**Developing and Testing a Theory for Predicting the stages in which Exploratory Inbound OI Activities are needed for Different Innovation Problems**

**Abstract**

The notion that organizations can improve their innovation capabilities and performance by making relationships with external sources with the aim of accessing their knowledge, technologies, and ideas (is called inbound open innovation) has become important in innovation literature, and particularly in open innovation studies. The main focus of this research is on inbound open innovation for exploring new ideas, technologies, and knowledge. We argue that literatures on open innovation have ignored the micro-foundations of inbound open innovation whereas their main focus has been on firm level and industry level variables. Specially, less attention has been paid to the role of innovation problem characteristics and different stages of open innovation (micro level) in selecting process of inbound open innovation dimensions. In other words, what different inbound open innovation dimensions are needed for different types of innovation problem characteristics and across different stages of open innovation projects. Actually, we want to match dimensions of inbound open innovation with problem innovation characteristics (e.g., problem complexity and the hiddenness of relevant knowledge) over the two stages of open innovation project (problem formulation and problem solving). The objective of current research is to develop and testing a theory in order to understand what different inbound open innovation dimensions are needed for different innovation problems and different stages. In this research, conceptual framework and related hypotheses will be developed and tested based on a survey of large firm in Europe and the United States working on the high-tech and medium high-tech industry with annual total revenues more than $250 million and more than 1000 employees which are listed in the US-NYSE or Europe stock exchanges.

*Key words:* inbound open innovation; problem complexity; the hiddenness of knowledge; problem formulation; problem solving

**Introduction**

Innovation has been recognized as one of the most important and critical activities playing a pivotal role in increasing organizational performance (e.g., Hall, 2000; Han et al., 1998; Hurley & Hult, 1998; Kessler et al., 2000). Innovation helps organizations to develop their competitive advantages by exploring new technological trends, by developing new products or services, by improving quality of their goods and services, by reducing production cost per unit output, or by entering new markets; which in turn cause the long term survival and growth of organizations (e.g., Baum et al., 2000; Boddy et al., 2003; Browning et al., 2003; Buchel et al., 2000; Deeds et al., 2003; George et al., 2002; Narver & Slater, 1990; Nelson & Winter, 1982). Thus, innovation development is considered as an important organizational goal and organizations follow two main strategies to achieve desired innovative goal. Traditionally, organizations focus more on their internal R&D capabilities and also internal technologies and knowledge in order to achieve innovation objectives (Tidd., 2001). On the other hand, recently greater numbers of organizations rely heavily on collaborative innovation by interaction with different types of external partners and sources such as; indirect customers or final consumer, suppliers, competitors, customers, and a wide range of research centers (e.g., Brown & Duguid, 2000; De Rond & Bouchikhi, 2004; Ness & Haugland., 2005; von Hippel., 1988).

The importance of the second innovation development strategy can be explained in terms of the changing industry, market, and technology. Industry and market condition have become increasingly competitive due to the rapidly changing environment. In this environment, rapid technological changes force organizations to utilize a wide range of external ideas, knowledge, technologies, and complementary resources for innovation development (e.g., Hagedoorn, 2002; van Burg et al., 2014; Vlaar et al., 2007; von Hippel., 1988) . The second strategy that is built on collaboration with external sources to acquire resources and ideas, helps organizations to reduce internal R&D costs, accelerate time to complete R&D processes, and to mitigate risks involved in innovation processes to successfully cope with the competitive industry and the technological uncertainty (Chesbrough, 2003; Faems et al., 2005; Hagedoorn, 2002; Laursen & Salter, 2005; Dahlander & Gann, 2010; West & Bogers, 2014). In short, using external ideas and resources, which are outside the organizational boundaries has become an important strategy in developing innovation (Dahlander & Gann, 2010).

“Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as firms look to advance their technology” (Chesbrough, 2006: 1). According to this definition, open innovation is comprised of two distinct concepts and modes: 1) Inbound (Outside in), which is the practice of establishing relationships with external partners with the aim of accessing their knowledge and technological capabilities; in this case, new ideas and knowledge flow into organizations, and 2) Outbound (Inside out), which is the practice of establishing relationships with external partners with the aim of commercialization of internally developed knowledge, and technological capabilities that can be acquired by external partners (Chesbrough, 2003; Dahlander & Gann, 2010). The main focus of this study is on inbound open innovation.

**Literature Review: Inbound Open innovation dimensions**

The main objective of inbound open innovation is that organizations have interaction with different types of external sources which are in their environment to bring external ideas and knowledge into the organizations to successfully response to the rapidly changing environment (Chesbrough, 2006).

Literature on collaborative innovation and also open innovation has distinguished between explorative and exploitative innovation (e.g., Koza & Lewin, 1998; Faems et al., 2005). The goal of explorative innovation is discovering new ideas, opportunities, and technology trends whereas exploitative innovation tends to focus on existing knowledge and assets for enhancing existing organizational capabilities (Koza & Lewin, 1998). The main focus of this study is on explorative inbound open innovation which involves search, experimentation, and discovery (Parmigiani & Rivera-Santos, 2011). The main focal point in explorative innovation is new knowledge. From now on, in this study, when referring to inbound open innovation, the focus is on the inbound open innovation for exploration.

According to literature on open innovation, there is a wide range of inbound open innovation activities to acquire knowledge and ideas from external partners such as formal licensing agreements, contracting agreements, collaborative R&D consortia, running contests and tournaments, alliances, joint ventures, corporate venture capital, user communities (see table 1) (Chesbrough & Brunswicker, 2014; Dahlander & Gann, 2010; Faems et al., 2005; Felin & Zenger, 2013; Foss et al., 2013; Laursen & Salter, 2005; Salter et al., 2014).

Table 1 Inbound Open Innovation Activities

|  |  |
| --- | --- |
| Market and contracts | Accessing to externally owned technologies, knowledge, products, or solutions for narrowly specified application via formal licensing agreements |
| Purchasing externally owned technologies, knowledge, products or solutions ‎completely with single payment |
| Contracting with external firms and organizations for the generation of specified ‎technologies, knowledge, products, or solutions |
| Alliance and partnership | Engaging in a collaborative relationship and activities with the external firms or ‎organizations and jointly created needed technologies, knowledge, products, or ‎solutions |
| Participation in collaborative R&D consortia with other external firms or organizations and jointly developed technologies, knowledge, products, or solutions in which R&D collaboration is fully or partly funded by governmental organizations like European Commission |
| Contests and tournaments | Invitation of existing external firms, organizations, entrepreneurial teams, or ‎start ups to participate in innovation and submit innovative ideas related to ‎needed technologies, knowledge, products, or solutions via open competitive ‎call ‎ |
| User communities ‎ | Developing innovation communities with users for accessing the dispersed knowledge and expertise for needed products, services, processes and even business model |
| Involvement of lead users in the innovation process for products, services, ‎processes and even business model ‎ |

It is a challenge for organizations to evaluate the inbound open innovation activities (listed in the table 1) due to evaluation problem. The evaluation problem is related to lack of specific dimensions that can be used through the selection process of inbound open innovation activities. For example, different dimensions such as different types of external sources, different types of interaction, different kinds of governance forms, and different forms of information flows direction are mixed by the inbound open innovation activities. For example, the focal firm can use a contract agreement with different types of external sources and different forms of control (process or outcomes) can be specified by them in the contract agreement. Also, over the contract agreement, the focal firm can learn from external sources or they can learn from each other. So, different dimensions are mixed by the list of inbound open innovation activities. As a result, we need to develop a single set of dimensions that can be applied to all of activities. So that we can describe and evaluate the characteristics of inbound open innovation activities based on a set of dimensions. The set of dimensions can be derived open innovation and Inter Organizational Collaboration (IOC) literature as follows:

