

## Chapter 12

### Investigating Inter-Industry Differences in the Implementation of Open Innovation<sup>1</sup>

*Tommaso Buganza, Davide Chiaroni,  
Gabriele Colombo and Federico Frattini  
Politecnico di Milano, Department of Management,  
Economics and Industrial Engineering, Italy*

#### Introduction

Innovation has been traditionally conceived as a process taking place mainly within the boundaries of the firm. Accordingly, a critical capability for an innovative company is to recruit the most talented scientists and to staff them inside well-resourced internal research and development (R&D) departments. In contrast to this closed innovation approach, open innovation suggests that firms should open up their boundaries in the attempt to make the most out of the opportunities coming from interacting with external parties throughout the innovation process (Chesbrough, 2003).

Following the early studies of Henry Chesbrough, open innovation has become one of the most debated topics in management research in the last decade (see, e.g., Pullen *et al.*, 2012; van de Vrande and de Man, 2011; Bianchi *et al.*, 2011; Di Minin *et al.*, 2010; West and Gallagher, 2006). Although our understanding of this management paradigm has expanded over the years, there are still some aspects that deserve further investigation

---

<sup>1</sup>This chapter was previously published as Buganza, T., Chiaroni, D., Colombo, G. and Frattini, F. (2011). Organisational implications of open innovation: an analysis of inter-industry patterns, *International Journal of Innovation Management*, 15(2), 423–455.

(Gassmann, 2006). Among these open gaps, studying what organizational and managerial levers firms act upon to implement open innovation is at the top of the innovation management scholars' research agenda (Chesbrough *et al.*, 2006). It should be noted here that some authors have recently questioned the novelty of the open innovation concept, suggesting that many practices underlying this paradigm were already applied well before its conceptualization in 2003 (van de Ven and de Man, 2011; Mowery, 2009; Trott and Hartmann, 2009). However, we believe that the novelty of the open innovation concept lies primarily in the fact that many innovative and successful firms have created new organizational structures and processes which allow them to use on a continuous basis and to strategically integrate several traditional collaborative innovation practices. The empirical evidence presented in the paper further reinforces this argument.

Consistent with established organization research (Dill, 1958; Burns and Stalker, 1961; Chandler, 1962; Woodward, 1970), we also argue that, when studying the implementation of open innovation, it is important to take into account the peculiarities of the external environment in which a firm operates. By doing so, we will be able to provide exploratory evidence of inter-industry differences in the implementation of open innovation. In this paper we first consider the high-tech or low-tech nature of the industry in which the firm operates, by using the established OECD taxonomy (OECD, 2005), which separate into high-technology, medium-high technology, medium-low technology, and low-technology industries. Following this classification, high-tech industries are those characterized by high levels of R&D intensity. This taxonomy is a useful starting point since it is popular among both academicians and policy makers (Mendonça, 2009) and it has been already used in other studies on open innovation (Chesbrough and Crowther, 2006). However, we propose that it is necessary to look into further industry-level characteristics, to address the pitfalls of the high-tech versus low-tech classification (Smith, 2004; von Tunzelmann and Acha, 2004). In particular, we suggest that the differences in the organizational and managerial solutions that firms adopt to implement open innovation can be explained not only by looking at the R&D intensity of the industry in which they operate, but also by considering the following variables:

- Technological uncertainty (Henderson and Clark, 1990), which refers to the unpredictability of technological changes that have the potential to make the development efforts undertaken in the industry obsolete.

Research has acknowledged technology uncertainty as an important determinant of firms' collaboration choices (Pisano, 1990; Teece, 1992).

- Technology appropriability, which refers to the ease with which a firm is able to capture the profits generated by a technology (Teece, 1986). It is well known that different appropriability regimes influence a firm's strategic decisions in terms of collaborations (Teece, 1986).
- Technology clockspeed, which measures the speed at which technology evolves in an industry and hence proxies the turbulence of this industry (Fine, 1998). Research has found that coping with high levels of turbulence requires firms to develop specific organizational capabilities (Chakravarthy, 1997).

