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Connecting open and closed innovation markets: A typology intermediaries

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Open Innovation embraces the process of cultivating and internalizing value from opportunities external to the firm, as well as the skilful deployment of internal discoveries to external complements. For a subset of open innovation practice, well-known innovation intermediaries such as InnoCentive and NineSigma can help transgress the boundaries between open and closed innovation markets. Moreover, less publicised forms of intermediation exist, representing consultants, incubators and science and technology parks that further complement innovative practice. Based on an exploratory cross-case analysis, this study enhances our understanding of the operational practices of innovation intermediaries. We develop a theoretical typology that anchors the formulation of generalizable propositions concerning the function and business logic of predominant innovation intermediary types. Implications for management are considered.

Keywords: intermediaries; open innovation; innovation intermediaries; business model; typology

Introduction

The novelty of Open Innovation is that it advocates knowledge-sharing not only internally but also with actors beyond a firm's boundaries. Chesbrough (2003 p.63) stresses that the key to profiting from these interactions depends on the specific architecture and system of a firm's business model for each technology. When designing those features, it is vital that managers take into account both the frequency and range of possible interactions with several innovation partners. However, exchanging knowledge with partners is not straightforward as knowledge may be embedded in people in the organization. Difficulties of codifying and transferring knowledge have been analyzed by Kogut and Zander (1993). As a consequence, firms usually decide to

develop and exploit knowledge in-house rather than licensing, or buying it from / selling it to innovation partners.

Recently though, the Open Innovation literature has emphasized the existence of innovation intermediaries that help alleviating these problems typical for innovation or technology markets. These intermediary markets that (1) facilitate the entry and interaction of firms into unknown industries or sectors and (2) help those firms lacking of an appropriate architecture to create and capture value from external networking opportunities (Chesbrough et al. 2006 p. 7). These intermediate markets are constituted by a so-called “innovation intermediary”, which speeds up the quest for possible solutions to a customer’s problems by drawing on broader sources of ideas and by helping inventors find firms interested in their inventions (Chesbrough 2006). A remarkable example is Ninesigma, which has received over 20,000 innovation proposals from solution providers in 135 countries facilitated over 12USD million in contract awards for companies such as Kraft, Philips, Unilever.

A comprehensive literature review reveals these new innovation intermediaries actively help customers to (1) unlock the potential of customers’ business models (Chesbrough 2006), (2) facilitate outward and inward technology commercialisation (Lichtenthaler and Ernst 2008; Benassi and Di Minin 2009), (3) connect innovation requests with potential innovation providers (Huston and Sakkab 2006), (4) screen firms external market for potential start-ups, (5) segment customer’s needs (Becker and Gassmann 2006). Moreover, a wide-ranging literature review explored other innovation intermediaries such as consultants and science, and technology parks, which might also actively contribute to the innovation process. Such intermediaries may perform functions such as (1) foresight and diagnosis, technology road-mapping, (2) knowledge processing, generation and combination, (3) demand articulation (Howells 2006). An

example is the design company IDEO (Hargadon and Sutton 1997), which helps companies come up with new solutions by drawing on processes and experience in other sectors.

Yet despite all the research, too little attention has been paid to the way these intermediaries could be integrated in a typology, the mechanisms they use to create and capture value for their customers and the implications for companies searching for a intermediaries. This paper attempts to fill the gap by looking at the kinds of business model categories (Chesbrough and Rosenbloom 2002; Schweizer 2005) used by innovation intermediaries in 32 selected cases.

The cross-case analysis evidenced a typology of four kinds of innovation intermediaries, who draw on internal and/or external ideas to facilitate their clients' innovation efforts. Our typology is the first attempt to integrate intermediation theories such as structural holes (Burt 1992; Obstfeld 2005), innovation systems (Stankiewicz 1995), technology transfer (Youtie and Shapira 2008) with emerging research on (open) innovation intermediaries (Huston and Sakkab 2006). Furthermore, this research suggests what is required if an intermediary is to systematically tackle companies' innovation requests (Lichtenthaler and Ernst 2008).

The paper is structured as follows: In the next section we review the literature on the theories contributing to a better understanding of the role of intermediaries. The third section discusses our research strategy. Section 4 gives the results of the data analysis. Section 5 discusses the emerging typology and intermediation propositions. The last section wraps up the paper with the conclusions, a brief discussion of the implications of our work and suggestions for further research.

Literature review

This section synthesises research on innovation intermediaries. Before reviewing previous research on the functions of innovation intermediaries, we shall briefly trace the development of intermediation research. A literature review then focuses on work covering brokerage, innovation systems, technology transfer and innovation management. Because the literature is extensive, we limit our discussion to the main theoretical approaches, activities and theoretical implications.

Innovation intermediaries: A synthesis of the antecedents, functions and theories

While internally-generated information and knowledge is key to a company's performance, innovating firms have increasingly sought to snap up interesting technologies and knowledge and to keep abreast of scientific developments through access to informal networks (Allen 1977 p. 148). Initially, firms with professional R&D centres relied on individual gatekeepers or boundary spanners able to link specific and critical knowledge for their sub-units, from (1) vendors, (2) governmental scientific consultants, (3) users or, rarely, (4) private consultants. Gatekeepers performed a bi-directional role: on the one hand they represented individuals processing and translating scientific knowledge (usually of a specialist nature) to the company's internal setting, and, on the other hand, they disseminated internal information to outsiders (Rothwell 1992, Cohen and Levinthal 1990). Internally, it involves a two-step process: (1) obtaining information from outside units (2) and disseminating this information internally. The process could be defined as one that is conducted by individuals who are able to codify scientific and industrial information from opposing sides of organisational boundaries (Turpin, et al. 1996; Tushman and Scalan 1981). The central drawback of gatekeepers, however, lies in either their narrow remit for gathering

external information or in channelling only intra-organizational conversations to their innovating sub-units (Tushman 1977).