1. External search breadth is defined as “the number of external sources that firms rely upon in their innovative activities” (Laursen and Salter, 2005: 135).
2. External search depth that is defined in terms of “the extent to which firms draw deeply from the different external sources” (Laursen and Salter, 2005: 135).
3. The information flows direction between the focal organization and external sources that can be 1) unidirectional, where the focal organization only learns from other external sources, 2) bi-directional, where the focal organization and external sources learn from each other (Hardy et al., 2003).
4. The resource exchange between the focal organization and external sources, including 1) transaction, where, only resources were transferred from external sources to the focal organization, 2) partnership, where the focal organization and external sources work together (Hardy et al., 2003).
5. The control governance applied by the focal firm, including 1) process control in which the process of achieving innovation objective is specified by the focal organization and 2) outcome control, in which the focal organization set specific milestones, target dates, and performance standards (Faems et al., 2008).
6. The type of external sources, a wide range of external sources can be applied by the focal organization during inbound open innovation as follows[[1]](#footnote-1) (Chesbrough & Brunswicker, 2014; Dahlander & Gann, 2010; Laursen & Salter, 2005; Faems et al., 2005; Foss et al., 2013)

* Market sources: suppliers, indirect customers or final consumer, competitors, consultants or private R&D institutes
* Institutional sources: University or other higher education institutions, public research centers
* Other sources: Conferences, trade fairs, scientific journals, professional and industry associations

This set of dimensions will be applied during current study in order to answer to the research question (it is explained in the following sections).

**Literature Review: Framing Gaps**

Based on the literature review on open innovation, we try to frame two main gaps that we are going to address during this study in this section.

Organizations have increasingly invested in clarification of problem (problem definition) as much as they can in order to engage in more effective interaction with external sources for finding innovative solutions (Felin & Zenger, 2013). Baer et al., (2012) show that organizations committed to greater openness in their innovation have redirected their internal R&D efforts away from problem solving and toward problem formulation. Literature on open innovation indicates that the focal organization needs to separate problem formulation and problem solving for open innovation (Kotha, 2012). But it is not specified in the literature that what different inbound open innovation dimensions are needed for each stage.

Selection of inbound open innovation activities for each stage (problem formulation and problem solving) is crucial for organizations since each inbound open innovation activity has its own dimensions. Most of literatures on open innovation focus on firm level (such as; firm size, firm strategic orientation, etc.) and industry level characteristics (such as; different types of industrial uncertainty) as determinants of open innovation dimensions choice. But, literature on open innovation ignores the role of innovation problem characteristics in selecting process of inbound open innovation dimensions that leads to misunderstanding about required inbound open innovation dimensions. Although, there is an emerging research area on open innovation literature about determinants of open innovation activities choice but there is relatively lack of understanding about the role of innovation problem characteristics in inbound open innovation dimensions selection (Felin & Zenger, 2013). As a result, more specific research is needed on the innovation problem characteristics and how they affect the inbound open innovation dimensions selection.

In sum, two main gaps found from literature on open innovation are addressed during this study: 1) Lack of understanding about what different inbound open innovation dimensions are needed for each stage of OI; and 2) Insufficient attentions to the impact of innovation problem characteristics in selecting inbound OI dimensions.

**Discussion: Objective, Research Question, and Expected Contributions**

Related to open innovation literature, this study mainly focuses on the inbound open innovation. As noted, organizations need to separate two stages for open innovation, problem formulation and problem solving, but the literature does not specify what different inbound open innovation dimensions are needed for each stage. Also, the studies have ignored characteristics of the innovation problem in selecting inbound open innovation dimensions. Actually, this research tries to shed light on inbound open innovation activities choice, especially 1) by developing a set of dimensions for describing inbound open innovation activities, 2) by studying what different dimensions of inbound open innovation activities are needed for problem formulation and problem solving? 3) by studying the effect of innovation problem characteristics on the dimensions of inbound open innovation activities (see table 2). Therefore, the overall research question in this study can be articulated as follows:

