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The Role of Information Technology in Enabling Open Innovation: Complementarity or Substitutability?

Reza Ghaffari[*], *Benoit Aubert*[†]

Résumé/abstract

This paper conceptualizes the role (complementarity or substitutability) of a set of IT-enabled capabilities in effectively facilitating inbound open innovation - the strategy to open up the organization's internal innovation process to external ideas and partners. These IT-enabled capabilities have been argued to contribute significantly to innovation in organizations.

Mots clés/keywords : Innovation, Open innovation, Information Technology, IT capabilities

[*] Department of Information Technology, HEC Montréal, Montréal, Canada. Reza.Ghaffari@hec.ca. +1 (438) 993 7401.
[†] School of Information Management, Victoria University of Wellington, Wellington, New Zealand and CIRANO, Montreal, Canada. Benoit.Aubert@vuw.ac.nz. +64 (4) 463 5421.

I. Introduction

In the current turbulent economy and business environment, innovation has been considered essential for firms' survival and sustaining competitive advantage in the long run (Ahuja, Lampert, & Tandon, 2008; Zahra & Covin, 1994). Recently, firms are recommended to take an open approach toward their innovation process and try to innovate in collaboration with their external partners, such as customers, suppliers, or any other individual or organization that can provide valuable ideas or can complement the firm's innovation activities. This approach, called open innovation, has gained popularity in the last decade. Several mechanisms have been proposed to implement this strategy: some of them represent the outside-in flow of knowledge from external partners to complement the firm's innovation (e.g., customer focus groups), and some of them represent the inside-out flow of knowledge to external partners to realize or accelerate commercialization of new ideas (e.g., selling intellectual property) (Gassmann & Enkel, 2004). In this study, we focus on the first set of mechanisms – called inbound open innovation.

The role of information technology in the innovation process has been extensively studied in the literature, and it has been found that IT, in general, has significant contributing role in this process (e.g., Bardhan, Krishnan, & Lin, 2013; Kleis, Chwelos, Ramirez, & Cockburn, 2012; Kohli & Melville, 2009). However, there is scant literature on the influence of IT on open innovation specifically and how IT can support this approach and result in more innovation outputs (Majchrzak & Malhotra, 2013; Whelan, Conboy, Crowston, Morgan, & Rossi, 2013).

A close look at the recommended processes for open innovation suggests that IT can play an influential role in many aspects. It is argued that theorizing and investigating IT at a finer level of analysis than general IT entities, such as IT investment and IT capability, provide a richer understanding of the complexities of this role. Taking such finer-grained level of analysis, Joshi, Chi, Datta, and Han (2010) and Kleis et al. (2012) identified the primary IT-enabled capabilities that contribute to innovation process. Based on these studies, we aim to investigate and theorize the role of these IT-enabled capabilities in enabling inbound open innovation.

In the following section, we briefly describe the relevant theoretical background. The section covers relevant literature, motivations, definition for basic concepts, some of the boundary conditions, and finally the research question

for this study. In the next section, we continue to explain the remaining components of the theory by defining the theoretical constructs, providing the hypothesis statements, and justifying hypotheses based on existing literature. We conclude the paper by discussing the contributions of the study to research and practice, and suggest two future avenues for the researchers to continue enhancing our understanding on this topic.

II. Theoretical Background

Innovation

"Schumpeter famously divided technological change into three phases: 1) invention (the creation of new ideas or elements); 2) *innovation* (the implementation of these ideas or elements, or the commercial introduction of them); and 3) diffusion (the spreading of these ideas or elements)" (Arthur, 2007, p. 274). While IS literature mostly has studied the third phase, the focus of this study is on the second one.

Innovation in this study is defined as "*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*" (OECD, 2005, p. 46). This definition provided by OECD organization[1] in the Oslo manual, is consistent with Schumpeter's model and has been widely used in management literature (Garcia & Calantone, 2002). A close look at this definition reveals that innovation is considered to have occurred if it has been implemented in or commercialized by the organization. Therefore, the creation of abstract knowledge, or the invention of new products or processes is not considered innovation until it is transformed into concrete operational procedures or tools in the organization or commercial products or services.

