A., Song, M.: Digital innovation management: reinventing innovation management research in a digital world. MIS Q. **41**(1), 223–238 (2017)
Norman, D.A.: Affordance, conventions, and design. Interactions **6**(3), 38–43 (1999)
Norman, D.A.: The Design of Everyday Things: Human Factors and Ergonomics in Manufacturing. Basic Books, New York (2013). https://doi.org/10.1002/hfm.20127
Norman, D.A., Nielsen, J.: Gestural interfaces: a step backward in usability. Interactions **17**(5), 46–49 (2010)
Ortmann, J., Kuhn, W.: Affordances as qualities. Front. Artif. Intell. Appl. **209**, 117–130 (2010)
Piller, F., Vossen, A., Ihl, C.: From social media to social product development: the impact of social media on co-creation of innovation. Die Unternehm. **65**(1), 7–27 (2012)

Pozzi, G., Pigni, F., Vitari, C.: Affordance theory in the IS discipline: a review and synthesis of the literature. In: 2014 Twentieth Americas Conference on Information Systems, Savannah, vol. 13, pp. 1–12 (2014)

Pucillo, F., Cascini, G., Milano, P., Giuseppe, V., Masa, L.: A framework for user experience, needs and affordances. Des. Stud. **35**(2), 160–179 (2014)

Ramírez-Montoya, M.S., García-Peñalvo, F.-J.: Co-creation and open innovation: systematic literature review. Comunicar **26**(54), 09–18 (2018)

Ringle, C., Wende, S., Becker, J.: SmartPLS 3, Boenningstedt: SmartPLS GmbH (2015). http://www.smartpls.com

Roser, T.: Managing your co-creation mix: co-creation ventures in distinctive contexts. Eur. Bus. Rev. **25**(1), 20–41 (2013)

Sawhney, M., Verona, G., Prandelli, E.: Collaborating to create: the internet as a platform for customer engagement in product innovation. J. Interact. Mark. **19**(4), 4–17 (2005)

Strong, D.M., Johnson, S.A., Tulu, B., Trudel, J., Volkoff, O., Pelletier, L.R., Bar-on, I., et al.: A theory of organization-EHR affordance actualization. J. Assoc. Inf. Syst. **15**(2), 53–85 (2014)

Sutcliffe, A.G., Gonzalez, V., Binder, J., Nevarez, G.: Social mediating technologies: social affordances and functionalities. Int. J. Hum.-Comput. Interact. **27**(11), 1037–1065 (2011)

Volkoff, O., Strong, D.: Critical realism and affordances: theorizing IT-associated organizational change processes. MIS Q. **37**(3), 819–834 (2013)

Wang, N. (Tina), Carte, T., Schwarzkopf, A.: How should technology affordances be measured? an initial comparison of two approaches. In: Twenty-First Americas Conference on Information Systems, pp. 1–14 (2015)

Wellman, B., Quan-Haase, A., Boase, J., Chen, W., Hampton, K., De Diaz, I.I., Miyata, K.: The social affordances of the internet for networked individualism. J. Comput.-Mediated Commun. **8**(3), 1–28 (2003)

Zebrowitz, L.A.: The affordances of immersive virtual environment technology for studying social affordances. Psychol. Inq. **13**(2), 143–145 (2009)

Zhang, Y., Fang, Y., Wei, K.-K., Chen, H.: Exploring the role of psychological safety in promoting the intention to continue sharing knowledge in virtual communities. Int. J. Inf. Manag. **30**(5), 425–436 (2010)