

## **RESEARCH PAPER**

## **Openness in developing inter-organizational innovation**

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The paper describes empirical findings on how openness is realized in practical innovation projects involving different organizations. The purpose of the study is to increase the understanding of how openness should be managed in the various forms of inter-organizational innovation development. The main research interest is in how openness is manifested in developing innovations with different organizations involved in inter-organizational innovation projects. Subsidiary research questions are: 'What is open?', 'To whom is it open?' and 'How open is it?'. The study applied qualitative case study methodology, and empirical data were collected by semi-structured interviews with management personnel in 40 organizations in Finland and the Netherlands. The findings reveal that openness in innovation is a multifaceted issue that can have very different meanings in different contexts. In the context of the study, the answer to the first sub-question ('What is open?') is obvious. It is the innovation project; its input, process and outcome. As for 'To whom is it open?', interviewees made a clear distinction between projects with known actors and projects that may include unknown actors. Answering 'How open is the project?', one can distinguish between different projects according to which attribute best describes the openness of the project – readable, usable, or modifiable. Answers to the three subquestions conceptualize the issue of openness in inter-organizational innovation development and can be considered theoretical conclusions of the study. By combining the answers, five characteristic levels of openness in inter-organizational innovation were derived as practical implications of the study for R&D and innovation management.

#### Introduction

Inter-firm networking for innovation has a long tradition (see, e.g. Hughes, 1983; Aitken, 1985). It has been said that single firms do not produce innovation in isolation, except in a minority of cases. Instead, innovative endeavors commonly take place in informal and formal interaction between two or more organizations, where the organizations bring different and complementary elements (DeBresson, 1999; Maxwell, 2006; Laursen and Salter, 2006; Lazzarotti and Manzini, 2009). Designs for new innovation, however, are often developed internally by individual firms that keep strategic control over these designs, but there are exceptions for the control of innovation outcome. Open source software is a good example of that in that a single firm cannot have strategic control over the developed technology.

Any collaborative innovation action between two or more actors requires that the actors share their knowledge with each other in one way or another.

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Accordingly, openness has become a technical and philosophical tenet in the field of innovation and R&D management. But what does this tenet of openness actually mean? Most projects and processes related to innovation cannot simply be described as open or closed. Instead, there are different degrees and types of openness in a continuum that ranges from closed to open (Maxwell, 2006; Dahlander and Gann, 2010).

A great variety of different collaboration models in developing inter-organizational innovation has been identified in the network research literature (see Jarillo, 1993; Achrol, 1997; Ahuja, 2000; Dyer, 2000; Möller and Rajala, 2007), in the knowledge management literature (see March, 1991; Grant and Baden-Fuller, 2004; Valkokari et al., 2012) and in the open innovation literature (see von Hippel, 1988; Ward, 1996; Chesbrough, 2003; Dahlander and Gann, 2010; Paasi et al., 2010; Huizingh, 2011). The variety of models is often placed under the umbrella of open innovation that encompasses, connects and integrates a range of inbound and outbound innovation activities (Huizingh, 2011). The umbrella type of open innovation concept encourages innovating new forms of collaboration among various actors in innovation, but hinders theoretical understanding about the phenomena it covers. This is particularly true for the openness in inter-organizational innovation. The absence of coherent framing for openness in the various forms of inter-organizational innovation makes it difficult to manage open innovation at the level of the company (Dahlander and Gann, 2010). This is the research gap the paper aims to fill.

We describe empirical findings about how openness is realized in practical innovation projects between different organizations. The purpose of the study is to increase the understanding on how openness should be managed in various forms of inter-organizational innovation development. We first offer a summary of what has been written about openness in the development of inter-organizational innovation. Next, research questions and research methodology are described. This is followed by our main empirical findings. These findings are then discussed and linked to the literature before a summary of the paper's theoretical implications is provided. Finally, conclusions for R&D management and innovation are considered.

## **Openness in inter-organizational innovation**

The fundamental idea behind openness in innovation is that a single organization cannot innovate in isolation but, in order to innovate successfully, has to have some kind of interaction between other actors where ideas, knowledge, resources, individuals, etc. flow in and out of organizations (DeBresson, 1999; Maxwell, 2006; Dahlander and Gann, 2010). Forms of inter-organizational innovation have been described broadly in the network research literature (Jarillo, 1993; Ahuja, 2000; Dyer, 2000; Swan and Scarbrough, 2005; Möller and Rajala, 2007) and in the knowledge management literature (March, 1991; Grant and Baden-Fuller, 2004; Hagel and Brown, 2008; Valkokari *et al.*, 2012), but neither literature discusses openness in developing inter-organizational innovation. That discussion is confined to the open innovation literature. In this section, we will first give a brief overview of what has been written on openness in open innovation in general. After that, we will focus on a particular aspect of open innovation – openness in developing inter-organizational innovation.