***Do innovation problem characteristics differently influence the inbound open innovation activities selected at the two different stages of open innovation project?***

Table 2 Summary of the gaps and objective of current research

|  |  |
| --- | --- |
| **Gaps in the literature** | **Objectives of this research** |
| * Lack of understanding about what different inbound open innovation activities are needed for each stage of OI * Insufficient attentions to the impact of innovation problem characteristics in selecting inbound OI activities | * Studying what different dimensions of inbound open innovation activities are needed for problem formulation and problem solving? * studying the effect of innovation problem characteristics on the dimensions of inbound open innovation activities |

To address the overall research question, based on our specific objectives in this study we divide this research into three main research questions (we are going to study them over two/three papers) as follows:

1. What different dimensions of inbound open innovation activities are needed for different stages of open innovation project?
2. What different dimensions of inbound open innovation activities are needed for different combinations of innovation problem characteristics?
3. Does the combination of two stages (problem formulation and problem solving), where the selection of dimensions of inbound open innovation activities is done based on innovation problem characteristics, lead to more innovation performance from interaction with external sources?

In order to answer to our research questions, we need to define key characteristics of innovation problem which are most relevant in inbound open innovation dimensions selection. Consistent with previous studies (Leiblein & Macher, 2009; Felin & Zenger, 2013), two main characteristics of innovation problem can be defined for each stage of open innovation project as follows:

**Problem formulation**

1) Unknown knowledge: It is defined in terms of the degree to which the focal firm knows what knowledge they need for solving their innovation problem (Felin & Zenger, 2013). In other words, it is related to the situations in which the focal firm does not know what relevant knowledge for their innovation problem is needed.

2) Problem ambiguity: it is defined as the lack of clarity about the nature of problem that should be solved by the focal firm (Leiblein & Macher, 2009).

**Problem solving**

1) The hiddenness of needed knowledge: It is defined in terms of “the degree to which the sources or location of knowledge deemed relevant are unknown” to the focal organization (Felin & Zenger, 2013: 4). That is, the hiddenness of knowledge is related to the situations in which the focal organization does not know 1) where knowledge is located or 2) who has it.

2) Problem complexity: Complex problem is comprised of a large number of parts with high degree of nonsimple interaction among them (Leiblein & Macher, 2009); consequently, complex problem is less decomposable.

The main objective of the first two research questions is to match dimensions of inbound open innovation activities with problem innovation characteristics over the two stages of open innovation project (please see table 1 and 2 as examples of our expected contributions). Moreover, the third research question focus on studying the effect of using the two stages (combination of them) on innovation performance.

**Figure 1 Innovation Problem Characteristics and Inbound OI Dimensions**

**(Problem Formulation Stage)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Unfamiliarity | |
| Low | High |
| Ambiguity | Low | -Narrow external sourcing  -Unidirectional information flow | -Broad external sourcing  -Unidirectional information flow |
| High | -Narrow external sourcing  - Bi-directional information flow | -Broad external sourcing  - Bi-directional information flow |

**Figure 2 Innovation Problem Characteristics and Inbound OI Dimensions**

**(Problem Solving Stage)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Hiddenness | |
| Low | High |
| Complexity | Low | -Narrow external sourcing  -Shallow external sourcing  -Unidirectional information flow  -Transaction | -Broad external sourcing  -Shallow external sourcing  -Unidirectional information flow  -Transaction |
| High | -Narrow external sourcing  -Deep external sourcing  - Bi-directional information flow  -Partnership | -Broad external sourcing  -Deep external sourcing  - Bi-directional information flow  -Partnership |

**Methodology**

The main source of data for this study is survey of OI projects nested in the firms. We are currently working on designing sampling process and also a questionnaire according to cover the objective of this research. Our sample will include the large companies in Europe and the United States working on the high tech and medium high tech industry (since open innovation makes more sense for these industries) with annual total revenues more than $250 million and more than 1000 employees which are listed in the US-NYSE or Europe stock exchanges. Based on these criteria our target population is 3308 large firms[[2]](#footnote-2).