Therefore there are strong theoretical reasons to believe that these industry-level variables will affect the organizational and managerial solutions that a firm adopts to implement open innovation. Despite the importance of this topic, there is no systematic research addressing it, at least to the best knowledge of the authors. This paper represents a first attempt to address this gap, by making use of a rich empirical basis which documents the implementation of open innovation in a sample of eight large Italian firms, operating in industries with different characteristics. In particular, this paper addresses two specific research questions:

- How do firms belonging to different industries implement open innovation from an organizational and managerial point of view?
- What are the reasons underlying the differences in the organizational and managerial solutions that firms belonging to different industries adopt to implement open innovation?

The paper is structured as follows. In the next section we provide an overview of the relevant literature on open innovation. We then develop and discuss the theoretical framework used to gather and interpret the empirical evidence. Next, we explain the research methodology used in the exploratory empirical analysis, and the results are presented and discussed thereafter. The final section concludes and identifies a number of avenues for future study.

## **Overview of the Literature**

Open innovation is defined by Henry Chesbrough as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation,

and expand the markets for external use of innovation, respectively” (Chesbrough, 2003: 1). Following the seminal work of Chesbrough, a huge body of research has been developed to explore the anatomy of this emerging innovation management paradigm (see, e.g., Giannopoulou *et al.*, 2011; Huizing, 2011; Dahlander and Gann, 2010; Christensen *et al.*, 2005; Dodgson *et al.*, 2006; Gassmann, 2006; Vanhaverbeke, 2006; West and Gallagher, 2006). What is interesting to remark here is that, despite this huge interest raised by open innovation, limited systematic research has been conducted on how firms organize themselves to adopt the open innovation practices. On this topic, mainly scattered and anecdotal empirical evidence is available. Chesbrough (2003) shows the organizational changes introduced by Intel in its journey toward open innovation. Intel created three research labs characterized by great focus and specialization in their own technological area, with the primary role of better linking the firm with the outside research community. Tao and Magnotta (2006) describe the attempt of Air Chemicals to create a broader interface linking scientists dispersed all over the world and hence the firm with this external network of knowledge. Dittrich and Duysters (2007) describe how Nokia accessed and managed a huge number of new external partners to develop its third-generation mobile phones. The authors document different ways of organizing innovation projects in Nokia, depending on the type of partners involved in the collaboration, whereby more organic approaches are used with new partners and structured and formalized systems are employed with established partners. Kirschbaum (2005) looks at how the multinational life sciences and performance materials company, DSM, opened up its innovation process and underlines the importance of teamwork and entrepreneurial culture. Adopting an organizational standpoint, he stresses the need for creating a business group dedicated to business development and venturing. Muller and Hutchins (2012) illustrate how Whirlpool uses open innovation to discover new market opportunities in consumer goods segments. Di Minin *et al.* (2010) describe the organizational challenges that Fiat was confronted with in the 1990s when introducing the open innovation principles in its research centre. A recent study from Bigliardi *et al.* (2012) investigates the approaches used to implement open innovation in the ICT industry, focusing on the use of teamwork or task force as an organizational solution to introduce the open innovation principles.

Most of these studies focus on cases of medium- or high-tech firms. More recently, some scholars have started to study the adoption of open innovation in low-tech industries. Van Der Meer (2007) shows that innovative Dutch companies, operating in both high-tech and low-tech industries, have successfully adapted their culture and knowledge management systems to the principles of open innovation. Similarly, Chesbrough and Crowther (2006) document the adoption of open innovation in mature and consolidated industries, showing in particular how these firms mainly employ inbound open innovation<sup>2</sup> to optimize project development and execution, and to create growth opportunities through the identification of promising new technologies. Huston and Sakkab (2006) explore the innovation model adopted by Procter & Gamble, showing how the application of open innovation principles has improved the innovation performance of a firm in a traditional industry (i.e. consumer goods). Similarly, Jacobides and Billinger (2006) discuss the case of a fashion firm, which has increased the permeability of its boundaries to the external environment to improve its own innovative, strategic and productive capabilities. Finally, Chiaroni *et al.* (2009) examine the organizational change process through which firms in low-tech industries shift from being closed to open innovators, identifying the main changes in terms of inter-organizational networks, organizational structures, evaluation processes, and knowledge management systems entailed by this transformation process. Some recent studies have also looked at the adoption of open innovation in service industries (see, e.g., Hsieh and Tidd, 2012; Lee *et al.*, 2012; Padilla-Melendez and Garrido-Moreno, 2012).

