International Journal of Innovation Management
Vol. 13, No. 4 (Dec. 2009) pp. 615–636

ICP Imperial College Press
www.icpress.co.uk

DIFFERENT MODES OF OPEN INNOVATION: A THEORETICAL FRAMEWORK AND AN EMPIRICAL STUDY

VALENTINA LAZZAROTTI* and RAFFAELLA MANZINI†

Università Carlo Cattaneo
Corso Matteotti 22, 21053 Castellanza (VA), Italy
**vlazzarotti@liuc.it*
†*rmanzini@liuc.it*

Starting from the several conceptual and empirical studies about open innovation modes, this paper attempts to integrate them by suggesting a framework which reveals four basic ways to collaborate. Two variables are considered that represent the degree of openness for a company: (i) the number/type of partners with which the company collaborates, briefly labelled as "partner variety"; (ii) the number/type of phases of the innovation process that the company opens to external contributions, briefly labelled as "innovation funnel openness". By crossing these two variables, four basic modes of open innovation are identified: *closed innovators*, *open innovators*, *specialized collaborators* and *integrated collaborators*. The framework shows its practical validity in an empirical study that is conducted in Italy with the specific aim at verifying whether companies can really be mapped using this framework, i.e. whether the four modes of open innovation can be found in real companies (framework applicability); whether different modes correspond to different companies' strategies, capabilities, organisational and managerial processes (framework explicative power and usefulness). The framework shows that, in some cases, being totally open in innovation activities is not the only and most suitable option, but that different degrees and ways of "openness" can be implemented successfully, as well as the totally closed option.

Keywords: Open innovation; technological collaboration; partner variety; R&D process; innovation funnel openness; modes of collaboration; innovation strategy; capabilities and processes; multiple case study; Italy.

*Corresponding author.

Introduction

Open innovation may be pursued in many different ways, in terms of: (i) organisational form of acquisition or exploitation and consequent time horizon; (ii) number of partners, from dyadic partnerships to networks, and typologies of partners, from traditional supply chain relationships to collaboration with universities, technical service companies, competitors, firms operating in different industries (Chiesa and Manzini, 1998); (iii) phases of the innovation process that exploit external sources (Gassmann, 2006). The literature has already studied in depth the problem of choosing the specific governance and organisation of open innovation processes, analysing the relative organisational and managerial implications. In other words, the literature has already characterised the different approaches to open innovation in terms of level of integration, organisation and forms of governance (van de Vrande *et al.*, 2006).

This paper attempts to study and the implications of other variables — namely, the number and attempts types of partners and the phases of the innovation process which are "open" to external contributions — to significantly different approaches to open innovation.

In the literature, many contributions have studied collaborations with specific partners: universities, TSS, customers, suppliers, competitors, public governmental institutions, private research centres (Chiesa *et al.*, 2004; Hoegl and Wagner, 2005). It seems that collaborating with different subjects gives rise to different problems and advantages and requires specific organizational and managerial approaches. Collaborating with a single partner, such as customers in NPD, would presumably be quite easy. Accessing a wide set of external partners (e.g. customers, competitors, universities), coordinating their contributions, organising the innovation process around them and managing all the relationships is significantly different. In other words, it can be argued that the number and type of partners with which a company collaborates is something that determines the level of openness of the innovation process of a company: the more partners the company has, the more "open" its innovation process.

A second relevant observation concerns the number and type of phases in the innovation process for which the company accesses external sources of technology and know-how. Many authors have studied the specific advantages companies may gain by opening their idea generation phase (Berger *et al*., 2005), the prototyping or engineering phase, the production phase and the commercial phase (Emden *et al*., 2006; Gassmann and Henkel, forthcoming). Again, it could be quite simple to open a specific phase of the innovation process, while managing the whole innovation funnel as an open funnel would probably more be complex. In any case, it can be

argued that the more phases of the innovation process in which the company accesses external sources, the higher the level of openness of the innovation process.

Starting from the several conceptual and empirical studies that analyze and give examples of different types of partners operating in different phases of the innovation funnel this paper attempts to integrate them by suggesting a framework which reveals four basic ways to collaborate. In fact, by crossing the two variables introduced above, four degrees of openness are firstly identified to become the drivers of the four basic ways to collaborate: low partner variety and few phases (*closed innovators*), high partner variety and many phases (*open innovators*), high partner variety and small phase variety (*specialized innovators*), and low partner variety and large phase variety (*integrated innovators*). Secondly, the framework shows its practical validity by means of an empirical study that is conducted in Italy with the specific aims at verifying:

- Whether companies can really be mapped in this framework, i.e. whether the four modes of collaboration can be found in real companies (framework applicability);
- Whether different modes correspond to different companies' features: strategies as well as capabilities, assets, organisational and managerial processes (framework explicative power and usefulness). This point is particularly important in light of the literature that stresses the importance of the "right conditions" (in terms of the company's strategy, capabilities, organizational factors, etc.) to successfully carry out any open approach for innovation (Pisano and Verganti, 2008). In other words it is important to pay attention to how firms can in reality implement open innovation (Chesbrough *et al.*, 2006). Following this suggestion, we try to enrich the available evidence by identifying the strategic, managerial and organizational contextual factors for some specific modes of collaboration.

The result of the second aim of the empirical study is that the paper tries to give also some normative indications of how to choose different collaboration modes. Differences in strategies and companies' capabilities, organizational and managerial features can in fact lead to different kinds of open modes although companies are operating in the same industry, with analogous size (revenue, number of workers).