Regarding methodology, first of all, we will run Confirmatory Factor Analysis (CFA) via Structural Equation Modeling (SEM) in order to assess the factor structure (measurement model) and also the psychometric properties of different variables. After confirming of measurement model, we will apply different types of regression (OLS, Tobit, Probit, etc.) according to the nature of our dependent variable. Also, we plan to apply Multi Level Modeling (MLM) in this research since we have two level of analysis (project level and firm level, projects nested within firms). Likewise, we will use Structural Equation Modeling (SEM) ‎since we might have some complex mediated relationships in our model, specially, for third research question.

**References**

Baer, M., Dirks, K., Nickerson, J., 2012. Microfoundations of strategic problem for-mulation. Strategic Management Journal.

Baum, J.A.C., Calabrese, T. and Silverman, B.S. (2000). Don’t Go It Alone: Alliance Network Composition and Startups’ Performance in Canadian Biotechnology. Strategic Management Journal 21(3): 267–294.

Boddy, D., Macbeth, D., & Wagner, B. 2000. Implementing collaboration between organizations: an empirical study of supply chain partnering. *Journal of Management studies*, 37(7), 1003-1018.

Brown JS, Duguid P. 2000. *The Social Life of Information*. Harvard Business School Press: Boston, MA.

Browning, L. D., Beyer, J. M., & Shetler, J. C. 1995. Building cooperation in a competitive industry: SEMATECH and the semiconductor industry. *Academy of Management Journal*, 38(1), 113-151.

Büchel, B. 2000. Framework of Joint Venture Development: Theory‐Building Through Qualitative Research. *Journal of Management Studies*, 37(5), 637-661

Chesbrough H. 2003. *Open Innovation*. Harvard University Press: Cambridge, MA.

Chesbrough, H. W. 2006. ‘New puzzle and new finding,” in Open innovation: Researching a new paradigm, H. W. Chesbrough, W. Vanhaverbeke, and J. West (eds.), Oxford: Oxford Univ. Press, pp. 15–34.

Chesbrough, H., & Brunswicker, S. (2014). A Fad or a Phenomenon?: The Adoption of Open Innovation Practices in Large Firms. *Research-Technology Management*, *57*(2), 16-25.

Dahlander, L., and Gann, D. 2010. ‘How open is innovation?” Research Policy (39:6), pp. 699–709.

Deeds, D.L. and Rothaermel, F.T. (2003). Honeymoons and Liabilities: The Relationship between Age and Performance in Research and Development Alliances. Journal of Product Innovation Management 20(6):468–485.

De Rond, M., & Bouchikhi, H. 2004. On the dialectics of strategic alliances. *Organization Science*, 15(1), 56-69.

Faems, D., Van Looy, B., & Debackere, K. (2005). Interorganizational collaboration and innovation: toward a portfolio approach\*. *Journal of product innovation management*, *22*(3), 238-250.

Faems, D., Janssens, M., Madhok, A., & Van Looy, B. 2008. Toward an integrative perspective on alliance governance: Connecting contract design, trust dynamics, and contract application. *Academy of Management Journal*, 51(6), 1053-1078.

Felin, T., & Zenger, T. R. (2013). Closed or open innovation? Problem solving and the governance choice. *Research Policy*.

Foss, N. J., Lyngsie, J., & Zahra, S. A. (2013). The role of external knowledge sources and organizational design in the process of opportunity exploitation.*Strategic Management Journal*, *34*(12), 1453-1471.

George, G., Zahra, S.A. and Wood, D.R. (2002). The Effects of Business– University Alliances on Innovative Output and Financial Performance: A Study of Publicly Traded Biotechnology Companies. Journal of Business Venturing 17(6):577–609.