Chesbrough (2003, p.24) defines openness broadly by arguing that 'open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to markets, as firms look to advance their technology'. Such a broad and loose definition allows both researchers and practitioners to take different standpoints towards openness in developing innovations. Accordingly, openness has a variety of different meanings in the open innovation literature. Firstly, the openness in open innovation may refer to a variety of inbound and outbound innovation activities and forms, including acquiring, sourcing, selling, and revealing knowledge and intellectual property (IP) (Gassmann and Enkel, 2004; Dahlander and Gann, 2010). Secondly, openness may refer to the number of external sources of innovation (Laursen and Salter, 2006). Both meanings have in mind knowledge transactions and IP transfer across organizational boundaries. While the transaction kind of openness certainly is important, we argue that it gives too narrow a perspective on open innovation because it neglects co-creation between two or more actors in developing innovations. The third approach towards openness in innovation addresses the flow of knowledge across organizational boundaries by including aspects of knowledge exploration, retention and exploitation that can be performed either internally or externally (Lichtenthaler and Lichtenthaler, 2009), and by emphasizing the difference between innovation networks and practices for the transaction of existing knowledge and IP, and the co-creation of new knowledge between the actors of innovation (Valkokari et al., 2012). Accordingly, the third approach covers both aspects of transaction and co-creation of knowledge related to the development of inter-organizational innovation.

Fourthly, openness in innovation may be related to the innovation process and to the innovation outcome, which might be closed (proprietary) or open (available to others) (Chesbrough, 2003; Maxwell, 2006; Pykäläinen, 2007; Huizingh, 2011). Fifthly, openness can be related to actors of open innovation, whether they are known or not (Paasi *et al.*, 2010). In bilateral projects and in closed consortia, actors know each other, but public societies, open communities and forums contain unknown actors of open innovation. The five approaches to openness above (listed in Table 1) are not independent. Instead they are more or less related to each other. They consider the same phenomenon, but they approach the phenomenon from partially different standpoints. The first four address the question 'What is open?' and the fifth addresses the question 'To whom is it open?'.

Approach	Authors (examples)
1 Forms of open innovation activities	Gassmann and Enkel (2004); Dahlander and Gann (2010)
2 Number of external sources of innovation	Laursen and Salter (2006)
3 Flow of knowledge across organizational boundaries	Lichtenthaler and Lichtenthaler (2009); Valkokari <i>et al.</i> (2012)
4 Innovation process and outcome	Chesbrough (2003); Maxwell (2006); Pykäläinen (2007); Huizingh (2011)
5 Actors in innovation	Paasi et al. (2010)

Table 1. Approaches in the literature to openness in open innovation

In this paper, we are aiming to increase the understanding of how openness in innovation should be managed in the various forms of inter-organizational innovation development. The aim is best supported by following the line of Chesbrough (2003), Maxwell (2006) and Huizingh (2011) and by considering the actual interorganizational innovation project, because the various inbound and outbound forms and activities of open innovation as well as the internal and external knowledge flow can be taken into account when studying an actual innovation project. Based on the openness of both the process and the outcome of innovation, Huizingh (2011) developed a  $2 \times 2$  matrix relating whether the process and its outcome are closed or open (i.e. available to others). In this  $2 \times 2$  matrix, closed process and closed innovation outcome reflects the situation where a proprietary innovation is developed in-house. Closed process and open innovation outcome corresponds to situations where the original innovator allows others to use the innovation outcome. In a strict sense, it means that the innovation becomes public. In the second row, open process but closed outcome reflects situations where other actors are involved in the innovation, but the outcome is proprietary. Open process and open outcome of innovation indicates open source kinds of innovation activities.

While the  $2\times2$  matrix gives a simple model for the openness related to actual innovation projects, it gives only limited support for the practical innovation management in developing inter-organizational innovation because it is based on the dichotomy of open versus closed. Many inter-organizational innovation practices are not as simple (Paasi *et al.*, 2010). Pykäläinen (2007) considers the openness of innovation from the standpoint of company strategy and makes a three-level categorization: open (we share everything), mixed (we share some things and some rights are reserved) and closed (we share nothing). Therefore, the  $2\times2$  matrix gives little support for the question 'How open is the innovation project?', however, it establishes a starting point for the development of theories and practical implications.

Maxwell (2006) overcomes the dichotomy by exploring the degrees of openness in innovation works. He finds three key attributes that determine a work's degree of openness: its availability, accessibility and responsiveness. The first two attributes (availability and accessibility) refer to results of earlier innovation works and the possibility of other actors using the results as an input for their own innovation project, a dimension not included in Huizingh's model (2011). The input is considered to gather know-how, background information and IP relevant to the innovation project. The third attribute (responsiveness) defines the potential for modifying an innovation work based on contributions from others. The work of Maxwell (2006) provides a second starting point for the theories and practical implications discussed in this paper.

## Research question and methodology

The literature on openness in inter-organizational innovation brings out many important aspects of openness, but it does not give a coherent framing for openness in the various forms of inter-organizational innovation development. The absence of such framing makes it difficult to manage inter-organizational innovation projects. In this paper, the original aim was to increase understanding on how openness should be managed in the various forms of inter-organizational innovation development. After some preparatory work, we formulated the main research question into the final form: • How is openness manifested in developing innovations when different organizations are involved in inter-organizational innovation work?