Despite the richness of the empirical evidence available on open innovation, there is no systematic attempt to compare the approaches used to implement open innovation in different industries; to unearth differences and illuminate the reasons underlying them. Moreover, the existing empirical evidence on the organizational and managerial solutions used to implement open innovation mainly comes from single case studies and is

---

<sup>2</sup>Open innovation has two distinct, although entangled, dimensions: (i) “inbound open innovation”, which is the practice of leveraging the discoveries of others and entails the opening up to, and establishment of relationships with, external organizations with the purpose of accessing their technical and scientific competences for improving its own innovation performance; (ii) “outbound open innovation”, which is the practice through which firms enter into relationship with external organizations with business models that are better suited to commercialize and exploit a proprietary technology.

focused on a single aspect of the firm's organization, without providing an organization-wide picture of the organizational implications of open innovation. A systematic understanding of the inter-industry differences in the implementation of open innovation is also absent in the stream of research that has attempted to study the performance implications of open innovation (see e.g. Mazzola *et al.*, 2012; Dahlander and Gann, 2010), although it would be important to gain a more thorough picture of what moderates the impact of open innovation practice on the determinants of competitive advantage.

The paper represents a first attempt to fill these gaps through an exploratory comparative analysis which involved eight firms from heterogeneous industries. As a first step, a reference framework has been developed and subsequently used as a lens to support the multiple case study research. This model is discussed in the next section.

### **Theoretical Framework**

Implementing open innovation has a deep impact on all organization and management systems of a firm. As noted by Christensen (2006: 35), "open innovation can be considered an organizational innovation" in itself. The organizational change entailed by open innovation is highly pervasive and multifaceted. As highlighted in recent research (Trott and Hartmann, 2009; Lazzarotti and Manzini, 2009), open innovation is not an "all or nothing" approach to innovation management. A continuum exists between open and closed innovation, and a firm has several options regarding how to put the new management paradigm into practice. It becomes essential therefore, to study in detail the different organizational dimensions through which a firm can put open innovation into practice.

Chesbrough and Crowther (2006) propose a taxonomy of the dimensions along which changes in open innovation become manifest, although they do not investigate them empirically. These dimensions are: "strategy/goals", "sourcing", "integration and management", and "metrics and organization".

Starting from the Chesbrough and Crowther's framework, we identify two dimensions of the firms' organization which are affected by the implementation of an open innovation strategy, i.e. "external organization" and "internal organization". The former is closely related to the "sourcing" dimension of Chesbrough and Crowther's framework, although we want

to focus especially on the organizational characteristics of the external network and on how it is built, rather than on the intellectual property (IP) management strategies.<sup>3</sup> On the other hand, the “internal organization” dimension includes both the “integration and management” and the “metrics and organization” variables of Chesbrough and Crowther’s framework, which are, in our opinion, closely interrelated and hence difficult to isolate and study separately. We deliberately excluded the “strategy/goals” dimension because we are interested in investigating how a firm which has decided to pursue an open approach to innovation (and has therefore changed its “strategy/goals” accordingly) modifies its organization to implement this strategic orientation.

Furthermore, considering that becoming an open innovator requires a significant cultural and organizational change (Dogson *et al.*, 2006) that might be affected by path dependence phenomena (Eisenhardt and Martin, 2000; Teece *et al.*, 1997; Zollo and Winter, 2002), we added to our framework a dynamic perspective by looking at the antecedents and the characteristics of the change process through which firms developed certain organizational structures. In particular we focused on the “trigger” of open innovation, i.e. on the approaches through which firms created the sense of urgency for change and established a “guiding coalition” for championing it.

In the next subsections, the three main points underpinning our reference framework are described in more detail.