During the 90s, research provided evidence on new governmental mechanisms for helping firms' seek external know-how and access complementary assets (Shohet and Prevezer 1996), which may include technology centres, science parks, joint ventures (Seaton and Cordey-Hayes 1993). These public external intermediaries increasingly complemented the work performed by gatekeepers and were clearing the technology market for companies that were interested in sourcing technologies. At the same time, research revealed the emergence of private incubators fostering partnerships among start-up teams, facilitating the flow of knowledge and talent (Bergek and Norrman, 2008; Hansen et al. 2000). Recently, firms have decided to establish independent incubators to screen the market for high-potential start-ups and build bridges from the star-up to the corporation and vice-versa (Becker and Gassmann 2006). Another emerging form of external intermediation was outside consultants that helped and advised firms in bridging the gap between technological opportunity and user needs (Bessant and Rush 1995). For example, consultants were trained to transfer specialised expert knowledge into new technologies by exploiting their network position.

Nowadays, innovation intermediaries are much deeper-rooted in companies and they seek long-term relationships with their clients. Innovation intermediaries perform functions beyond simple information retrieval and dissemination to study a much wider and more diverse set of functions than hitherto and that include knowledge creation, brokering and diagnosis. Recently, innovation intermediaries were broadly defined as: "An organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to

provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations (Howells 2006)".

The functions of innovation intermediaries

Based on a wide-ranging literature review and his field research, Howells (2006) came up with a list of the ten most common functions of innovation intermediaries. Five functions were identified from the literature: (1) scanning and information processing, (2) knowledge processing and combination, (3) gatekeeping and brokering, (4) testing and validation and (5) commercialisation. The remaining five functions were identified from field research: (6) foresight and diagnosis, (7) accreditation and standards, (8) regulation and arbitration, (9) intellectual property and (10) testing, evaluation and training. We conducted a comprehensive literature review to identify unexplored functions, group them, and to link activities to each intermediation function. The results suggest demand articulation functions (Boon et al. 2008) and brokerage between science, policy and industry spheres (Winch and Courtney 2007; Kodama 2008), neither of which were integrated in previous research. Furthermore, our review suggests innovation intermediary functions might be grouped under three general headings: (1) connection, (2) collaboration and support and (3) provision of technological services (Table 1).

Table 1. Groups, functions and activities of innovation intermediaries

Group	Functions	Activities	Contributing literature
Connection group	Gatekeeping and brokering	Link innovation or patent providers and seekers; build bridges from start-ups to internal corporations; represent a single point of contact to several parties; enable the flow of knowledge generated in the science-base to end-user firms; build networks to overcome weaknesses; provide neutral spaces for innovation	Chesbrough (2006); Huston and Sakkab (2006); Benassi and Di Minin (2009); Becker and Gasmann (2006); Bessant and Rush 1995; Turpin et al. (1996); Winch and Courtney (2007); Hansen et al. (2000); Wolpert (2002)
	Middle men between science policy and industry	Facilitate communication in and co-ordination of social-physical relationships in an innovation system; provide the opportunity to find partners; resources and join research projects	Kodama (2008); Piore (2001); Stankiewicz (1995)
	Demand articulation	Provide interfaces between users and firms; use complementary market demand to provide services; narrow down demand options and furnish more information	Steward and Hyysalo (2008); Boon (2008); Smits (2002)
Collaboration and support group	Knowledge processing and combination	Integrate knowledge from stakeholders; generate in-house scientific and technical knowledge; benefit from the firm's network position and internal behaviour; direct transfer of specialised knowledge; mobilise university research	Hargadon and Sutton (1997); Tether and Tajar (2008); Van der Meulen and Rip (1998); van Lente et al. (2003); Youtie and Shapira (2008); Becker and Gassman (2006)
	Commercialisation	Support marketing, sales and funding activities; inward and outward technology commercialisation	Lichtenthaler and Ernst (2009); Bessant and Rush (1995)
	Foresight and diagnosis	Align public research toward industry needs; provide an interactive model of technology transfer and reception	Van der Meulen and Rip (1998); Seaton and Cordey-Hayes (1993);
	Scanning and information processing	Technology intelligence; scoping and filtering; screen external markets	Howells (2006); Becker and Gassmann (2006)
Technological services group	Intellectual Property	Intellectual property advice; management and IP control	Benassi and Di Minin (2009)
	Testing and training	Testing, diagnostics, analysis and inspection; prototyping and pilot facilities; validation; training	Howells (2006)
	Assessment and evaluation	Technology assessment and technology evaluation	
	Accreditation and standards	Provision of advice on standards and standard-setting	
	Regulation and arbitration	Regulation; self-regulation; informal regulation; arbitration	

The connection group covers intermediaries' three main innovation functions. The gatekeeping and brokering function goes beyond the internal and external translation, deal-making and contract finalisation activities mentioned by Howells (2006). As Table 1 shows, intermediaries foster innovation by playing a middle man role between groups of innovation seekers and innovation providers (Huston and Sakkab 2006; Benassi and Di Minin 2009). They also seek to link entrepreneurial initiatives to internal corporations (Becker and Gasmann 2006; Hansen et al. 2000) and channel the flow of knowledge from science base to end-user firms (Tether and Tajar 2008). Second, the innovation systems literature sees intermediaries as middle men between science policy and industry within a given technological system of innovation and as transforming relationships (Carlsson and Jacobsson 1997). This middle ground between policy and science may foster communication and the co-ordination of social-physical relationships (Piore 2001), improving the chances of finding partners, pooling resources and joining research projects. Third, intermediaries help bridge the gap between companies and communities, furnishing valuable insights on customers' demands and needs (Steward and Hyysalo 2008).