[1] The Organisation for Economic Co-operation and Development. The Oslo manual, provided by OECD, aims to set a benchmark for innovation surveys and research for its members to facilitate a common understanding and enable comparisons between studies.

Open Innovation

Firms have innovated in different ways and there is not yet a universal strategy that has proven successful in all cases. However, there are recommendations that have been seen as beneficial for many organizations. One of such recommendations is to open up the innovation process to external ideas and partners. Traditionally, firms preferred to use a "closed" approach to innovation, leveraging in-house R&D resources and capabilities (Chesbrough, 2006). More recently, many organizations have moved toward a more "open" approach in which firms innovate jointly in collaboration with other firms and entities (Gianiodis, Ellis, & Secchi, 2010; Huizingh, 2011). The term "*open innovation*" was first used by Chesbrough (2003), who indicated that firms can (and should) use external ideas as well as internal ideas, and internal and external paths to market, as the firms seek to advance their technology. Open innovation is commonly defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and to expand the markets for external use of innovation, respectively" (Chesbrough, Vanhaverbeke, & West, 2006, p. 1). Open innovation is sometimes known as a very close concept to crowdsourcing or co-creation (Elmquist, Fredberg, & Ollila, 2009; Schlagwein & Bjørn-Andersen, 2014).

Nowadays, many companies in different industries are shifting their strategies toward this approach with the hope to increase their chances of innovating. For example, many large firms have launch web platforms in which their customers can submit their creative (usually patented) ideas and sometimes receive money after the firm's review process. Examples of these platforms are LEGO IDEAS[2] (formerly Cuusoo) (Schlagwein & Bjørn-Andersen, 2014), P&G Connect+Develop[3] (Dodgson, Gann, & Salter, 2006), DELL IdeaStorm[4], and My Starbucks Idea[5]. In addition, user online communities such as a firm's forum, club, or blog, if administered and monitored purposefully by the firm, are sources of potential ideas that can complement the firm's innovation process (Gianiodis et al., 2010). Public

[2] https://ideas.lego.com/

[3] http://www.pgconnectdevelop.com/

[4] http://www.ideastorm.com/

[5] http://mystarbucksidea.force.com/

announcement of crowdsourcing challenge calls for innovative solutions to a complex problem is another example of open innovation practises (Majchrzak & Malhotra, 2013). It is important to note that adopting open innovation is not a black or white decision, and there is a continuum of approaches from extremely closed on one side to very open approaches on the other (Dahlander & Gann, 2010).

Despite its appeal and numerous telling examples, open innovation has not always been found effective. In addition to many success stories (Chesbrough et al., 2006; Dodgson et al., 2006; Hung & Chiang, 2010; Thorén, Agerfalk, & Edenius, 2014), some companies have reported that their innovation outputs have not increased since they moved toward more open approach. Such conflicting results of open innovation effectiveness (the link between open innovation adoption and innovation performance) have been reported in open innovation literature (Dahlander & Gann, 2010; Gianiodis et al., 2010; Huizingh, 2011). Some studies have provided possible explanations for this conflicting results. For example, various measures and conceptualizations have been used as the performance impact of open innovation practises, such as financial benefits, number of innovations, and radicalness of innovations. Depending on the selected measure, studies may find positive or negative impact for open innovation (Gianiodis et al., 2010; Huizingh, 2011). Laursen and Salter (2006) suggest that there is a curvilinear (inverted U-shape) relationship between openness and innovation performance; therefore, too much openness may appear counterproductive. Some scholars also highlight the dependence of the effectiveness of open innovation on contextual factors (Gassmann, 2006; Huizingh, 2011). In line with the suggestion of these scholars, this study contributes to this area by proposing that following this approach should be accompanied by some complementary factors (capabilities) to be effective, and the organizations with high levels of these capabilities are more likely to experience the positive impacts.