### ***External organization***

One critical aspect associated with the implementation of open innovation is the external organization through which firms search for new ideas and potential external partners with whom to collaborate (Pullen *et al.*, 2012; Fetterhoff and Voelkel, 2006). In this chapter we look explicitly at how the “external organization” is established and used to access external knowledge and technologies, i.e. to implement the inbound dimension of open innovation. As also noted by Chesbrough and Crowther (2006), low-tech and mature firms mainly use open innovation practices to in-source pieces of relevant knowledge and technologies, whereas outbound

---

<sup>3</sup>As will be explained in the next section, we deliberately focus on how the network of inter-organizational relationships is used to access and acquire external pieces of knowledge, i.e. on the inbound dimension of open innovation.

open innovation is far less widespread among them. Therefore, in order to compare the organizational implications of open innovation in low-tech and high-tech industries, we focused our analysis only on the inbound side of the paradigm.

Literature identifies three sourcing methods, namely information transfer from informal network, R&D collaboration, and technology acquisition, for implementing inbound open innovation processes (Kang and Kang, 2009). Similarly, Simard and West (2006) distinguish between deep ties, which enable a firm to capitalize on existing knowledge and resources, and wide ties, which are more appropriate to find novel technological and market opportunities. Collaborations can indeed have explorative or exploitative purposes (March, 1991) and this is reflected in the type of tie linking the actors of the network. Explorative collaborations usually require weaker ties, which imply a more informal way of working, in comparison with exploitative collaborations, which are based instead on established and formalized inter-organizational relationships (Dittrich and Duysters, 2007). In addition, several pieces of research focus on the type of actors, e.g., universities (Santoro and Chakrabarti, 2002; Perkmann and Walsh, 2007) and users (von Hippel, 1987; Brown and Hagel, 2006) involved in the network, and discuss the extent to which they are appropriate for different types of innovation processes. Actors of the network can also be seen as a source of complementary assets over which the firm does not have a hierarchical control (Dahlander and Wallin, 2006). Dahlander and Wallin (2006) further develop a set of common and shared practices enabling effective collaboration and technology exchange. In this process, a key role is played by those individuals who take a central position in the scientific, technical, or market community.

It clearly follows that the “external organization” concept is a very multifaceted one. For the purpose of this chapter, we focus in particular on: (i) the aim for which it is created and the prevailing typology of partners involved; (ii) the typologies of tie established with external partners; and, finally, (iii) the process of creation of the network.

### ***Internal organization***

Innovation management and organization research studied the relationships between the firm’s innovation capabilities and its organization, long before

the diffusion of the open innovation concept. In particular, organization scholars have thoroughly investigated the coupling processes between innovation and internal organizational structures. Burns and Stalker (1961) argue that in a dynamic environment, formalization reduces organizational adaptability to environmental changes and increases, therefore, the risk of organizational failure in pursuing innovation. Another stream of research which has looked at the relationships between organization and innovation capabilities refers to the concept of ambidexterity. Ambidexterity identifies a firm's ability to contemporarily pursue exploration and exploitation activities, incremental innovation in the existing business and radical innovations in an unknown market space (Tushman and O'Reilly, 2004). It can have either a structural (Tushman and O'Reilly, 2004) or a contextual nature (Birkinshaw and Gibson, 2004). More recently, it has been shown that the organizational context has an impact over the firm's ambidexterity (Brion *et al.*, 2010).

In keeping with this body of research, we propose that a firm's internal organization has a deep impact on the implementation of open innovation. Adopting open innovation requires significant barriers to be overcome, such as the so-called "not-invented-here" (NIH) syndrome (Katz and Allen, 1992). Huston and Sakkab (2006), describing the Connect & Develop innovation process at Procter & Gamble, point out the importance of several further organizational issues, mentioned also by other scholars, e.g., the need to develop a complementary internal network to smoothly integrate externally acquired knowledge (Hansen and Noria, 2004), the need to ensure a strong championship for the open innovation process (Schon, 1963; Chakrabarti, 1974; Howell and Higgins, 1990; Chesbrough and Crowther, 2006) and, finally, the introduction of a rewarding system which drives the efforts of employees toward the achievement of open, collaborative outcomes (Chesbrough, 2003).