Intermediaries provide collaboration and support services (second group), advising customers on technological, and managerial issues and revealing market trends. Initially, innovation intermediaries use their knowledge-gathering and processing skills to help firms "compensate for a lack of capability" (Bessant and Rush 1995). Currently, intermediaries also: foster in-house research (Becker and Gassman 2006); provide marketing and sales support, and facilitate funding (Howells 2006), commercialise firms' technological knowledge (Lichtenthaler and Ernst 2009) and advise firms on how best to identify and satisfy market needs (Bessant and Rush 1995). In addition, support functions involve anticipation and analysis of likely technological

trends (Seaton and Cordey-Hayes 1993) and screen information on external markets (Becker and Gassmann 2006) through technology intelligence and filtering mechanisms (Howells 2006). Last, Howells (2006) introduced five innovation functions associated with technological services (see Table 1). A literature review shows that more research is needed on the relevance of these functions to innovation processes. Benassi and Di Minin's work (2009) is a welcome exception to the rule, exploring the set of services provided to license patents and to monitor their infringement.

This review sought to identify and delve into the functions performed by innovation intermediaries. The proposed groups of functions highlight what links and differentiates their work in their contribution to innovation processes in companies.

Theories contributing to the study of intermediation

The following comprehensive literature review revealed how research on intermediary organisations draws on contributions from various bodies of research: brokerage (Burt 1992), innovation systems (Stankiewicz 1995), technology transfer (Youtie and Shapira 2008) and innovation management (Hargadon and Sutton 1997; Bessant and Rush 1995; Verona 2006). We review the central theoretical approach, activities and theoretical implications in the next section.

Brokerage

The initial research on individual gatekeepers (Allen 1977; Tushman 1977) was followed up with the study of intermediaries such as science parks (Wright et al. 2008), consultants (Hargadon 2002), incubators (Hansen et al. 2000) and virtual innovation brokers (Verona et al. 2006; Huston and Sakkab 2006; Sawhney et al. 2003). Apparently, these forms of intermediaries act as brokers in all aspects of the innovation

process (Howells 2006). A closer review of the literature (Simmel 1902), however, reveals that third-parties can be differentiated by the level of collaboration and co-ordination they exhibit. In addition, the literature on structural holes mentions that brokers initiate both tight and loose reciprocity among unlinked competing parties in exploiting the relationships forged. This type of intermediary represents the building block of Burt's theory on structural holes, which sees intermediaries as “buffers” between two non-redundant contacts (Burt 1992 p. 18-34). Intermediaries or mediators may also be considered as mediators facilitating co-ordination and collaboration among parties (Obstfeld, 2005).

These differences are exhibited in the business model used by innovation intermediaries. On the one hand, brokers connect firms to a large number of innovation providers using web site platforms (Chesbrough 2006) or by turning “old knowledge into innovative solutions (Hargadon 2002 p. 49)” through the application of established processes. On the other hand, mediators tend to create physical forums for collaborative innovation or co-ordination of activities. For example, Hansen et al. (2000) noted that incubators such as Idealab! provide a channel for entrepreneurial firms to access a network of established companies and to foster entrepreneurial drive.

Innovation Systems

The Technological Innovation Systems (TIS) literature refers to intermediaries as firms that either foster or constrain the generation and exploitation of ideas, disseminate know-how (Carlsson and Jacobsson, 1997), link and transform relations among players and integrate the development of competences (Stankiewicz, 1995). Furthermore, at the National System of Innovation (NSI) level, intermediaries are a central plank in the

learning process in production and innovation system settings (Lundvall et al. 2002) and for co-ordinating activities between users and producers (Smits 2002).

Steward and Hyysalo (2008 p. 306) argue that intermediaries at the system level also have a role in facilitating, configuring and brokering social learning. The facilitation process involves the creation of social, knowledge, economic and regulatory forums for innovation and the organising of activities to integrate users, technology suppliers, governments and private funds. This facilitates technology appropriation by firms, sponsors and users. Finally, the brokering process involves the entrance of new actors, adding the resources and knowledge needed to underpin innovation systems.

University and business incubators

Early research on technology transfer explored the co-ordination of information flow during the innovation scanning, evaluation and implementation services (Lynn, et al. 1996) offered by technology and science parks (Seaton and Cordey-Hayes 1993; Shohert and Prevezer 1996). The 2008 special issue of *Research Policy* delved into the knowledge exchange between universities and business, stressing the role played by intermediaries (see Yusuf 2008). Recent studies note that intermediaries facilitate technology transfer by giving firms and universities information on potential partners, and resources and by co-ordinating joint research projects Kodama (2008). Second, science, and technology parks and Technology Transfer Offices (TTO) are seen as knowledge-hubs that speed up the development of new capabilities and innovation (Youtie and Shapira 2008).