The rest of the paper is organized as follows. First, it introduces the theoretical framework of the variables entailing different modes of collaboration. This section also points out the typical trade-offs of each mode. Second, it documents an empirical study and discusses the specific conditions that make it easier to carry out the different kinds of collaboration modes. Then, it draws the final conclusions by summarizing the contribution of this study.

The Theoretical Framework

Since Chesbrough published his book in 2003, the concept of open innovation has received a considerable amount of attention from practitioners and researchers. A large number of studies are adopting this term to describe the phenomenon where firms rely increasingly on external sources of innovation, which means that ideas, resources and individuals flow in and out of organizations (Chesbrough, 2003). While contributions are still growing, the debate on innovation management is enriched by relevant studies that critically examine the open innovation concept by exposing its weakness and limitations (Dahlander and Gann, 2007; Trott and Hartmann, 2009). First of all, authors argue that the concept is not particularly new and there has been a strong research tradition on the topic for decades, which is evidence that innovation has always been open to some degree (Freeman, 1974; Pavitt, 1984; von Hippel, 1986; Chandler, 1990; Tidd, 1993). Moreover, the concept has been criticised for constructing an artificial dichotomy between closed and open approaches (Dahlander and Gann, 2007), while the idea of exploring different degrees and types of openness in a sort of continuum seems to provide a more interesting and rich avenue for investigation. In particular, this view allows a deeper and more realistic investigation of companies' behaviour and of the particular nature and context of sources of innovation (Gassmann, 2006; Dahlander and Gann, 2007). The number of studies adopting this approach is growing: for example, Dahlander and Gann identify three types of openness according to (1) the different degrees of formal and informal protection, (2) the number of sources of external innovation, (3) the degree to which firms are relying on informal and formal relationships with other actors, while Lichtenthaler (2008) defines the degree of openness by crossing two dimensions of a firm's strategic approach to open innovation (i.e. the extent of external technology acquisition and the extent of external technology exploitation). Lichtenthaler identifies groups of firms that pursue homogeneous strategies and then practically characterizes them in terms of variables such as R&D intensity, emphasis on radical innovation, product diversification, etc.

In this paper, we follow this idea that openness needs to be placed on a continuum and we try to explore its different degrees basically in terms of the number of sources of external innovation.

On this topic, it has been recently suggested by literature that the degree of openness in a collaboration network for innovation depends on the degree to which membership is open to anyone who wants to join (Laursen and Salter, 2004; Pisano and Verganti, 2008). In totally open collaboration (i.e. crowd sourcing), everyone (suppliers, customers, universities, students, inventors, TSS, governmental institutions, private research centres and even competitors) can participate. A company makes a problem public and looks for support from an unlimited number of problem

solvers. Closed networks, in contrast, are like private clubs and tend to be smaller than open ones (Pisano and Verganti, 2008). Here, the company shares the problem with few parties (usually, suppliers and customers) that it selects because it believes they have the crucial capabilities and assets to provide innovative solutions. Several conceptual and empirical studies hint at the importance of the outside subject's innovative capabilities as a major determinant of innovation success: traditionally, suppliers (Wynstra, 2001; Wagner, 2009) and customers (von Hippel, 1986; Berger *et al*., 2005) and, more recently, an integration of different types of partners in manifold relationships (Chesbrough *et al.*, 2006). For example, some authors (Gassmann and Henkel, forthcoming) provide a lot of empirical evidence of large and well-known companies (e.g. IBM, BASF, BMW, etc.) that shows the existence of different degrees of openness. Literature has also shed light on the advantages and challenges characterizing the open versus closed approach as well as some basic conditions that make it possible to adopt each approach. The big advantage of an open network (i.e. high partner variety) is its potential to attract an extremely large number of problem solvers and, consequently, a vast number of idea contributions (Coombs and Hull, 1998; Gassmann and Henkel, forthcoming; Pisano and Verganti, 2008). Moreover, in extremely open approaches, it is not necessary to know the potential contributors. Indeed, this fact could be particularly valuable: interesting innovative solutions can come from people or organizations that the company might never have imagined had something to contribute. However, open modes have their disadvantages. First of all, the costs of screening and testing several solutions could be very high. Rarely, in fact, is the screening process is cheap and fast (for example, in the assessing the working of a software code). Usually, because expensive and time-consuming experiments are necessary, it is better to consider fewer ideas. This means choosing a closed mode by inviting those parties that company thinks will have the best chance of providing good ideas. Besides, as the number of participants increases, the likelihood that a participant's solution will be selected decreases. In such situations, transaction cost theory (Williamson, 1985) suggests that the best potential partners can be discouraged from participating because they do not want to make transaction-specific investments that cause resource-wasting, if they are not sure of being selected. Thus, the best parties prefer to participate in small relationships (i.e. closed modes), to be maintained in the long run (Pisano and Verganti, 2008). In addition, repetitive cooperation builds familiarity between the partnering firms, which in turn creates trust (Gulati, 1995). From a transaction cost perspective, trust decreases the fear of opportunistic behaviour among the partner firms, allowing the reduction of the spill-over risk. More generally, as the number of selected partners increases, the need for coordination and control (of the above behaviours and results) increases too, generating organizational costs and risks that can become onerous (Mintzberg, 1983; Dahlander and Gann, 2007). In contrast,

fewer partners can be more easily coordinated and controlled and this is in favour of more closed approaches. Such trade-offs suggest that extremely open modes can be effective only under certain conditions: collaboration should concern problems that can be partitioned into discrete parts that partners can work on autonomously with low coordination needs (i.e. "high product modularity", see Gassmann and Henkel (forthcoming)). Over the last years, this has been made easier by information technology that allows partners to make contributions, share work and observe the solutions of others (Gassmann and von Zedtwitz, 2003; Dogson *et al.*, 2006). Of course, not all problems can be partitioned. Indeed, the research and development related to new product concepts are usually integral tasks which require strong integration and coordination among partners. In such cases, less open modes allow coordination at a lower cost and thus they should be preferable (Pisano and Verganti, 2008).