Hagedoorn, J. (2002). Inter-firm R&D Partnerships: An Overview of Major Trends and Patterns since 1960. Research Policy 31(4): 477–492

Hall, B. H. 2000. Innovation and market value. R. Barro, G. Mason, M. O’Mahony, eds. Productivity, Innovation and Economic Performance. Cambridge University Press, Cambridge, UK, 177–198.

Han, J. K., N. Kim, R. K. Srivastava. 1998. Market orientation and organizational performance: Is innovation a missing link? J. Marketing 62(4) 30–45.

Hardy, C., Phillips, N., & Lawrence, T. B. (2003). Resources, knowledge and influence: The organizational effects of interorganizational collaboration. *Journal of management studies*, *40*(2), 321-347.

Hurley, R. F., G. T. M. Hult. 1998. Innovation, market orientation, and organizational learning: An integration and empirical examination. J. Marketing 62(3) 42–54.

Kessler, E. H., Bierly, P. E., & Gopalakrishnan, S. (2000). Internal vs. external learning in new product development: effects on speed, costs and competitive advantage. R & D Management, 30(3), 213-223.

Kotha, S.,2012. Boundary emergence: a multi-theoretical approach to understandingboundary choice in a large transnational corporation. In: Department of Infor-mation Systems Friday Research Seminar Series. Washington State University.

Koza, M.P. and Lewin, A.Y. (1998). The Co-evolution of Strategic Alliances. Organization Science 9(3):255–264.

Laursen, K., A. J. Salter. 2006. Open for innovation: The role ofopenness in explaining innovative performance among UK manufacturing firms. Strategic Management J. 27(2) 131–150.

Leiblein, M.J., Macher, J.T., 2009. The problem solving perspective: a strategicapproach to understanding environment and organization. Advances in Strate-gic Management 26, 1–24.

Narver, J. C., S. F. Slater. 1990. The effect of a market orientation on business profitability. J. Marketing 54(4) 20–35.

Nelson, R. R., S. G. Winter. 1982. An Evolutionary Theory of Economic Change. Harvard University Press, Cambridge, MA.

Ness, H., & Haugland, S. A. 2005. The evolution of governance mechanisms and negotiation strategies in fixed-duration interfirm relationships. *Journal of Business Research*, 58(9), 1226-1239.

Parmigiani, A., & Rivera-Santos, M. (2011). Clearing a path through the forest: A meta-review of interorganizational relationships. *Journal of Management*,*37*(4), 1108-1136.

Salter, A., Criscuolo, P., & Ter Wal, A. L. (2014). Coping with Open Innovation: Responding to the Challenges of External Engagement in R&D. *California Management Review*, *56*(2).

Tidd, J. 2001. ‘Innovation management in context: Environment, organization and performance,” International Journal of Management Reviews (3:3), pp. 169–183.

van Burg, E., Berends, H., & Raaij, E. M., in press. Framing and interorganizational knowledge transfer: A process study of collaborative innovation in the aircraft industry. *Journal of Management Studies*. doi: 10.1111/joms.12055

Vlaar, P. W., Van Den Bosch, F. A., & Volberda, H. W. 2007. Towards a dialectic perspective on formalization in interorganizational relationships: How alliance managers capitalize on the duality inherent in contracts, rules and procedures. *Organization Studies*, 28(4), 437-466.

von Hippel, E. 1988. The Sources of Innovation. Oxford University Press, New York.

West, J., & Bogers, M. (2013). Leveraging external sources of innovation: A review of research on open innovation. *Journal of Product Innovation Management*.

1. Adopted form Community Innovation Survey 2010 (CIS 2010) [↑](#footnote-ref-1)
2. Adopted from presentation about target population of survey (presented by Sabine Bruswicker at Purdue university, April 08, 2013) [↑](#footnote-ref-2)