Inbound and Outbound Open Innovation

Open Innovation has been divided into two types: *inbound* and *outbound* (Dahlander & Gann, 2010; Gianiodis et al., 2010; Huizingh, 2011; Lichtenthaler, 2011). If we refer back to the definition of open innovation by Chesbrough et al. (2006), the first process (i.e., the use of purposive inflows of knowledge to accelerate internal innovation) reflects the inbound open innovation and the second process (i.e., the use of purposive outflows of knowledge to expand the markets for external use of innovation) reflects the outbound open innovation process. These

types are also compatible with outside-in (i.e., scanning of new technologies and integrating external knowledge, customers, and suppliers) and inside-out (i.e., bringing ideas to market and selling intellectual properties) core processes, as defined by Gassmann and Enkel (2004). Organizations usually do not perform only inbound or only outbound activities, but they usually more or less benefit from a coupled approach (Gassmann & Enkel, 2004; Huizingh, 2011); therefore, there is a continuum for situations with respect to inbound or outbound approaches.

Organizations employing inbound open innovation are called "innovation seekers", according to Gianiodis et al. (2010) open innovation typology. They might purchase technological solutions in markets for innovation to supplement or complement their existing technology, or leverage and integrate user innovation ideas (e.g., ideas gathered in customers clubs and forums that are usually administered by the organization). The former mechanism is called "sourcing" and the latter is an example of "acquiring", according to Dahlander and Gann (2010) typology.

On the other side, there are "innovation providers" (Gianiodis et al., 2010). "These organizations exploit their technological discoveries not to build commercial solutions, but rather to sell them as products to partners, who then reconfigure the technologies to package them as final products." (p. 564). This mechanism is called "selling" by Dahlander and Gann (2010); however, another mechanism also exists (i.e., revealing), which deals with how organizations reveal internal resources without immediate financial rewards, seeking indirect benefits to the focal organization (e.g., publication of papers in research-based universities).

In this study, we focus on organizations taking inbound open innovation. As described above, the guidelines and processes in these two approaches are different and focusing on one of them is essential for this study because various components of IT have different and sometimes contrasting roles in enabling each of them. The focus on inbound open innovation was chosen mainly because "empirical studies have consistently found that companies perform more inbound than outbound activities" (Huizingh, 2011, p. 4); therefore, more companies can benefit from the results of the study if it is focused on inbound open innovation. In addition, during the empirical testing, it is more likely that we can find organizations with varied levels of use of the inbound approach.

Influence of IT on Innovation and Open Innovation

A review of studies investigating the relationship between IT and innovation reveals that in general, IT contributes to innovation process in organizations (Ghaffari & Aubert, 2014). Various constructs have been studied on the IT side (independent variable) of the relationship between IT and innovation. For example: IT investments (Bardhan et al., 2013; Kleis et al., 2012; Ramamani, 2010), IT competencies (Kohli & Melville, 2009; Tarafdar & Gordon, 2007), IT-enabled knowledge capabilities (Joshi et al., 2010), usage of a specific IT system (Banker, Bardhan, & Asdemir, 2006; Saldanha, 2012), and effective use of or investment in a specific portfolio of IT systems (Nambisan, 2003; Pavlou & El Sawy, 2006; Xue, Ray, & Sambamurthy, 2012). Similarly, various types of innovation have been studied on the innovation side (dependent variable) of this relationship. For example, new products (Banker et al., 2006; Joshi et al., 2010; Nambisan, 2003; Pavlou & El Sawy, 2006), new processes (Tarafdar & Gordon, 2007), and new products and processes (Ramamani, 2010; Saldanha, 2012). Sometimes, implicitly all types of innovation are considered by measuring innovation with items such as R&D budget (Bardhan et al., 2013; Xue et al., 2012) and number (and quality) of patents (Kleis et al., 2012; Xue et al., 2012).

