Innovation & Open Online Communities: A Network Perspective

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Abstract

Innovation is an important source of a firm's competitiveness but innovation is increasingly being understood as the product of interacting networks of firms rather than their independent efforts. Research has examined the nature and role of networks in innovation in various contexts and how it can be managed. One under-researched but increasingly important, form of innovation, in which network interactions play a key role is the development of new software applications or apps, in online communities. This form of innovation lends itself to research because it is accessible, provides information about the network of participants and their interactions over time and the sequences of resulting innovations. We describe how online communities can be studied to test various network based propositions about innovation as well as the effects of contextual factors.

Keywords: innovation, online communities, innovation networks, innovation processes, open innovation

Track: Industrial Marketing

1.0 Introduction

Innovation plays an important role in sustaining a firm's competitiveness (Lee, Smith, and Grimm 2003; Gyer et al. 2009; Cho and Pucik 2005; Hult et al. 2004; Stock and Zacharias 2011) and is an important area of research spanning many different disciplines, including marketing, international business, engineering, economics, management, entrepreneurship and technological development. A significant and fast growing type of innovation is the development of software programs or applications, apps, to provide value for people and organisations. An important way this occurs is through the use of online communities of users, enthusiasts and researchers. Surprisingly, the way innovation takes place in online communities has not been the subject of much research, even though many of them are open communities in which information on the pattern of development of apps and the communications taking place among participants over time is readily available. In addition they have been used by a large number of organisations in the technology sector for product development. Of particular relevance here is that these communities provide a valuable and accessible opportunity to study the role of network interactions in the innovation process, which are increasingly being seen as the way innovations occur.

The purpose of this paper is to contribute to our understanding of innovation in online communities and the role of network interactions among participants. We first review theories of the innovation process, highlighting the role of relations and networks. Second, we develop propositions about the innovation processes in online communities and contextual factors likely to affect these processes. Third, we describe a research methodto test and identify the impact of contextual factors. Finally we discuss the implications for further research and practice.

2.0 Theories of Innovation

Innovation can be described as "the successful implementation of creative ideas" (Amabile 1996, 8). Past research on innovation has focused on identifying the characteristics of innovations, people

and organisations that innovate, and how to manage innovation. Innovation has been classified in 3 main ways: (1) product or service (technical) innovations; (2) process innovations; or (3) a new form of market organisation (Schumpeter 1934). Innovations have also been distinguished in terms of whether they are incremental or radical (Schumpeter 1934 ; Damanpour 1991) and how disruptive they are to existing methods of production and distribution (Christensen 1997).

Earlier theories of innovation tended to explain the process in magical ways as the product of lone geniuses having Eureka moments and the focus of research and theory was on the characteristics of individual people and firms, who were innovative, creative and entrepreneurial and how to manage research and development within firms. Innovation was seen as a linear process of invention and commercialisation, as evident in stage-gate models of the way new products and services are invented in R&D departments and then developed and refined over time by progressing through various stages in various departments, such as manufacturing and marketing, until the product/service is launched into the market (Cooper 1990). Innovation and creativity were viewed as "something done by creative or [innovative] people[/organisations]" (Amabile 1996, 1). Research also examined the motivations of innovative individuals and firms (Fariborz Damanpour and Evan 1984; Manu 1992; Laursen and Salter 2006; Stock and Zacharias 2011; Quintane et al. 2011) and how to increase a firms innovativeness and innovation orientation (Manu 1992).

Three main perspectives of the nature of innovation have emerged. The first sees innovation as a cyclical pattern of trial and error (March and Olsen 1975, Cohen and Sproll 1991) and sense making engaged in by organisations (Weick 1979; Brunsson 1982). The second sees innovation as a purely random process where an organisation simply plays a reactive role and must take as many chances as possible (Cohen, March, and Olsen 1972; Hannan and Freeman 1989; Tushman and Anderson 1986). The third sees innovation as a nonlinear dynamic system that is chaotic, in that the "process" is both random and structured at different points in time (Cheng and Ven 1996).

More recently theories of innovation have come to the view that any person "with normal capacities [is] able to produce at least moderately creative work" (Amabile 1996, 1). New ideas do not emerge from nothing, they result from the combing and recombining of knowledge and ideas that already exist (Koestler 1989; Romer 1990; Robinson 2011). Therefore innovative ideas are created through the combination of innate creativity and prior knowledge (Allen 1977; Bjork 2009; Shane 2000) and the successful implementation of the produced ideas (Van de Ven 1986)