Apart from the partner variety, relevant conceptual and empirical contributions have focused on the so called "innovation funnel" (see Fig. 1). Openness is the salient feature in this figure: in each phase, companies can potentially access external sources of ideas, technology and know-how, or transfer them to the outside environment (Chesbrough, 2003; van de Vrande *et al.*, 2006) for different reasons: gaining access to new areas of knowledge (also complementary knowledge), managing capacity problems (more flexibility), concentration of core competencies,

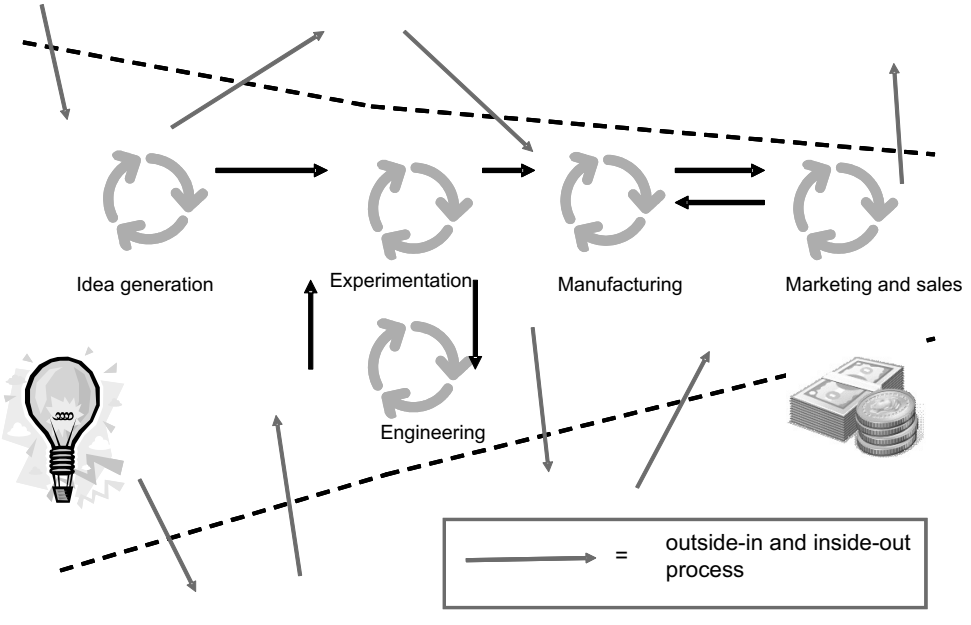

Fig. 1. The innovation process.

speed (reducing time-to-market) and sharing of risks and costs (Hour, 1992). There is empirical evidence about companies that seek support in a specific phase of the innovation funnel or that integrate partners into their entire innovation process in an articulated network of relationships (Gassmann and Henkel, forthcoming). Thus, it can be argued that the degree of openness for a collaboration network can be further specified depending on the number and type of phases of the innovation process for which the company accesses (or transfers) third sources. Openness in collaboration increases moving from external sources in a few phases of the innovation funnel to their contributions to the overall innovation process. In other words, in a less open or closed network, a company chooses one or a few phases (for example, idea generation in the early stage of its innovation process) in which it looks for interesting opportunities for collaborating, while in a totally open conception all the phases are involved. Following the largely accepted suggestion by organizational theories (Mintzberg, 1983), it can be assumed that as the number of phases involved in collaboration increases, the level of complexity increases too, generating transaction costs in a similar way with respect to the partner variety. Therefore, it can be argued that analogous trade-offs characterize open versus closed approaches: on the one hand, managing the whole innovation funnel as an open funnel can provide advantages (in terms of creativity, access to new areas of knowledge, etc.). On the other hand, some disadvantages in terms of coordination and control costs, spill-over risks, etc. can become prevalent.

Recently, some of the studies emphasise the importance of investigating how firms can in reality implement open innovation (Chesbrough *et al.*, 2006; Dahlander and Gann, 2007; Pisano and Verganti, 2008; Raasch *et al.*, 2008; Bilgram *et al.*, 2008), stressing the importance of the "right conditions" (in terms of company's strategy, capabilities, organizational factors, managerial tools, etc.) to implement any open approach successfully. For instance, Sakkab (2002) describes the different types of networks and the strategic planning process which characterizes Procter & Gamble's open innovation approach (Connect & Develop); another contribution (Kirschbaum, 2005) describes how the multinational company DSM has built teamwork and an appropriate culture for opening its innovation process; other authors (Gassmann and Henkel, forthcoming; Christensen *et al.*, 2005) identify the characteristics (companies' capabilities, characteristics of product, technology and industry) to follow an open or closed innovation approach. Effectively managing externally acquired technologies seems to also require the development of complementary internal networks (Hansen and Nohria, 2004), as it is largely recognized that conducting internal research is a prerequisite for being perceived as an attractive partner and for absorbing external knowledge (i.e. the concept of absorptive capacity by Cohen and Levinthal (1990), more recently reviewed by Zahra and George, (2002)). A relevant contribution by Chesbrough and Crowther (2006) highlights

the importance of specific organizational roles facilitating the implementation of open innovation (i.e. the need of a champion) and the use of dedicated rewarding systems as well as knowledge management systems (Chesbrough, 2003; Piller and Walcher, 2006) that are able to support the diffusion, sharing and transfer of knowledge within the firm and with the external environment. The relevant message from the several cited authors is that "open innovation" is far more complicated than "the more openness, the better" (Dahlander and Gann, 2008). It can be costly (with respect to the benefits) and not always suited to the firm's context.