The influence of IT on innovation can also be studied in regard to specific approaches toward innovation, such as open innovation. IT has much to contribute to open innovation; however, investigating the role of IT in making this approach effective is an under-researched area. Information technologies, particularly communication and collaboration tools that facilitate exchanges with external partners and knowledge management systems that enable exploration and exploitation of relevant knowledge of these partners, would seem to have a pivotal role in enabling and even shaping open innovation initiatives. There are also several explicit recent calls in IS literature that highlight the importance of theorization and investigation of this role (Fichman et al., 2014; Majchrzak & Malhotra, 2013; Nambisan, 2013; Whelan et al., 2013).

Despite its importance, this topic has received little attention. Open source software (OSS) is a well-known example of application of open innovation concept in IS literature (Eseryel, 2014; Whelan et al., 2013); however, apart from literature on OSS, there are very few studies focusing on the influence of IT on other types of open innovation (Eseryel, 2014; Schlagwein & Bjørn-Andersen, 2014; Thorén et al., 2014). While these studies describe the role of IT

in enabling open innovation from different perspectives and in different contexts, there is still lack of understanding in this regard. This gap has been one of the motivations for this study.

Moreover, in line with Benbasat and Zmud's (2003) recommendation, we argue that in order to study the role of IT in enabling open innovation, it is better to break down IT into finer-grained components. Benbasat and Zmud (2003) recommend IS researchers to "avoid treating IT artifacts or IS systems either as a black box or as being synonymous with a more generic entity (e.g., innovation, investment, or Internet)" (p.193). Such finer level of analysis provide a richer theorization of IT-artifact and enhance our understanding of IS phenomena. In addition, different components of IT do not impact open innovation processes equally and they may cancel out each other. The importance of such break-down is another motivation for this study.

As explained earlier, there are studies that have taken such finer-grained analysis in investigating the relationship between IT and innovation. These studies can provide a foundation to explain the role of components of IT in enabling open innovation, as a form of strategy toward innovation. Particularly, in a recent paper, Kleis et al. (2012) identified the three primary mechanisms (capabilities) through which the application of IT contributes to the innovation process: 1) knowledge management (e.g., by connecting knowledge networks, improving search capabilities and data mining techniques, and generating new valuable knowledge from existing knowledge asset, 2) innovation production (e.g., by facilitating opportunity identification, concept development, and innovation design), and 3) external innovation collaboration (e.g., by providing the linkages for information exchange with external partners and creating an effective partnership between a firm and an external service provider). Moreover, Joshi et al. (2010) focused on the first mechanism and based on absorptive capacity theory (Zahra & George, 2002), introduced three IT-enabled knowledge capabilities that contribute to innovation: 1) IT-enabled potential absorptive capacity (IT-PACAP), 2) IT-enabled realized absorptive capacity (IT-RACAP), and 3) IT-enabled social integration capacity (IT-SIC). These two studies serve as foundational theories in this paper, by identifying the influential IT-enabled capabilities on organizations' innovation process. Therefore, building upon these theories and based on the motivations and boundary conditions described above, this study attempts to answer "*what are the roles of IT-enabled capabilities that are influential on innovation, in enabling inbound open innovation?*"

III. Theoretical Development

Taking a more open approach toward an innovation process is considered to be effective if it increases the capability of an organization to innovate. The level of this capability in an organization is called *organizational innovativeness*. Organizations with high levels of organizational innovativeness, or in simple words innovative organizations, introduce more innovation outputs, both in terms of value and quantity (Kleis et al., 2012)[6]. Oslo manual, as explained before, describes four types of innovations: product, process, marketing methods, and organizational methods (OECD, 2005). While the first two types have been the focus of most studies in innovation literature (Baregheh, Rowley, & Sambrook, 2009), innovation touching marketing methods and organizational methods (i.e., third and fourth types) have been highlighted and stressed more recently (e.g., (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Fichman et al., 2014)). In this study, we take the broader scope and include all types of innovations within the boundaries of theorization.