As a consequence of this brief analysis, our framework encompasses the following variables regarding the firm's internal organization: (i) organizational structures, e.g., the establishment of dedicated units or sub-units devoted to the implementation of open innovation; (ii) organizational procedures used to screen, select, and integrate new business opportunities and ideas coming from both internal and external sources; and (iii) rewarding and incentive mechanisms used for the assessment of the effort devoted to open innovation.

### ***“Trigger” for open innovation***

Building on the early work of Lewin (1947), several scholars (Judson, 1991; Kotter, 1995; Galpin, 1996; Clark *et al.*, 1997) have advanced different multi-phase models which explain and guide the process of introducing and institutionalizing change into an organization. In particular, organizational change literature has clearly shown that in order to start and guide this transformation process it is necessary to create a sense of urgency for change and to establish a leader or a group of leaders for championing it. There is wide consensus on the fact that a jump-in approach (Kotter, 1995) is usually effective in pursuing this objective, because it reinforces the discontinuity with the introduction of a new management style (Orlikowski and Hofman, 1997).

It should be reiterated here that shifting from a closed approach to innovation management to an open one is not a continuous process, but tends to occur in shocks (see Chapter 12 in this book). Therefore, in our model, the trigger of the transformation process from closed to open innovation has been included to understand how the firms that we studied have started the shifting process from a closed innovation approach to an open one, and perhaps if the trigger of the process has affected the organizational implications of open innovation.

### **Research Methodology**

The methodology used for the empirical analysis is a multiple case study. As suggested by a number of scholars, this is a very useful method for building a rich understanding of complex phenomena (Eisenhardt and Graebner, 2007), where answers to “how” and “why” questions are required and it is not possible to isolate the subject of the investigation from the context in which it is embedded (Yin, 2003). In particular, a multiple case study design was chosen because it ensures both an in-depth examination of each case study and the identification of the role played by a number of contingency variables (e.g., firm size and extent to which the firm has conformed to the open innovation paradigm).

A final sample of eight firms, comprising firms operating in different industries, was built. These firms have been selected as examples of Italian “early adopters” of open innovation. First, Italian open innovation firms were identified through a systematic screening of Italian newspapers and

other public information sources, carried out with reliance on professional databases ([www.lexisnexis.com](http://www.lexisnexis.com) and [www.infotrac.com](http://www.infotrac.com)) and using the following search keywords: “open innovation”, “IP management”, “technological collaborations”, “spin off”, etc. We deliberately focus on large firms under the assumption that implementing open innovation in these companies entails a higher number of complex managerial and organizational challenges, in comparison with small- and medium-sized firms. This makes large organizations an interesting setting for our empirical analysis.

A first list of 12 companies was created. We had a preliminary phone interview with senior managers from each firm included in the list, in order to assess its suitability for the research. During this interview, we asked some preliminary questions to determine if the firm could be considered as an example of an open innovator. In particular, we invited our respondents to answer three main classes of questions: (i) whether the firm has deliberately established a strategic priority to improve its relationships with external organizations, through both inbound and outbound open innovation processes; (ii) whether the firm has introduced a dedicated budget for the establishment and management of external collaborations and partnerships; (iii) whether the firm has undergone a reorganization of internal processes to improve its ability to manage collaborative innovation activities. According to the literature, these are the three main characteristics which qualify open innovation firms (Chesbrough, 2003; Chesbrough, 2006). We found that only eight firms out of the twelve could be considered open innovators, albeit at a varying extent, and they were included in the final sample of the analysis.

Table 1 provides some preliminary information about the firms in our sample (real names have been removed for confidentiality reasons) and the industries in which they operate. As regards R&D intensity, the sampled firms were classified according to the OECD taxonomy (OECD, 2005). Concerning the other three industry-level variables, we asked three professors of strategic management and innovation management at our university to rate the firms in our sample on a three-level scale (low, medium and high), based on the aforementioned definitions of technology uncertainty, appropriability, and clockspeed. All the professors provided the same evaluations along the three industry-level variables.