In sum, the basic assumption in our study is that the two variables introduced above (partner variety and phase variety) can represent the degree of openness of collaboration networks for innovation. The literature has already in effect studied these variables and it has pointed out different open (versus closed) approaches. However, the attention is often focused on a single variable (for example, partner variety with questions such as: "Is the involvement of suppliers important, or customers, or both, or neither? What are the advantages and the challenges?") or on limited aspects of integration between the two variables ("Is it important to involve customers in the idea generation?"). Moreover, the interest among scholars and practitioners in the role of contextual factors (i.e. strategic, organisational and managerial characteristics) that make possible different collaboration modes is growing (Dahlander and Gann, 2008). First of all, we try to enrich this body of knowledge by crossing the two variables in order to identify all the available options in terms of degrees of openness. Consequently, four basic modes of collaboration are suggested as synthesised in Fig. 2. The variables are defined as follows:

(1) The number/type of partners with which the company collaborates (labelled "Partner variety");
(2) The number/type of phases of the innovation process that the company opens to external contributions (labelled "Innovation funnel openness").

From a theoretical point of view, each area has significantly different characteristics:

- The closed innovators model corresponds to companies that access external sources of knowledge only for a specific, single phase of the innovation funnel and typically in dyadic collaborations. This is the case, for example, in companies that access to external prototyping services in the new product development process;
- The specialised collaborators model corresponds to companies that are able to work with many different partners, but concentrate their collaborations at a single point of the innovation funnel. This is the case, for example, of companies that involve a wide set of actors (customers, experts, suppliers, research centres) in the idea generation phase of the innovation process;

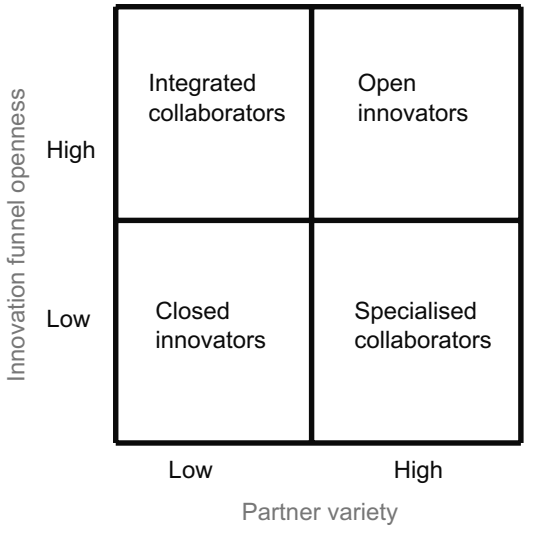

Fig. 2. The four modes of open innovation.

- The integrated collaborators model corresponds to companies that open their whole innovation funnel, but only to contributions coming from a few types of partners (typically, suppliers and/or customers);
- The open innovation model corresponds to companies that are really able to manage a wide set of technological relationships, that impact the whole innovation funnel and involves a wide set of different partners.

These are options that seem to be available from a theoretical point of view. Therefore, our second attempt concerns the validation of the framework: it is necessary to identify real companies for each suggested open approach (framework applicability); each approach must then be contextualized by recognizing those factors and features (strategies, characteristics of products, organizational and managerial capabilities and assets) that lead to a particular approach or that make it suitable. In the next section the empirical study will be described and its results will be discussed.

The Empirical Study

The empirical study started with a large set of interviews, with 52 Italian companies involved, operating in different sectors of activities and including small, medium and big companies, as shown in Table 1.

Table 1. Companies interviewed.

Company	Sector of activity	Size
Alenia Aermacchi	Aerospace	Big
Area3 Engineering	R&D services	Small
Explora Italia S.r.l.	Chemical	Small
BMP Bertelli Materie Plastiche S.p.A.	Rubber and plastics	Medium
CPC S.r.l.	Textile	Small
Rancilio S.p.A.	Mechanical	Medium
Ineos	Rubber and plastics	Medium
Nikem Research	R&D services	Medium
Condor's Rubber	Rubber and plastics	Medium
Dipharma Francis S.r.l.	Pharmaceutical	Big
Blue Moon	Electronic machineries	Small
Ecofuel	Chemical	Medium
Kemira Chimica S.p.A.	Chemical	Medium
ICAP Leatherchem S.p.A.	Chemical	Big
National Starch S.p.A.	Chemical	Medium
Silvay-Solexis S.p.A.	Chemical	Big
Blue Star Silicones	Rubber and plastics	Small
Slimpa S.p.A.	Mechanical	Medium
Agusta (Westland) S.p.A.	Mechanical	Big
Afros S.p.A.	Mechanical	Medium
Gimac	Mechanical	Small
Rima	Mechanical	Small
MV Agusta Motor S.p.A.	Mechanical	Big
Cobra Automotive Technologies S.p.A.	Electronic	Big
Redco Telematica S.p.A.	Electronic machineries	Small
Digicom	Electronics	Medium
Mitric	R&D services	Small
Pietro Carnaghi	Chemical	Big
Vamag	Electronic machineries	Small
Munksjo Paper	Paper	Medium
Alfredo Grassi	Textile	Medium
Tintoria Finissaggio Ticino	Textile	Small
Vibram	Rubber and plastics	Big
Secondo Mona S.p.A.	Mechanical	Medium
Lodetex S.p.A.	Textile	Small
Mario Cavelli S.p.A.	Textile	Medium
Mario Crosta S.p.A.	Mechanical	Medium
Mobert S.r.l.	Mechanical	Small
Near Chimica	Chemical	Small
Diffuplast	Rubber and plastics	Small
Tema	R&D services	Small