A person's or firm's ability to innovate is now explained more in terms of their connections with others, and the way they are positioned in relations and networks that enable them to discover, develop and exploit opportunities for change. Through their interactions with others over time, people and firms gain access to the knowledge and resources that allow them to innovate (Lee et al. 2010; Von Hippel 2007; Mick, Bateman, and Lutz 2009). People acquire their knowledge, and therefore form and refine their ideas, through informal knowledge networks and by interacting with other individuals (Brown and Duguid 1991; Wenger and Snyder 2000; Burt 2004). In the internet age, informal knowledge networks have been produced through the use of online forums, wikis and blogs which have developed online communities. These informal knowledge networks have been pointed out as highly important for learning and innovation (see, e.g., Amabile 1996; Quintane et al. 2011; Robinson 2011). The creativity of individuals when collaborating in a group is claimed to be enhanced, leading to what has been termed "collective creativity" (Hargadon and Bechky 2006, 489) as result of the effect interactions have on people's ability to absorb and choose between alternative ideas and link them to their existing ideas (Burt 2004).

A network perspective on innovation is consistent with the development of network theories of business and markets, in which the behaviour and performance of firms are explained more in terms of the relations and networks in which they operate (Wilkinson 2008). The role and functions of

relations include access to information and ideas and collaborative opportunities in the development of products and services.

The role and importance of relations in innovation is evident in dyadic models of managing open innovation including cocreation of value through working with customers, suppliers and lead users. Lead users are users who have needs that are not being satisfied by the market and which in time will be "mainstream" needs (Von Hippel 1986). Studies suggest that innovations created and developed by working with lead users are more commercially attractive in terms of providing increased profit and market potential (Von Hippel 1986; Lüthje and Herstatt 2004).

More network rather than dyadic focused models of managing innovation are based on creating numerous external ties to tap into for the purposes of innovation. These include network positioning strategies in which firms try to keep many weak links to SMEs and other start-ups in order to suck up good ideas (Chesbrough and Appleyard 2007;Powell and Koput 1999; Powell and White 2005). Other examples are crowd sourcing (Howe 2006), open innovation (Chesbrough 2003) and online communities.

Crowdsourcing is a model for managing innovation where an "open call" is made to large groups of people and organisations (crowds) to complete some value adding activity for the organisation. The value exchange in this case is weighted towards the organisation as the crowd, in many ways, are acting as if they are outsourced workers for the organisation (Howe 2006). Crowd sourcing takes four primary forms: 1) crowd wisdom or collective intelligence, in which the crowd is used for the purpose of providing ideas and feedback about an organisaiton's services, products or brand; 2) crowd creation or user-generated content, in which the crowd is used to provide content that organisations can use; 3) crowd voting, where the feedback of crowds is used as a quality mechanism; 4) crowdfunding, in which pledges of funding is sought from a large amount of individuals (Howe 2006). Crowd sourcing is a method by which users, customers and consumers are formed into business knowledge networks to benefit an organisation's activities.

Open innovation is also a way of managing innovation which focuses on creating ties with users, consumers and customers.What it is exactly has been subject to some confusion (Giudice, Peruta, and Carayannis 2013), and how it differes from user-innovation, distributed innovation, collegial innovation and crowdsourcing is questioned. Some scholars, such as Trott & Hartmann (2009), claim that the concept is simply "old wine in a new bottle" and no different to the network model of innovation posited earlier by Rothwell and Zegveld (1985). Open innovation can be dintinguished from crowdsourcing in that the model refers to the opening of an internal network with an external network for the process of innovation. Crowd sourcing, in comparison, focuses on how this 'opening' is done. Open innovation, or the networked model of innovation, is being used by companies through the use of crowd sourcing and cocreation of value to increase innovation.

3.0 Online Communities

The implementation of open innovation is evident in open online communities, which allow users to freely collaborate with others and benefit from ideas, feedback and code sharing (Gassenheimer, Siguaw, and Hunter 2013). Open online communities are the focus of this paper. They are an economically significant research context that is growing fast. And provide unique opportunities for researching innovation and the role of networks, as they provide publicly accessible information about the processes and interactions among participants over time and the pattern of innovations resulting. They can also be used as the basis for follow-up research. But have been the subject of only limited research to date.

The focus of research in this area has been mostly on what motivates participants to contribute, and how organisations can manage these communities. How innovation occurs within these communities, which are used by many but controlled by no one, has not been explored much. Moreover, how the motivations of participants and who participates over time varies has been given scant research attention – none to our knowledge.

Online communities have been used to produce collective creativity and as a source of ideas for new product development (Kozinets 2002; Prahalad and Ramaswamy 2004; Von Hippel 2005). It is through collaboration with others from a wide variety of different backgrounds in these online communities that collective creativity, creativity which is distinctly generated as a result of social interactions, is claimed to be unleashed (Hargadon and Bechky 2006). Examples of online communities used for product development include www.github.com and www.sourceforge.com.