In addition, McAdam et al. (2006) note that TTO are not the only intermediaries fostering technology transfer. Private incubators are also common. These focuses on the technology commercialisation stages and: forge partnerships for start-ups; facilitate the

flow of knowledge and talent (Hansen et al. 2000); spread core and non-core technologies (Becker and Gassmann 2006). A case in point is the Siemens Technology-to-Business Centre (TTB), which works with entrepreneurs and researchers to find emerging technologies and gauge their market potential.

Innovation management

Early studies on the intermediaries' role in innovation looked at how boundary spanners (Tushman 1977) interpreted external information and transferred it internally. Subsequent research focused on the way innovation consultancies exploit existing specialist solutions to come up with new technological/managerial innovations (Hargadon 2002) and the role consultants play in bridging the gap between technological opportunities and user needs (Bessant and Rush 1995). Nowadays, consultants such as Accenture and Capgemini also furnish innovation labs for customers to help share ideas and highlight trends (Wolpert 2002).

In addition, the innovation management literature has paid attention to incorporated novelty, as a value driver (Amit and Zott 2001), present in new intermediaries' business models. One form is known as Virtual Knowledge Brokers (Verona 2006) and is represented by intermediaries such as NineSigma, Innocentive and YourEncore. These firms provide an internet platform for integrating scientific, technological and managerial innovation requests from customers with a network of solution providers (Huston and Sakkab 2006). Other intermediaries facilitate the inward and outward dissemination of technologies, Intellectual Property (IP) and licensing (Lichtenthaler and Ernst 2008; Benassi and Di Minin 2009). Yet others provide physical settings to facilitate user-driven innovations (Sawhney et al. 2003; Schumacher and Nitamo 2008).

A comparison of the knowledge sources used by these two kinds of intermediaries sheds light on the limitations of off-the-peg solutions. On the one hand, consultants provide novel solutions to customers when both knowledge and the consultancy process can be replicated. However, when previous knowledge and processes are not needed, virtual innovation brokers provide processes and platforms to capture novel ideas from outside customers' boundaries (Verona et al. 2006). This distinction between internal and external sources of ideas not only goes to the heart of Open Innovation but also sharpens the distinction between two well-studied forms of intermediaries.

Data and Method

Research strategy

This research employs an inductive cross case study to establish a typology of innovation intermediaries. The case study approach was chosen in this instance because the underlying phenomena are still poorly understood. In-depth enquires were made into the business model used by thirty two comparable innovation intermediaries. The research design was based on multiple case studies and on the interaction of senior and junior investigators to ensure replicable findings (Yin 2009) when examining the types of business model used by intermediaries. As suggested by Eisenhardt (1989 p. 538), the use of multiple investigators enriches studies and strengthens the convergence of perceptions. This approach was used to develop a typology of innovation intermediaries of "consisting constructs linked together by propositions that have an underlying, coherent logic and related assumptions" (Davis et al. 2007). Furthermore, case studies allowed conceptual induction from a deep meaning of conversations to generalisation of categories (Glaser and Strauss 1967).

Sample

The selection criterion for our cases was based on a theoretical sampling strategy and unexplored forms of intermediaries (Appendix 1). The sample only included those intermediaries engaging in innovation activities ranging from the provision of infrastructure to commercialisation phases. We decided to exclude intermediaries that did not address any of the intermediary functions presented in Table 1.

Data Collection

Two data-gathering methods were employed. First, we conducted interviews (McCracken 1988) lasting around an hour and a half with company directors and in some cases with managers. This part of the research began in 2008 with interviews at Living Labs and ended in February 2009. A second round of interviews with three different intermediaries took place between February and June 2009. Second, our junior investigators reviewed the business model categories from thirty innovation intermediaries and gathered detailed information from publicly available sources, such as web sites, reports and personal interviews. We dropped two cases from our sample because they did not address any innovation functions. In both cases, guidelines were set for gathering information on business model categories.

Data Analysis

A theory-building trade-off arises from the overlap between data analysis and data collection (Glaser and Strauss 1967; Van Maanen, 1988). Eisenhardt (1989) suggested “overlapping data analysis with data collection not only gives the researcher a head start in analysis but allows researchers to take advantage of flexible data collection”. In this research, we simultaneously combined the collection of data with the analysis of case

studies to identify possible categories and relationships. We applied techniques for both within and cross-case analysis displays (Miles and Huberman 1994; Yin 2009). Finally, we triangulated and integrated all the data from the aforementioned sources and clarified the major categories of innovation intermediaries.

An integrated framework of intermediation

Our initial inductive analysis of the business models employed led us to formulate four categories in which innovation intermediaries may fall: innovation consultants, innovation traders, innovation incubators and innovation mediators (Table 2). We continue our analysis below, highlighting points from the literature on business models where necessary.