Table 1. (*Continued*)

Company	Sector of activity	Size
Missoni	Textile	Medium
Ultrabatch S.r.l.	Rubber and plastics	Small
Scatolificio Da.Ra.	Paper	Small
Trigo	R&D services	Small
Vibiplast	Rubber and plastics	Small
A.D.E.A.	R&D services	Small
Rossi di Albizzate	R&D services	Small
Junior S.r.l.	Textile	Medium
Fratelli Rossetti	Textile	Big
BTSR International S.p.A	Mechanical	Medium
Bticino S.p.A.	Electronic machineries	Big

For each company, depending on the specific size and organization, the CEO and/or the R&D manager were interviewed. Questions in these interviews concerned:

- The company's corporate and business strategy;
- The characteristics of the company's innovation process;
- The R&D organisation and management;
- The attitude with respect to technological collaborations and innovation networks in terms of relevance to the innovation strategy, objectives and perceived risks, most relevant partners, success and failure factors.

These interviews allowed us to form a general picture about whether and how companies actually rely on external sources of knowledge and technology for their innovation process. As expected, they demonstrated that companies adopt many different ways to open their innovation process, not only in terms of partners involved and phases opened, but also in terms of organisational and managerial approaches adopted to open such processes. Some of them consider technological collaborations as a strategic opportunity and dedicate time and resources to exploiting such an opportunity; others believe that opening the innovation process is risky, and clearly limit the aim and scope of their collaboration, defining tight rules and control; others, again, avoid resources and time consumption, keeping their innovation process completely closed. The "variety" observed in the way companies adopt to open their innovation process was then classified according to the theoretical framework laid out in the previous section, distinguishing open innovators, closed innovators, specialised collaborators and integrated collaborators. This allowed us to verify the

Table 2. Companies mapped according to the theoretical framework.

	Open innovators	Closed innovators	Specialised collaborators	Integrated collaborators
Number of companies (as percentage of total companies interviewed)	43%	41%	9%	7%
Size	25% big; 40% medium; 35% small	26% big; 21% medium; 53% small	0% big; 50% medium; 50% small	0% big; 67% medium; 33% small
Sectors of activity	All those included in the study	All those included in the study	Paper; rubber and plastics; R&D services; mechanical	Mechanical; electronics; textiles

applicability of the model, and also have a first rough picture of the diffusion of each different model. The result of this process is synthesised in Table 2.

Table 2 clearly shows that:

- The two "extreme" models (open and closed) are far more diffused then intermediate ones (specialised and integrated collaborators), but all models are actually represented;
- It does not seem that the sector of activity and the company's size are main drivers in determining the open innovation model adopted: for each of the four models, we cannot identify a prevalent size or sector of activity. Thus, the degree of openness seems to be determined mainly by the individual strategic choice of a company, although this finding must be considered with caution due to the limited sample size. Moreover, an analysis of prior, more extensive research suggests the existence of industry and size differences regarding the degree of open innovation (Pavitt, 1984; Chesbrough and Crowther, 2006; Lichtenthaler, 2008).

The various forms and levels of "openness" observed suggested that a more in-depth analysis was necessary to fully understand the strategic, managerial and organisational choices of companies and that a multiple case study was the most suitable research method to achieve this objective. This study was then designed by taking as guidelines all the results achieved by means of the interviews. Twelve cases were selected, according to the literal and theoretical replication criterion (Yin, 2003), with three companies for each different open innovation model: companies from

different industries and of different sizes, but adopting the same open innovation model (literal replication); companies from the same industry and of similar size, but adopting different open innovation models (theoretical replication). Among others, these companies were also selected because data and information were available with a high level of reliability, transparency and detail. All companies selected considered their open innovation approach successful (meaning that the major part of their partnerships are able to reach the defined objectives). A short profile of the twelve companies selected for the multiple case study is given in Table 3.

Table 3. Companies involved in the multiple case study.

Company	Open innovation model	Sector of activity	Size	Critical Success Factors	R&D organisation
Alenia Aermacchi	Open inn.	Aerospace	Big	Technological excellence; time to market; brand, organisational capabilities; business portfolio	Matrix
Rancilio	Open inn.	Mechanics	Medium	Quality, service level, technological excellence, organisational capabilities	Input oriented
Area3 Engineering	Open inn.	R&D services	Small	Price, time to market, technological excellence	No formal org.
Vibram	Closed inn.	Rubber & plastics	Big	Quality, service level, brand	Input oriented
Digicom	Closed inn.	Electronics	Medium	Price, quality, time to market,	Matrix
Lodetex	Closed inn.	Textile	Small	Quality, time, service level, technological excellence, brand, organisational capabilities	Input oriented
BMP	Specialised collab.	Plastics	Medium	Time to market, service level, business portfolio	Input oriented

Table 3. (*Continued*)

Company	Open innovation model	Sector of activity	Size	Critical Success Factors	R&D organisation
Cavelli	Specialised collab.	Textile	Medium	Quality, time, service level, technological excellence, organisational capabilities	Input oriented
Blue Moon	Specialised collab.	Electronic machinery	Small	Technological excellence, brand	Input oriented
Nearchimica	Integrated collab.	Chemical	Small	Time to market, quality, business portfolio	Input oriented
Crosta	Integrated collab.	Mechanics	Medium	Quality, time, service level, technological excellence, organisational capabilities	Input oriented
Tema	Integrated collab.	Electronics	Small	Quality, technological excellence	Matrix

The case study allowed us to analyse more in depth:

- The innovation process of companies, in terms of typical activities and actors involved, phases/steps in the R&D activity, costs, technical and commercial risks, time;
- The roles and organisation used by companies to support the open innovation model adopted;
- The process through which companies organise and manage their innovation networks, i.e. (i) the definition of objectives and risks of activities "open" to external partners; (ii) the selection and analysis of partners; (iii) the identification of the organisational and contractual form for the partnerships; (iv) the planning of network activities: time, technological and financial resources, competencies and other intangible assets.