The unit of analysis of the research is the firm as a whole and, in particular, the managerial and organizational approaches it employs to

Table 1. Preliminary data about the firms in the sample.

Firm	Annual sales (2007)	Employees	Annual investments in R&D (% sales)	R&D Intensity*	Appropriability	Uncertainty	Clockspeed	Role of interviewed people
Building and construction	€ 6 billion	23,000	3%	MLT	LOW	LOW	SLOW	<ul style="list-style-type: none"> <li>• Head of R&amp;D</li> <li>• Head of marketing and innovation</li> </ul>
Steel pipes	€ 10 billion	21,700	0.6%	MLT	LOW	LOW	SLOW	<ul style="list-style-type: none"> <li>• Head of corporate R&amp;D</li> <li>• Coordinator of R&amp;D and technological innovation projects</li> <li>• Divisional product development manager</li> </ul>
Laying floors	€ 1.2 billion	5,000	3.5%	MLT	LOW	LOW	SLOW	<ul style="list-style-type: none"> <li>• CEO</li> <li>• Head of corporate R&amp;D</li> <li>• Coordinator of university — industry relationships</li> </ul>
Automotive systems	€ 0.9 billion	4,300	6%	MHT	HIGH	MEDIUM	MEDIUM	<ul style="list-style-type: none"> <li>• Head of corporate R&amp;D</li> <li>• Head of IP office</li> </ul>

(Continued)

Table 1. (Continued)

Firm	Annual sales (2007)	Employees	Annual investments in R&D (% sales)	R&D Intensity*	Appropriability	Uncertainty	Clockspeed	Role of interviewed people
Pharmaceuticals	€0.5 billion	2,347	34%	HT	HIGH	HIGH	FAST	<ul style="list-style-type: none"> <li>Coordinator of R&amp;D and innovation projects</li> <li>Innovation projects manager</li> </ul>
Complex systems integrator	€1.7 billion	7,050	18%	HT	HIGH	HIGH	FAST	<ul style="list-style-type: none"> <li>Head of IP office</li> <li>Divisional head of technological development</li> </ul>
Semiconductors	7€billion	50,000	16%	HT	HIGH	HIGH	FAST	<ul style="list-style-type: none"> <li>CEO</li> <li>Head of R&amp;D</li> <li>Innovation projects manager</li> </ul>
Aerospace and defence	13 €billion	9,000	12%	HT	HIGH	HIGH	MEDIUM	<ul style="list-style-type: none"> <li>Head of R&amp;D</li> <li>CTO</li> </ul>

\*MLT = medium-low technology; MHT = medium-high technology; HT = high technology.

manage technological innovation under the open innovation model. All the eight firms included in the final sample are very successful players in their industry and are acknowledged to be popular examples of innovating firms.

The main source of empirical data has been semi-structured, direct interviews. We interviewed at least two managers for each firm. Our first key informant was the head of corporate R&D, but we also interviewed managers with different roles and responsibilities in innovation, e.g., chief executive officers, project managers, and intellectual property managers (see Table 1). Multiple respondents were used to reduce the risk of personal and *post hoc* interpretation biases (Yin, 2003). Each interview lasted on average one and a half hours, and followed a replicable protocol. Secondary data were gathered in the form of company reports and project documentation, which have been triangulated with information drawn from the direct interviews in order to improve and ensure constructs' validity (Yin, 2003). All interviews were tape-recorded and transcribed. A telephone follow-up with the respondents was necessary at this stage to collect some important missing data.

The following section reports and discusses the main results of our empirical analysis.

## **Results and Discussion**

The collected evidence is presented in Table 2 and mapped along the three dimensions of our reference framework.

From a cursory analysis of Table 2, it is immediately clear that a number of differences exist in the organizational approaches adopted by firms belonging to different industries in implementing open innovation. In the following sections, a detailed discussion of such differences is provided, distinguishing between the three dimensions of our framework, namely "external organization", "internal organization", and "trigger for open innovation".

### ***External organization***

Implementing open innovation requires the firm to collaborate with several external actors and to manage the relations with them. Starting from our framework, we collected evidence at three levels: (i) the purpose for creating the network and the typologies of actors with which the firm