So far, research has extensively studied the different dimensions of business models (Vanhaverbeke and Cloudt 2006; Morris et al. 2005; Chesbrough and Rosenbloom 2002), value creation drivers (Amit and Zott 2001) and structural configurations (Chesbrough 2006; Schweizer 2005). This paper draws on previous research in exploring the following business model categories of a business model configuration for the four types of innovation intermediaries:

- Articulation of the value proposition. The value proposition includes the mechanism or process intermediaries use to create value for customers. It arises through the following value drivers: novelty, lock-in, complementarities and efficiency (Amit and Zott 2001)
- Definition of the value chain to identify intermediaries' specific functions or activities for capturing value
- Identification of market segment

- Definition of value network. The value network denotes the apparent position an intermediary occupies for enabling transactions throughout the value chain.
- The conceptualization of a competitive strategy to identify the resources and mechanisms intermediaries use to maintain advantage over their competitors
- The revenue model depicts the cost structure and profit potential

Innovation consultant

Our data analysis led to two major findings: (1) innovation consultancies create value by developing efficient value drivers to come up with new innovation methods and tools for tackling issues ranging from R&D to commercialisation and (2) an emerging group of intermediaries facilitate technology outsourcing and acquisition by leveraging co-ordination among licensors, IP databases, universities and firms. The value added by such intermediaries lies in their ability to leverage a large number and variety of participants. For example, UTEK addresses the apparent disconnection between scientific research and SME needs. The company leverages its large patent database, internal innovation consultants and innovation methods in providing its services.

Previous research (Youtie and Shapira 2008; Hargadon 2002; Bessant and Rush 1995) addressed the functions of knowledge processing and combination presented in conventional innovation consultancies such as IDEO. In this part, we decided to emphasise the functions¹ addressed by emerging forms of intermediaries. First, scanning and information processing attempts to: 1) solve innovation problems and search

¹ In this paper, the value chain or appropriation denotes the innovation functions performed by intermediaries (Table 1).

possible trends locally and internationally, 2) increase the predictability of results and resource flexibility, 3) detect and explore technological and innovation opportunities and 4) provide services for analysing, assessing, protecting and leveraging patents. Second, intellectual property involves the provision of advice during license acquisition by firms or commercialization of R&D results from universities and research labs. Third, intermediaries also provide mechanisms for analysing, assessing, protecting and leveraging patents.

Table 2. Business model configuration of innovation intermediaries

Categories	Innovation consultant	Innovation trader	Innovation incubator	Innovation mediator
<i>Value proposition</i>	N: Coordinate IP, and licenses databases and relationships with universities to provide technology in-sourcing, licensing, and commercialization services	N: Create and enlarge a community of solution providers and firms to: 1) enable match of solution providers and seekers, 2) facilitate	L: Establish physical spaces to connect university outputs with company requests; identifies scientific or technological opportunities for universities, firms, entrepreneurs	N: Create environments for firms and universities to collaborate in innovation opportunities initiated entrepreneurs, users
	E: Provide innovation processes or tools to address innovation problems relying on a community of consultants	networks of inventors to gather, redefine and commercialize inventions	C: Provide environments, coordinate activities and facilitate access to resources for distributed R&D and innovation	N: Provide facilities for user integration in collaboration with universities, entrepreneurs, companies and local institutions
<i>Value chain</i>	Scanning and information processing; intellectual property; commercialization	Gatekeeping and brokering; scanning and information processing; intellectual property	Knowledge processing, generation and combination; intermediates between science policy and industry; testing, validation and training	Creates spaces for knowledge processing, generation and combination; intermediaries between science policy and industry; demand articulation; testing and validation

Market segment	Large companies; SMEs; research institutes; local governments; investors	1) Firms in search for scientific or technical solutions; 2) scientists; retirees	University institutes and R&D organizations; start-ups; service providers	Large organizations; SMEs; entrepreneurs; research institutes; service providers
Value network	Integrate technological capabilities and market needs; advice specific license and brokering activities	Attempts to set up the conditions for innovation seekers and solvers to solve problems	Connection of university research and firms; creation of a technological or non-technological ecosystems	Creates relationships with external stakeholders to identify opportunities and commercialize technologies
Competitive strategy	Competes providing: access to a network of innovation resources e.g. patent databases or experts; methods and processes for conceptual thinking	Competes leveraging an extensive community of scientists, national labs and an established community of firms	Competes providing technological services; establishing relationships among diverse sectors	Competes enabling: cooperative projects based on shared interests; spaces for collaborative innovation projects; ecosystems for user involvement in early stage technologies
Revenue model	Consultancy fees, selling of software; bonus on results	Fee for solved innovation problems; posting challenges	Public grants; technology testing; private/entrepreneurial projects	Rents from spaces; public or private funding

Following Amit and Zott (2001) business models of intermediaries might be: N= Novel; L= Lock-in; C= Complementarities; E= Efficiency

Some functions resulting of the analysis of the business models overlap in different types of intermediaries. We tried to represent the dominant orientation used by the studied intermediaries.

The market segment for ‘innovation consultants’ includes firms that demand a broader view of innovation opportunities or additional help for innovating in other sectors. Furthermore, they integrate technological capabilities and market needs through the value network by selecting, evaluating and commercialising technologies and supporting specific licensing activities. Data also reveal both forms of intermediaries have a competitive strategy for stimulating interaction in an innovation resource network (e.g. patent databases or new methods addressing the innovation process). Finally, the revenue model is determined by fees for consultancy services, selling software and performance bonuses.

Innovation Trader

Research on Open Innovation reveals a novel form of innovation intermediary with the ability to create and enlarge virtual communities of scientists, retirees and users who provide solutions or sell IP addressing specific customer requirements. For example, NineSigma is one of the largest intermediaries, facilitating over 1,500 Open Innovation projects (Request for Proposal - RFP) in a host of industries and technical disciplines. Since its foundation in 2000, NineSigma has received over 20,000 innovation proposals from around two million solution providers and facilitated over US \$ 12 million in contract awards. According to Andy Zynga, CEO Europe at NineSigma, the value creation driver is the novel element in linking distant actors in the quest for an innovative solution. This process embraces: (1) companies' choice of innovation challenges; (2) translation of challenges into RFP; (3) connection to a global network of potential solvers; (4) evaluation and selection of potential solutions by firms; (5) award and acquisition by companies. Even so, it is unclear why intermediaries trying to replicate a similar business model have not been successful. For example 'Fellowforce', located in the Netherlands, wrongly assumed that innovation solvers will establish an extensive expert community of innovation solvers drawn from different scientific fields to address customer's innovation challenges. An interview with the founder of this company revealed their limited capacity to engage a large number of qualified innovation solvers. Apparently, the network of potential solution providers was simply too small to address the few innovation challenges requested by firms.