A research protocol was used in the study, consisting of a questionnaire with open and closed questions and in a list of data and documents to be collected (such as, for

example, economic and financial exhibits, R&D indicators of performance, organisational charts). This ensured homogeneous and coherent data and allowed cross case analysis, a necessary technique for pointing out differences and/or similarities among companies adopting the same open innovation models and between different clusters of companies, adopting different models. The results of this analysis are here briefly synthesised.

Open innovators

Open innovators are characterised by a high tension towards technological leadership and internationalisation of activities, even R&D; technology and innovation represent critical success factors and require excellent and diversified competencies; R&D and innovation activities have a very high level of risk, both technical and commercial and the level of R&D spending is quite high (as a percentage of sales). In particular, this high internal R&D intensity has to be emphasized because it supports the literature's suggestion that firms find open innovation to be complementary with internal R&D, instead of being a substitute (Cohen and Levinthal, 1990; Zahra and George, 2002). Prior research suggests also that a high level of R&D spending is required by the pursuit of a technological leadership (Freeman, 1982; Trott and Hartmann, 2009) and this seems the case of our "open innovator" profile. On the other hand, the emphasis on radical rather than incremental innovation further increases the relevance of external sources of technology. This finding is also consistent with suggestions from previous literature (Lettl *et al.*, 2006; Lichtenthaler, 2008): when developing radical innovations, firms may rely on a higher degree of external technology acquisition because they are not able to internally develop all the necessary knowledge. In addition, the high level of internationalisation seems to be a driver in favour of a high degree of openness, though findings on the topic in the literature are controversial (Lichtenthaler, 2008). Nonetheless, this open innovator said that opening the innovation process was perceived as a critical opportunity, to be exploited for a broad set of objectives, including: sharing risks with others, integrating and complementing arising competencies, increasing creativity, reducing time to market. The managerial style is highly participative, since the functions of many different companies are involved in the innovation process activities and decisions (R&D, marketing, manufacturing, after sales). The underlying idea is that high involvement makes for higher efficiency and effectiveness in the innovation process. At the same time, it is perceived as a risk and the complexity arising from several relationships to be managed (Mintzberg, 1983; Laursen and Salter, 2004; Dahlander and Gann, 2007) could negatively affect the innovation performance (Laursen and Salter, 2006). As a consequence, open innovators put in place a rather sophisticated organisation and process for supporting technological

collaborations and partnerships, i.e. organising for open innovation (Hansen and Nohria, 2004; Chesbrough and Crowther, 2006). This allows them to manage and control innovation networks as a whole, from the definition of objectives and risks, through partners analysis and selection, to the definition of each organisation's specific role and contractual form of collaboration, the detailed planning of activities and the measurement of actual results. Obviously, designing and implementing such a complex organisational process requires advanced managerial competencies. As a matter of fact, open innovators have proved to be experts at using sophisticated techniques for the technical and economic-financial analysis of all activities and decisions concerning innovation and technological collaborations (Dodgson *et al.*, 2005).

Specialised collaborators

These firms are very similar to the open innovators depicted above. They are characterised by a similar drive towards technological excellence, implying high R&D intensity (Freeman, 1982; Trott and Hartmann, 2009), but with a lower level of internationalisation. R&D risk is medium-high and very often the commercial risk is higher than the technical risk; together with technological excellence, other factors are strategic, such as the service and quality level and the variety of products. This strategy, which is more defensive and focuses on incremental rather than radical innovations, still requires high R&D intensity (Trott and Hartmann, 2009) but a lower degree of openness (Lichtenthaler, 2008). Open innovation is perceived as an interesting opportunity that, on the other hand, entails significant risks and requires too many resources (time, people, money). As a consequence, specialised collaborators define specific roles and organisational mechanisms to support their technological partnerships, but tend to limit relationships to a few phases of the innovation process in order to limit their impact on the company's resources and activities. Technological collaborations are mainly aimed at integrating and complementing competencies and concern only R&D phases in which those competencies are actually lacking. High managerial competencies are necessary to support this open innovation model, and, as in the case of open innovators, companies often use sophisticated decision supporting tools and techniques.

Integrated collaborators

In this open innovation model, technological excellence is only one of the relevant success factors, together with time, quality, service level, brand, and cost-cutting. As a consequence, technological leadership is not the main purpose of these companies as they focus on incremental innovations. Even internationalisation is not a top

priority and mainly concerns commercialisation activities. R&D risk is medium-low, particularly commercial risk. Managerial competencies are not very high, and only in some cases are technical, economic and financial analyses are used to support decision-making concerning innovations and technological collaborations. In accordance with these characteristics, integrated collaborators open their innovation process in a very selective way, traditionally involving mainly suppliers and customers and only in a few cases other types of partners. This choice allows them to avoid the creation of a specific "organisation for open innovation", since contacts with suppliers and customers are usually already established and based on trust, and are then exploited for R&D and the whole innovation process.