There is not a clear cut line between open and close approaches to innovation, and organizations fall in a continuum of approaches in this regard. The tendency of organizations to follow open innovation approach (i.e., innovate openly) is called "open innovation proclivity" (Hung & Chiang, 2010; Rangus, Drnovsek, & Minin, 2013). Based on these references, we define *inbound open innovation proclivity* (henceforth referred to as IOIP) as "inclination of organizations to utilize external ideas to complement their innovation process". This construct basically reflects the extent to which organizations innovate based on inbound open innovation model.

One way to explain the role of one factor on the effectiveness of another factor is to determine if these factors have complementarity or substitutability effect in increasing the measure of effectiveness. *Substitutability* is defined as "situation where the combined effect of two factors is less than the sum of each factor's separate effect and can be viewed as negative synergy, that is, increasing either factor decreases the marginal impact of the other. In contrast, *complementarity* or positive synergy reflects a situation where an increase in either factor increases the impact of the

[6] Innovativeness is sometimes used to refer to the level of radicalness of a specific case of innovation (Garcia & Calantone, 2002). It should be noted that this meaning of innovativeness is not intended in this study.

other." (Titah & Barki, 2009, p. 828). In the context of this study, for example, if it is considered that a specific capability has a complementarity effect with IOIP in influencing the organization's innovativeness, increasing the level of that capability increases the marginal or incremental returns of taking inbound open innovation approach. In other words, IOIP results in higher levels of organizational innovativeness, when the organization has higher levels of that specific capability. Statistically, complementarity and substitutability can be determined by the coefficient of the interaction between the two independent variables in influencing the dependant variable (Choi & Lee, 2012; Titah & Barki, 2009).

The third part of the research question – in addition to organizational innovativeness and IOIP - is a set of IT-enabled capabilities that has been suggested to be influential on organizational innovativeness. *Capability* is "the ability of a firm to deploy resources in combination with organizational processes to obtain desired outcomes" (Barua, Konana, Whinston, & Yin, 2004, p. 587). When these outcomes are achieved through the use of IT systems, it is called *IT-enabled capability* (Joshi et al., 2010). In this theoretical paper, we investigate the influence of each of the IT-enabled capabilities, suggested in the foundational theories (Joshi et al., 2010; Kleis et al., 2012), on the relationship between IOIP and organizational innovativeness, and develop hypotheses based on this investigation. Table 1 summarizes the definition of the constructs and concepts that are used in these hypotheses.

Table 1. Summary of Definitions

Construct/concept	Definition
Substitutability (complementarity)	A situation where the combined effect of two factors is less (more) than the sum of each factor's separate effect and can be viewed as negative (positive) synergy, that is, increasing either factor decreases (increases) the marginal impact of the other
Organizational innovativeness	The capability of an organization to innovate. Innovation is defined as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.
Inbound open innovation proclivity (IOIP)	Inclination of organizations to utilize external ideas to complement their innovation process
IT-enabled external (internal) collaboration capabilities	The ability of an organization to collaborate with its external (internal) partners through its IT systems
IT-enable internal knowledge exploitation	The ability of an organization to apply knowledge in its innovation process through its IT systems

Role of IT-enable external collaboration

Collaboration with external partners, the third capability among contributing capabilities to innovation (Kleis et al., 2012), has been emphasized as essential for open innovation in several papers (e.g., Antikainen, Mäkipää, & Ahonen, 2010; Gassmann & Enkel, 2004; Kleis et al., 2012; Laursen & Salter, 2006). For example, in an inbound open innovation model, in order to effectively incorporate the new ideas of people outside the organization in the organization's innovation projects, the project team members need to collaborate effectively with those people. Such collaboration is sometimes similar to collaboration among team members to gain a shared understanding and perform joint tasks. Furthermore, in order to explore and find those new ideas, people inside the organization require to collaborate effectively with many potential external partners (Lichtenthaler, 2011). Examples of groups of external partners are, but not limited to, organization's customers (Gianiodis et al., 2010), suppliers (Dodgson et al., 2006), open innovation communities (Antikainen et al., 2010), universities, innovation brokers (Gianiodis et al., 2010), and any individual or organization that can be a source of those new ideas.