Online communities are a form of networked innovation, that also produce a form of "swarm intelligence" where "no one is in charge", but "complex tasks are solved" (Gloor 2006, 20). Participants' knowledge is combined and recombined with other participants' knowledge, creating a pool of knowledge greater than the knowledge possessed by any individual in the community. At any one time individuals in online communities are progressing through different stages of the innovation processes. During this process an individual's own ideas are being altered by viewing others ideas and or through feedback. Whilst at the same time individuals own ideas are built upon by others. Online communities involve a complex, non-linear, network process of innovation by multiple individuals, as depicted in Figure 1. We argue that viewing innovation in this way provides a deeper insight into the process of innovation and how the participants interact with one another within the community over time will impact on the types and sequences of innovations produced. Some of the attributes of online communities which make them a source of innovation are summarised in Figure 2.

Figure 1-Simplified model of innovation process

Online communities may be distinguished in terms of whether participants can freely pariticipate or not. Open communities are ones in which any person may become a part of and contribute to the community, e.g. open projects on sugarforge.com.au. Or they may be closed, with only certain people able to join. Collaboration and participation in closed communities is based on meeting prior criteria, for example the paying of a fee or being a member of an organisation. The focus here is on open online commuities. Existing research on innovation within open online communities has focused on what motivates participants (e.g. Antikainen et al. 2010). The relationship between motivation and the types of innovation produced has not been explored. This leads to our first proposition that participants who are highly intrinscially motivated are likely to apply greater effort in acquiring necessary skills for their chosen activity (Amabile 1996; Harter 1978) and lead to more commercially successful innovations: *Proposition 1: Communities where intrinsic rewards are the main motivating factor for particpants will produce more commercially successful innovations.*

The size of the online community and the mix of types of participants are also likely to have an impact, such as the mix of potential and actual users, programming enthusiasts, professionals and software producers and suppliers. Based on Bagozzi and Dholakia (2006) suggestion that a certain number of participants in a community is needed before social influences impact user participation, we propose: *Proposition 2: There is a positive association between the number of participants in online communities and the number of commercially successful innovations*

Figure 2-Attributes of open online communities beneficial to innovation

During Ideation Process	During Idea Development Process
Access to More Ideas: **Low barriers** for consumers **to contribute** leading to **easy access** to a mass of **consumers** & **Swarm intelligence** (Gloor 2006). Access to Commercially Superior Ideas: **Collective creativity** (Kozinets 2002; Von Hippel 2005), access to more **lead users** (Lüthje & Herstatt 2004) & better documentation of consumers' needs.	Access to More Valuable Feedback: Access to mass of consumers with **greater motivation** to provide feedback (Antikainen & Vaataja 2010). More Easily Disseminated Feedback: Contributions are traceable & more easily communicated between participants.

We propose a general proposition about the impact of different mixes of participants: *Proposition 3: The number of commercially successful innovations will depend on the mix of types of participants in an online community*

Another research question is the effect of contextual factors on the innovation process and the types of innovations produced. Online communities are particular forms of networks in which interactions are limited and anonymised, participation is open (or not) and the innovations concern software, which has its particular characteristics, such as programming language, modularity, platform etc. At this stage of research no specific hypotheses are proposed and it is more a matter for exploratory research, although we do expect there will be some differences from other network innovation contexts. Hence we propose the following general proposition: *Proposition 4: The innovation process in online communities will differ from those in non internet based communities*

The characteristics of those who participate in online innovation communities, in addition to their motivations, is itself a further research question. How frequently do different types of people participate? What is their background? What are the effects of their participation on other aspects of their life? Is online participation addictive in some way? All these questions remain to be answered.

4.0 Researching Online Communities

In order to examine the role and importance of network interactions in software innovations in online communities and to test the propositions advanced we need to design an appropriate research method. Here we describe the methods we are using in our own research. The research focuses on three open online communities operating via the Github project management system. The communities were selected based on the number of online posts and to represent different types of software domains. The online communications are downloaded for text analysis and the patterns of interactions and innovations are mapped over time. A short online questionnaire is sent to all participants which asks about their motivations, background, contribution, attitudes to and participation in online communities. Finally, a follow up semi-structured interview will be conducted with respondents to the survey willing to cooperate. The research is currently underway and some of the results will be presented at the conference.

5.0 Conclusion

Open online communities are a commercially valuable source of innovation for organisations and more research is required to better understand this increasingly important form of innovation and how it can be managed effectively. They also provide a valuable opportunity to study the role and importance of networks in innovation. There is a potentially rich source of research data available, which is accessible and allows the content and pattern of interactions over time and the sequence of innovations resulting to be mapped and analysed. Research here will contribute to a better

understanding of this new form of innovation and suggest opportunities for further research. Identifying some of the characteristics of online communities and how they function in the innovation process will also provide practical implications for the management of them.

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