Closed innovators

These companies have decided to invest in their internal R&D effort and believe that keeping the innovation process closed allows them to avoid significant costs and risks. In other words, they perceive the openness and the relationships to be too difficult and costly compared to the potential benefits (Laursen and Salter, 2006). The idea is that all the resources (people, money, competencies) and managerial ability should be focused internally to develop innovation. Therefore, these firms develop most technologies in-house. Technological leadership is expected to be mainly the result of an internal effort instead of being the result of an innovation network. The R&D risk is not too high and there is little need to share it with other parties. It can be managed by the company itself, by using sophisticated managerial tools and techniques. Consequently, technological collaborations are episodic and involve few partners with which long-term relationships are established, allowing limited transaction costs and limited risk of spill-over.

Conclusions

The present study has analysed whether different models are used by companies to open their innovation process. The framework, hypothesised in accordance with existing literature, enriches it by identifying four specific different models of open innovation that depend on the number and type of partners involved and on the number and type of phases opened to external contributions: open innovators, specialised collaborators, integrated collaborators and closed innovators. The empirical study has confirmed that these four models exist in practice (i.e. are actually adopted by companies) and outlined them in terms of different levels of complexity and strategic, organisational and managerial characteristics. Different levels of complexity for the four models are depicted in Fig. 3.

Closed innovators avoid a great commitment, which means human, financial and technological resources as well as time, but on the other hand, cannot share

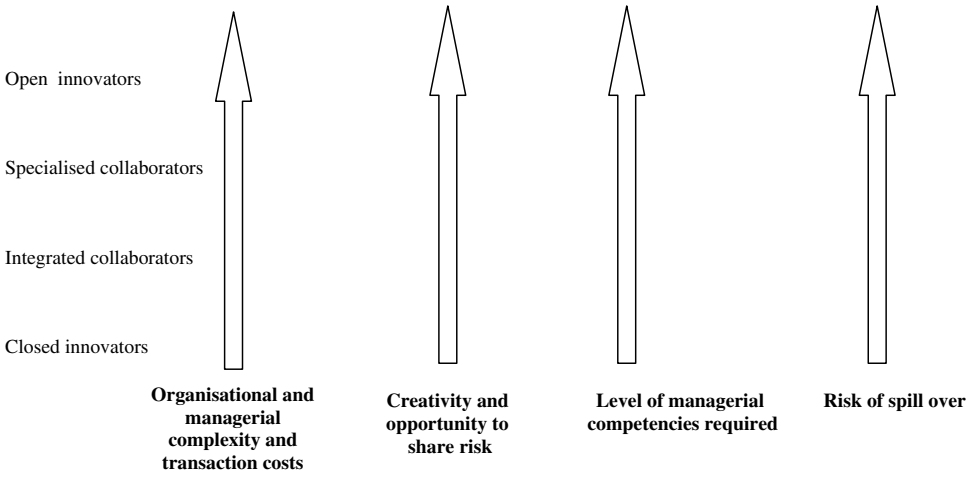

Fig. 3. Different modes of open innovation and their implications.

risks with others and limit their technological opportunities to those achievable by means of internal efforts. Open innovators maximise the exploitation of external technological opportunities, but to this end dedicate large amounts of resources and time to build the necessary organisation and processes. Specialised collaborators and integrated collaborators represent intermediate models that allow them to exploit some of the opportunities that can be captured externally, but limiting at the same time the resources dedicated.

Two models — open and closed innovators — are most diffused among the companies investigated, even if they probably represent "extreme" solutions with "extreme" advantages and limits. The two "intermediate" models may offer several advantages while reducing the disadvantages.

From this point of view, some normative indication can be drawn from the case study, linking different open innovation models to the strategic, organisational and managerial characteristics of different companies, as well as to different degrees of benefits and costs (see Table 4). The table provides a synthesis of the elements that drive choice among the described approaches. The relevant message is that that no mode is better than the others. In particular, according to Dahlander and Gann (2007), it is not true that "the more openness, the better". It can be costly and it is not always easy to have a high degree of openness. Indeed, the approach chosen by companies should depend on its coherence with the strategic, organizational and managerial contexts and on an acceptable balance between the benefits and costs. By adopting this reasoning, the "intermediate" approaches also appear as interesting options in the light of a reasonable compromise in terms of benefits and costs.

Table 4. Modes of open innovation and the relative context.

Open innovation model	Main critical success factors	Level of internationalisation	Technical risk	Commercial risk	Creativity and risk sharing	Innovation emphasis	Organizational and managerial complexity and transaction costs	Risk of spill-over	Level of managerial competence	Managerial style
Open innovators	Technological leadership	High	High	High	High	Radical	High	High	High	Highly participative
Specialised collaborators	Technological excellence, service, time + others	Medium-high	Medium-high	Medium-high	Medium-high	Incremental	Medium-high	Medium-high	High	Participative
Integrated collaborators	Quality, service, time, brand + others	Medium-low	Medium-low	Medium-low	Medium-low	Incremental	Medium-low	Medium-low	Medium	Mainly top-down
Closed innovators	Quality, service, time, brand, technological excellence + others	Medium-low	Medium-low	Medium-low	Medium-low	Incremental	Medium-low	Medium-low	Medium-high	Mainly top-down

However, the above conclusions are drawn from a limited set of companies. A further step in research could be by taking some of the relationships pointed out here and verifying them in an extensive study, for example through a cluster analysis that can validate the suggested framework in terms of its applicability and the identification of differences in complexity and contextual factors among open innovation modes.

References

Berger, C, K Moslein, F Piller and R Reichwald (2005). Co-designing modes of cooperation at the customer interface: Learning from exploratory research. *European Management Review*, 2, 70–87.