Our analysis, suggests that the main value proposition for 'innovation traders' lies in an established network of innovation solvers and strong ties with companies searching for novel and specific solutions. The main value appropriation functions are: (1) gatekeeping designed to connect or involve individual potential solutions providers

in specific customer innovation problems, (2) intellectual property in fields such as negotiation, acquisition and portfolio analysis of technologies and (3) scanning and information present in the strategic advisory services for customers.

This type of intermediary maintains a stronghold in two market segments: (1) customers searching for scientific or technical solutions to well-specified problems in fields such as life science, chemistry and engineering design and (2) highly qualified solutions providers willing to provide responses for monetary rewards. The value network's key to success lies in establishing the conditions for matching up distant innovation seekers and providers (Chesbrough 2006). The competitive strategy of this kind of intermediary is based on leveraging the interaction of an extensive and qualified innovation network of scientists, retirees, entrepreneurs and corporate clients such as Kraft, Philips, Unilever and Xerox.

Innovation incubator

Data analysis revealed two forms of 'innovation incubators'. On the one hand, there are established science or technology parks that aim to co-ordinate and facilitate access to scientific and technological resources for innovation. This form of intermediation uses a lock-in value driver to forge trust with universities, firms and governments in tackling scientific and technological challenges and in conveying companies' requirements to universities. On the other hand, Open Innovation parks (e.g. HTC Eindhoven and CREAPOLIS) are beginning to take root in Europe. Here, intermediaries seek complementarities among firms in terms of knowledge, resources and services in a physical setting. Although these intermediaries are emerging and their contribution to innovation has yet to be explored, the following section provides an overview of two such outfits.

The extensive literature on science and technology parks has studied different components of their business model. In this paper, we only mention them briefly to highlight the results of our data set. Science and technology parks usually capture value by fulfilling three innovation functions: (1) knowledge processing, generation and combination; (2) interaction between science, policy and industry through public-funded collaborative projects; (3) testing and training services for technology development. These parks target university institutes and firms with technological or scientific needs. These parks act as scientific mediators between universities and firms. Last, they compete in providing technological services and identifying the scope for innovation.

Innovation parks not only create value by providing physical settings for innovating firms but also (1) perform a gatekeeping role by providing access to a large face-to-face collaboration network, (2) share research facilities and (3) benefit from the prestige conferred by their high-profile sites. Ways of capturing value include (1) real state activities, (2) the provision of seminars and services and (3) the provision of expert advice and training. Resident firms constitute the market segment for such parks that in some cases are limited to given scientific, technological or management fields. Innovation parks bring external suppliers into the value network. For example, innovation parks have strong links with (1) local governments providing resources for resident firms, (2) external managerial or scientific consultants giving seminars or tendering advice. They create an environment that spurs the creation and development of technological and non-technological ecosystems. Last but not least, the competitive strategy pursued by such intermediaries is to foster relationships among resident companies and to give firms the facilities they need to innovate.

Innovation mediator

The last type of intermediary is the ‘innovation mediator’, which manages environments fostering collaboration between firms, entrepreneurs and scientists in the innovation field. Our analysis showed these intermediaries could be either private or Public-Private-Partnerships (PPP). On the one hand, private initiatives such as Connect+Develop (Huston and Sakkab 2006) were created to facilitate access to new business opportunities, emerging technologies or innovation services and to outsource trademarks, technologies and business services. On the other hand, PPP in Europe represent physical intermediaries that speed up the process of forging links between firms, entrepreneurs, universities and diverse users.

In Europe, Living Labs is an example of the latter kind of intermediary. Such outfits make up the European Network of Living Labs (ENoLL) and are either funded on a regional public basis or through Public-Private-Partnerships (PPP). Innovation mediators establish functional areas where universities, firms, public agencies and user communities create, prototype and test new services or products in real-life contexts. Most Living Labs are involved in the early stages of innovation processes such as conception and creation, also offering platforms for multi-stakeholder collaboration (Folstad 2005).

Living Labs’ business model creates value by (1) giving the company a key role in orchestrating science and technology to create and facilitate collaboration among universities, entrepreneurs, firms and users, (2) linking science and policy initiatives to address regional challenges, (3) providing technology testing services with large numbers of users, whose prototyping initiatives take them on a path of joint discovery. The European Living Lab initiative, begun in 2006, is gathering steam. Prior to this

date, some successful cases employing this model were: IBBT in Belgium and Helsinki Living Lab in Finland.