Information technology is a critical enabler of collaboration capability in organizations. "Infrastructure technologies such as computers, networks, and communications applications (e.g., e-mail) are instrumental to these collaborative efforts, … by providing the necessary linkages for information exchange with external partners" (Kleis et al., 2012, p. 46). As another example, when a new product development (NPD) project involves cooperation of the organization's product design team with external partners, effective use of collaborative product commerce (CPC) systems - a class of collaboration software for product design and development – has shown to play a significant impact on the project performance (Banker, Mitra, & Sambamurthy, 2011). Functions of such systems are beyond the simple communication and connectivity tools, and can enable virtual cooperative work on product design artifacts such as engineering drawings, product specifications, design inputs and outputs, test reports, and engineering change orders.

To summarize the discussion, collaborating effectively with external partners is important for organizations with high level of IOIP. In addition, IT is a critical enabler of such collaboration. Therefore, in the presence of strong IT-enabled external collaboration capability, the organizations with high IOIP are more likely to be highly innovative. Similarly, while IT-enabled external collaboration capability is important and influential for being innovative (Kleis et

al., 2012), this capability becomes more important when the organizations innovate more openly. Thus, there is positive synergy (complementarity) between these two factors in influencing the organization's innovativeness.

Hypothesis 1 (H1): *IT-enable external collaboration capability has positive synergy (complementarity) with inbound open innovation proclivity (IOIP) in influencing the organization's innovativeness.*

Role of IT-enable internal collaboration

Similar to external collaboration, collaborating with internal members of the organization also has been highlighted to be important for innovation. Particularly, this capability is essential for social integration mechanisms, one of the three knowledge capabilities explained by Joshi et al. (2010). These mechanisms help an organization to build social structures that "promote connectedness, interaction, coordination, and communication among members of {organization} by creating seamless networks of people, devises, and knowledge" (Joshi et al., 2010, p. 475). Using these mechanisms, employees collaborate with each other to share the relevant knowledge acquired by the organization in different departments.

Information technology is also instrumental in enhancing internal collaboration in organizations. At the basic level, IT provides the infrastructure for the cross-organization communication and sharing of the digital content. More recently, organizational social networks, such as forums, blogs, and wikis have become popular inside the organizations boundaries. Last, but not least, advanced web conferencing and groupware systems, can enable effective internal collaboration, especially when face-to-face meeting is not an option.

As a result of abovementioned discussion, when organizations take more open approaches, they rely more on external partners and less on their internal members; therefore, their dependence on internal partners and IT-enabled internal collaboration for innovation could decrease. In other words, increasing IOIP decreases the marginal impact of IT-enabled internal collaboration capability on organizational innovativeness. Thus, we hypothesize that:

Hypothesis 2 (H2): *IT-enable internal collaboration capability has negative synergy (substitutability) with inbound open innovation proclivity (IOIP) in influencing the organization's innovativeness.*

Role of IT-enable internal knowledge exploitation

After acquiring knowledge from internal or external sources, the knowledge should be transformed and exploited in the organization's innovation process. This capability is called realized absorptive capacity and has been proven to contribute not only to the innovation process in general (Joshi et al., 2010; Kleis et al., 2012) but also to open innovation in particular (Hughes & Wareham, 2010; Lichtenthaler, 2011; Lichtenthaler & Lichtenthaler, 2009). Lichtenthaler (2011) refers to "internal knowledge exploitation" as the relevant realized absorptive capacity in the context of inbound open innovation and explains that the critical process for this capability is "matching inventions with the context of {the organization's} final market" (p. 82). For inbound open innovation, the knowledge that is going to be applied in the organization's innovation "has been explored and retained *inside or outside* the firm" (Lichtenthaler & Lichtenthaler, 2009, p. 1321); however, in the end, the organization should rely on its own knowledge exploitation capability to leverage this absorbed knowledge in its new or improved products, services, marketing practices, or business model and make profit from them. In an outbound open innovation approach, knowledge exploitation is done together with external partners and on their innovation process; therefore, Lichtenthaler (2011) refers to "external knowledge exploitation" as the required exploitation capability in this approach.