Bilgram, V, A Brem and K Voigt (2008). User-centric innovations in new product development-systematic identification of lead users harnessing interactive and collaborative online-tools. *International Journal of Innovation Management*, 12(3), 419–458.

Chesbrough, H (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston: Harvard Business School Press.

Chesbrough, H and AK Crowther (2006). Beyond high-tech: Early adopters of open innovation in other industries. *R&D Management*, 36(3), 229–236.

Chesbrough, H, W Vanhaverbeke and J West (2006). *Open Innovation: Researching a New Paradigm*. Oxford: Oxford University Press.

Chiesa, V and R Manzini (1998). Organizing for technological collaborations: A managerial perspective. *R&D Management*, 28, 199–212.

Chiesa, V, R Manzini and E Pizzurno (2004). The externalisation of R&D activities and the growing market of product development services. *R&D Management*, 34, 65–75.

Chandler, AD (1990). *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge, Massachusetts: The Belknap Press of Harvard University Press.

Coombs, R and R Hull (1998). Knowledge management practices and path-dependency in innovation. *Research Policy*, 27, 237–253.

Christensen, JF, MH Olesen and JS Kjaer (2005). The industrial dynamics of open innovation — Evidence from the transformation of consumer electronics. *Research Policy*, 34(10), 1533–1549.

Cohen, WM and DA Levinthal (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35(1), 128–152.

Dahlander, L and D Gann (2007). How Open is Innovation? *DRUID Summer Conference paper*.

Dogson, M, D Gann and A Salter (2006). The role of technology in the shift towards open innovation: The case of Procter & Gamble. *R&D Management*, 36(3), 333–346.

Emden, Z, RJ Calantone and C Droge (2006). Collaborating for new product development: Selecting the partner with the maximum potential to create value. *Journal of Production Innovation Management*, 23(4), 330–341.

Freeman, C (1974). *The Economic of Industrial Innovation*. London: Pinter.

Freeman, C (1982). *The Economics of Industrial Innovation*. 2nd edition. London: Frances Pinter.

Gassmann, O and E Henkel (forthcoming). Implementing the open innovation approach: Three core process archetypes. *R&D Management*.

Gassmann, O (2006). Opening up the innovation process: Towards an agenda. *R&D Management*, 36, 223–228.

Gassmann, O and M von Zedtwitz (2003). Trends and determinants of managing virtual R&D teams. *R&D Management*, 33(3), 243–262.

Gulati, R (1995). Does familiarity breed trust? The implications of repeated choice for contractual ties in alliances. *Academy of Management Journal*, 38(1), 85–112.

Hansen, MT and N Nohria (2004). How to build collaborative advantage. *Sloan Management Review*, 46(1), 22–30.

Hoegl, M and SM Wagner (2005). Buyer-supplier collaboration in product development projects. *Journal of Management*, 31, 530–548.

Hour, G (1992). Stretching the knowledge base of the enterprise through contract research. *R&D Management*, 22(2), 177–182.

Kirschbaum, R (2005). Open innovation in practice. *Research Technology Management*, 48(4), 24–28.

Laursen, K and A Salter (2004). Searching high and low: What type of firms use universities as a source of innovation? *Research Policy*, 33(8), 1201–1215.

Laursen, K and A Salter (2006). Open for innovation: The role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, 27, 131–150.

Lettl, C, C Herstatt and HG Gemuenden (2006). Users' contributions to radical innovation: Evidence from four cases in the field of medical equipment technology. *R&D Management*, 36, 251–272.

Lichtenthaler, U (2008). Open innovation in practice: An analysis of strategic approaches to technology transactions. *IEEE Transactions of Engineering Management*, 55(1), 148–157.

Mintzberg, H (1983). *Structure in Fives: Designing Effective Organizations*. Englewood Cliffs: Prentice-Hall.

Pavitt, K (1984). Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy*, 13, 343–373.

Piller, FT and D Walcher (2006). Toolkits for idea competitions: A novel method to integrate users in new product development. *R&D Management*, 36(3), 307–318.

Pisano, GP and R Verganti (2008). Which kind of collaboration is right for you? *Harvard Business Review*, December, pp. 1–9.

Raasch, C, C Herstatt and P Lock (2008). The dynamics of user innovation: Drivers and impediments of innovation activities. *International Journal of Innovation Management*, 12(3), 377–398.

Sakkab, N (2002). Connect & Develop Complements Research & Develop at P&G. *Research Technology Management*, 45(2), 38–45.

van de Vrande, V, C Lemmens and W Vanhaverbeke (2006). Choosing governance modes for external technology sourcing. *R&D Management*, 36, 347–363.

Tidd, J (1993). Development of novel products through intraorganizational and interorganizational networks. *Journal of Product Innovation Management*, 12, 307–322.

Trott, P and D Hartmann (2009). Why "Open Innovation" is old wine in new bottles. *International Journal of Innovation Management*, 13(3).

von Hippel, E (1986). Lead users: A source of novel product concepts. *Management Science*, 32(7), 791–805.

Wynstra, F, AJ van Weele and M Weggemann (2001). Managing supplier involvement in product development: Three critical issues. *European Management Journal*, 19(2), 157–167.

Wagner, SM (2009). Getting innovation from suppliers. *Research Technology Management*, January–February, 52(1), 8–9.

Williamson, OE (1985). *The Economic Institutions of Capitalism: Films, Markets, Relational Contracting*. New York, NY: Free Press.

Yin, RK (2003). *Case Study Research: Design and Methods*. Thousand Oaks, California: Sage Publications.

Zahra, SA and G George (2002). Absorptive capacity: A review, reconceptualisation and extension. *Academy of Management Review*, 27(2), 185–203.