IBBT is an established Living Lab sited in Ghent, Belgium. It was set up by the Flemish authorities to speed up research on Information and Communication Technologies (ICT) in Flanders. The business model of this Living Lab facilitates the creation of value through the provision of facilities for creating, testing and prototyping technologies with user communities (between 60 and 8,500 users, depending on the technology) in sectors such as eHealth, new media, eGovernment and mobility technologies. It fulfils the following functions in the value chain (1) co-ordination of innovation labs (ilab.o.) for knowledge processing and combination, where representative user groups participate in designing early stage technologies, (2) methodologies for facilitating concept design, (3) production, piloting and technological dissemination. University research groups or institutes, local technological firms, regional governments and user communities of technologies are also involved. IBBT also contributes to the value network by establishing relationships with external stakeholders and facilitating activities among collaborating universities and companies. Finally, the revenue model reveals that Living Labs are primarily funded from public sources. The success of contract research and service provision is measured by the number of spin-offs, new projects and published academic articles.

Discussion: Emergent typology of innovation intermediaries

As discussed by Chesbrough et al. (2006 p. 1) the novelty of Open innovation lies in the idea that “firms can and should use external ideas as well as internal ones, and internal and external paths to markets, as they look to advance their technology”. They stress the relevance of business models to build organizational architectures for facilitating the

flow of ideas from external and internal sources. This core understanding of Open Innovation highlights two fundamental dimensions for the study of innovation intermediaries.

The first dimension is the distinction between external and internal sources of ideas and the paths taken by intermediaries in facilitating innovation. As mentioned earlier, intermediaries either rely on internal expert knowledge from consultants to propose new solutions (Howells 2006; Hargadon 2002) or depend on external sources of ideas to put forward solutions for innovation problems (Verona et al. 2006; Huston and Sakkab 2006). In our analysis, internal sources of knowledge used by intermediaries include: consultants; university scientists; IP/licence owners and service providers. External sources of knowledge include scientists, users, entrepreneurs and local governments.

The second dimension concerns the architecture and system embedded in the business model of intermediaries that is needed to foster value creation and capture. Our data analysis and a review of the literature distinguish two forms of systems and architectures. One form is where intermediaries act as 'buffers' in exchanges between individuals (Burt 1992) or help provide solutions for firms. Such services include: gatekeeping and brokering; scanning and information processing; foresight and diagnosis and management of IP (see Table 1). A second form of intermediary acts as mediator or facilitator among parties wishing to co-ordinate their activities and to pursue joint technological or entrepreneurial initiatives (Obstfeld 2005). These activities are likely to be conducted in shared physical environments to facilitate knowledge processing or generation, intermediation between science, university and private initiatives, demand articulation, testing, validation and training.

This two-dimensional distinction gives rise to a constellation of four ideal-types of innovation intermediaries that cohere in a systemic way. A suggestive two-dimensional perspective of innovation intermediaries hints at a narrow, isolated typology that is incapable of providing an extensive, predictive or prescriptive analysis. Worthwhile typologies create order from chaos and predict thematic relationships (Miller and Friesen, 1984) that draw upon theoretical constructs (Miller, 1999). The proposed typology takes these limitations and characteristics into account to suggest an initial underlying ‘logic’ for the business models used by innovation intermediaries.

Two theoretical insights emerge from our research on innovation intermediaries: (1) a typology comprising four business model configurations and (2) an integrated framework covering possible complementarities in the literatures. We shall now elaborate on these two theoretical insights. Figure 1 shows our proposed typology, which goes beyond the Chesbrough’s (2006) and Howells (2006) seminal description of the role played by innovation intermediaries. Whereas Chesbrough discussed a type of intermediary facilitating the participation of external sources of ideas and Howells referred to industry and technology research associations, our analysis focuses on consultants, science and technology centres, public and private incubators and virtual intermediaries providing either internal or external paths and innovation services and infrastructure. We shall now discuss each of the emerging structural configurations and highlight their relevance to customers.

Innovation consultants have been studied in the innovation management literature as those facilitating the methods or tools for creating new technological products or for changing business models (Hargadon and Sutton 1997; Bessant and Rush 1995). Recently, research on similar forms of intermediaries also included consultants facilitating the inward and outward of patents or licenses (Lichtenthaler and Ernst

2008). Our analysis reveals this kind of intermediary (see Table 2) helps untangle innovation problems by providing information on market trends or by visualising a given process. Accordingly, we posit that:

Proposition 1. Innovation consultants provide innovation services, relying on internal sources of knowledge, to solve specific innovation problems or requests.

Figure 1. Typology of Innovation Intermediaries

		Source of ideas or paths used by the innovation intermediary	
		Internal	External
Value creation	Services	Innovation consultants (P1)	Innovation traders (P2)
	Infrastructure	Innovation incubators (P3)	Innovation mediator (P4)

Innovation traders were seen by Chesbrough (2006) as a new form of innovation intermediary who were able to access external ideas whether of a business or a scientific nature. Analysis of the business model adopted by such intermediaries reveals its potential for simplifying access to external sources of ideas for customers and innovation solution providers alike and for capitalising on their knowledge of technologies, products and services. Although this kind of intermediary might be able to tap around two million potential users (Huston and Sakkab 2006), unknown limiting factors reduce the percentage of agreements for further collaboration. These factors may

include problem-solvers, lack of motivation, or client firms inability to assimilate and implement the technological solutions offered by solution providers.

Proposition 2. Innovation traders screen and provide access to a large amount of external ideas and innovations, relying on a platform of innovation solvers, to facilitate the identification of potential scientific and business oriented solutions.