Recent advances in information technology have dramatically improved the ability of organizations to effectively exploit their acquired knowledge (Alavi & Leidner, 2001; Kleis et al., 2012; Nambisan, 2003; Pavlou & El Sawy, 2006). Many organizations benefit from integrated knowledge management systems that are developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application" (Alavi & Leidner, 2001, p. 114); however, there are also more specific systems that focus on supporting knowledge exploitation, such as business intelligence, data analytics, data mining, simulation software, decision support system, digital dashboard, online analytical processing, visualization technologies, case-based reasoning and expert systems (Joshi et al., 2010). For example, business intelligence (BI) tools allow organizations to transform existing data and knowledge from various sources to gain new insights and understanding.

In summary, organizations that lean more toward inbound innovation (high IOIP) are more dependent on IT-enabled internal knowledge exploitation capability to accomplish their innovation projects than organizations with

lower IOIP. Therefore, in the presence of strong IT-enabled internal knowledge exploitation capability, the organizations with high IOIP are more likely to be highly innovative. Similarly, while IT-enabled internal knowledge exploitation has shown to be contributing to innovation process, such contribution is more important for inbound open innovation approach than outbound open innovation. Thus, we hypothesize that:

Hypothesis 3 (H3): *IT-enable internal knowledge exploitation capability has positive synergy (complementarity) with inbound open innovation proclivity (IOIP) in influencing the organization's innovativeness.*

IV. Conclusion

In this paper, we theorized the role (complementarity or substitutability) of influential IT-enabled capabilities in making inbound open innovation successful. While IT-enabled external collaboration and IT-enabled internal knowledge exploitation capabilities are hypothesized to have complementary effect on the effectiveness of inbound open innovation, IT-enabled internal collaboration capability is a substitute for inbound open innovation for strengthening the organizational innovativeness. These influential IT-enabled capabilities are selected based on two foundational studies that identified the influential IT-enabled capabilities on innovation process.

This paper offers valuable contribution to research both in information systems and innovation literature. First, this paper breaks down IT into a set of finer level IT-enabled capabilities and investigates the role of a set of these IT-enabled capabilities in enabling inbound open innovation, an approach that have gained considerable attention recently by scholars and practitioners. By explaining the value of IT in an approach toward innovation, this paper contributes to IT productivity research. In this case, innovation, as an essential element for firm's performance, is regarded as a mediating factor between IT and performance (Melville, Kraemer, & Gurbaxani, 2004). Second, this paper contributes to innovation body of knowledge, and in particular open innovation literature, by identifying some complementary capabilities for the effectiveness of this approach. Lack of strong presence of these complementary capabilities might result in failure of taking this approach.

This paper also can provide useful insights for practitioners and managers. By explaining the role of each of IT-enabled capabilities in enabling inbound open innovation, managers can evaluate the readiness of their

organizations in the domain of IT, before formulating and implementing innovation strategies to follow this approach. In addition, if the organization has low levels of IOIP, more attention should be devoted to the substitute capabilities to still experience high levels of innovativeness. Overall, these insights in the IT domain of organizations can help managers to strategically manage and allocate their IT resources.

Further studies can continue to enhance our knowledge in this promising area. First, the hypotheses of this paper can be empirically tested on a sample of organizations with varied levels of IOIP to validate our theorization. To the best of our knowledge, there is no published empirical study that has investigated the influence of IT on open innovation; therefore, further exploratory analyses in such study also can offer further insights in this area. Second, in this paper, we focused on inbound model of open innovation. As the recommended processes for outbound open innovation is different from inbound open innovation, different IT-enabled capabilities with different roles should be expected to be theorized; therefore, further studies can focus on outbound open innovation and identify the set of influential IT-enabled capabilities and their role in enabling this type of open innovation.

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1130, rue Sherbrooke Ouest, bureau 1400, Montréal (Québec) H3A 2M8

Tél. : 514-985-4000 • Téléc. : 514-985-4039

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