Innovation incubators provide physical spaces for new scientific, technological or business interaction with other firms. We noted that this kind of intermediary is used by private companies to screen external markets for high-potential start-ups or to build bridges between start-ups and major corporations (Becker and Gassmann 2006). On the other hand, public incubators tend to emphasise the creation of new scientific or technological initiatives facilitating the transfer of results to companies or providing services. We posit that:

Proposition 3. Innovation incubators provide infrastructures to facilitate the internal exchange of ideas and knowledge among firms searching to conduct science, technology or business activities

Finally, innovation mediators represent an emerging form of private or PPP intermediary facilitating the emergence of firm business (Becker and Gassmann 2006) or a specific system of innovation (Stankiewicz 1995). The central objective of these intermediaries is to rope in external entrepreneurs, users or scientists to work on problems that could not be solved or identified in a Closed Innovation environment. Private initiatives include virtual platforms such as Connect+Development, which is a P&G initiative for externally accessing technologies and business models. Companies such as Nokia or Siemens are establishing similar initiatives. In addition, actions such as

Living Labs may spur the emergence or development of systems of innovation (Carlsson and Jacobsson 1997) through collaboration and co-operation among companies, entrepreneurs, scientists and communities.

Proposition 4. Innovation mediators provide infrastructures to facilitate the use of external ideas and knowledge coming from users, entrepreneurs, R&D institutes to established firms searching to conduct science, technology and business opportunities.

Drawing upon Schweizer's (2005) dominant business model configurations, we noted that 'innovation consultants' and 'innovation traders' are likely be of a 'market maker' nature. This role is essential in intermediaries that screen existing information for users. By contrast, 'innovation incubator' and 'innovation mediator' intermediaries are likely to play an orchestrating role. This configuration resembles that found in organisations co-ordinating various activities throughout the industry value chain and which perform core functions.

To summarise this discussion, we consider the proposed typology offers a broader perspective of distinctive innovation intermediaries and a deeper insight into their business models. This new perspective proposes scenarios where certain intermediary configurations may be more beneficial than others. Furthermore, our typology suggests that literatures of innovation management, innovation systems, technology transfer and innovation management may cohere in thematic ways and need to be integrated to capture the role of intermediaries facilitating the innovation process at firm and inter-organizational levels.

Concluding remarks

This paper presents a typology of innovation intermediaries in which existing literatures on intermediation, innovation and Open Innovation were pulled together. It contributes to the research on Open Innovation intermediaries through the study of the business model of 32 selected intermediaries. We decided to study the business model because it shapes the mechanisms used to facilitate the inflow and outflow of knowledge as well as how intermediaries help firms create and capture value. The results of the cross-case analysis suggested that single bodies of literature could not explain the mechanisms used by heterogeneous forms of innovation intermediaries. Rather, they suggested the best way forward is to integrate different literatures – as in our proposed typology –in order to shed light on the mechanisms and relationships involved.

The managerial implications of our results reveal the choice of an innovation intermediary should be based upon deep analysis of its business model and the technology or service requested. Managers should think beyond simplistic differentiation between external, and internal sources of ideas or long-term or short-term relationships with the intermediary. To address the daunting task of selecting intermediaries, we would strongly encourage firms to study the business model of potential intermediaries as a first step. We provide an initial guideline for selecting the appropriate type of intermediary that begins with asking oneself two basic questions: (1) Could my innovation problem be better addressed by a broad range of potential innovation solvers or would a small band of specialists be more appropriate? and (2) Does my organization needs to be part of an innovation infrastructure to take advantage of potential solutions or might it be better served by short-term specific services?

Managers may then select one of the four kinds of innovation intermediaries identified in our typology, based upon the following conditions:

- ***Innovation consultants.*** Managers seeking specific solutions or information, interested on services and with a technology request close to the market
- ***Innovation traders.*** Managers searching for specific solutions to managerial or scientific problems in firms lacking either time or in-house resources to develop the technology and that are interested on short-term collaboration
- ***Innovation Incubator.*** Managers seeking interaction with other companies in order to come up with new innovations and to procure innovation services
- ***Innovation Mediator.*** Managers seeking to establish relationships in a open platform, develop early stage technologies and innovations

This paper represents just the first step in exploring the business model adopted by conventional and emerging innovation intermediaries. As this paper shows, both business models and intermediaries are undergoing rapid change and the number of literatures covering their roles offers considerable scope for future research. We believe each emerging form of intermediary represents a simplified description of a basic kind and thus other hybrid, unexplored forms might well form part of a future research agenda. Moreover, this research raises other future research questions such as: (1) What are the factors enabling successful intermediation for each intermediary?; (2) How do companies identify, select and interact with innovation intermediaries?; (3) How do

innovation intermediaries facilitate the generation and integration of knowledge among various innovation players? Answers to these questions might contribute to our understanding of innovation intermediaries to Open Innovation and the literatures reviewed here.

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Appendix 1

Company Name	Type of intermediary	Company Name	Type of intermediary
1) Brightidea 2) Creax 3) Gen3 4) Innovaro 5) Loop Business Innovation 6) Ocean Tomo 7) UTEK	Innovation consultant	21)Atizo 22)BIG - Big idea group 23)Connect2ideas (C2i) 24)Fellowforce 25)IdeaBounty 26)InnoCentive 27)InnovationExchange	Innovation traders
8) ASCAMM 9) Chemelot 10)CREAPOLIS 11)HTC Eindhoven	Innovation incubators	28)NineSigma 29)Pharmalicensing 30)Tekscout 31)yet2.com 32)YourEncore	
12)Kraft 13)P&G 14)Pfizer 15)Starbucks 16)Unilever	Private innovation mediators		
17)IBBT 18)Terretories of Tomorrow 19)Barcelona Digital 20)Frascati	Public innovation mediators		