Because the main research question is broad, it was refined through sub-questions that focus on R&D and innovation management and address the open innovation practices of organizations:

- What is open?
- To whom is it open?
- How open is it?

Together, the three sub-questions cover the main aspects of the development of inter-organizational innovation. While all these three aspects could be found in the innovation literature, they had been studied in the context of open innovation at large, not specifically addressing the development of inter-organization innovation. There was no single paper addressing all three aspects.

We applied a multiple case study research methodology with qualitative data (Eisenhardt, 1989; Eisenhardt and Graebner, 2007) in this study because we are studying phenomena of practices for which a coherent theoretical understanding is lacking and practices are still evolving. The collection of empirical material was executed in two phases. The first phase was part of a larger study on open innovation practices. The second phase was specifically for this study, and focused on questions that were not satisfactorily answered in the first phase. In the first phase of the study, a large interview study of open innovation practices was conducted. Altogether, 54 managers from 40 organizations were interviewed by means of semi-structured theme interviews. The organizations represented different fields of industry and different firm sizes, bringing diversity to the empirical material and maximizing the variety in the data. The criterion for selection was that the organization was generally known to be innovative and was among the leading actors in its branch of industry; 21 of the organizations were from the Netherlands and 19 from Finland (see Table 2). The interviews were conducted between February and October 2009. The interviewees were specifically senior corporate, R&D, business unit or IP managers. The themes of the interviews went beyond openness in developing inter-organizational innovation to cover the practices of open and interorganizational innovation in general, knowledge and IP management practices in inter-organizational relationships, challenges faced when innovating openly with other actors, etc. Findings from the interviews relating to open innovation practices and knowledge and IP management have been reported elsewhere (Luoma et al., 2010a, 2010b; Paasi et al., 2010). In this work we will focus on openness in developing inter-organizational innovations.

An interview usually began by enquiring into the company's business and its role and position in the business environment. The deeper inter-organizational relationships of the firm were then discussed, the main focus being on innovation and new business creation and offerings. Step by step, more specific issues relating to inter-organizational innovation practices as well as knowledge and intellectual property (IP) management practices within the firm and in inter-organizational relationships were investigated. Questions were thematic and included: what kinds of collaboration practices are you currently using in your inter-organizational relationships (in innovation)?; how do you share and protect your knowledge in these

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Organization Industry/products/services		Employees (2008)	Website	
ABN Amro	Finance, banking	50,000	http://www.abnamro.	
Arcusys Blancco	IT services Software, ICT	12 37	http://www.arcusys.fi/ http://www.blancco. com/	
Consolis	Construction	9000	http://www.consolis.	
Corus Group	Steel	42,000	http://www. tatasteeleurope.com/	
Damen Shipyards DSM Dun Agro	Shipbuilding Chemicals Agriculture	2100 23,000 3	http://www.damen.nl/ http://www.dsm.com/ http://www.linkedin. com/company/dun- agro-b.v.	
Forcit Defence	Chemicals Technical consultancy	220 13.000	http://www.forcit.fi/ http://www.fugro.com/	
Image Wear	geospatial industry Clothing	500	http://www.imagewear.	
Imtech WPS	Parking technology systems	150	http://www. wpsparkingsolutions. com/	
Kolster	IP management services,	200	http://www.kolster.fi/	
Koppert	Biological systems – pollination systems and integrated pest management	250	http://www.koppert. com/	
KPN	Telecommunication and ICT services	43,500	http://www.kpn.com/	
Krohne Altometer	Technology products and measurement solutions	315	http://krohne.com/	
Laitosjalkine Medisize	Textile and footwear industry Manufacturing industry	80 1000	http://www.laja.com/ http://www.medisize. com/	
Metso Automation Nammo	Industrial automation industry Defense industry	1500 1800	http://www.metso.com http://www.nammo. com/	
National Board of Patents and Registration of Finland (NBPR)	Government services, IP industry	500	http://www.prh.fi/	
Nokia Research Center	Telecommunication	500	http://research.nokia.	
Norit X-Flow	Water purification systems	1600	http://www.x-flow.	
Nederlands Vaccin Instituut (NVI)	Healthcare	400	http://www.nvi-vaccin. nl/	
Outotec	Metals and mining	2000	http://www.outotec.	
Philips Lighting	Lighting	40,000	http://www.lighting.	
Rabobank	Finance, banking	60,000	http://www.rabobank. com/	

# Table 2. Organizations in the interview study

(Continued)

Organization	Industry/products/services	Employees (2008)	Website	
River diagnostics	Measuring and testing equipment, healthcare and medical	26	http://www.riverd.com/	
Sandvik Mining and Construction	Mining and construction	17,000	http://www. miningandconstruction. sandvik.com/	
Stevens Idepartners	Engineering and designing	10	http://www.idepartners. nl/	
Strukton Rail	Railway construction and maintenance services	3500	http://www. struktonrail.com/	
Tamlink	Technology transfer	70	http://www.hermia.fi/	
ThyssenKrupp Accessibility	Accessibility	1100	http://www.tkaccess. com/	
Tremco Illbruck	Building materials	1000	http://tremco-illbruck. com/	
UPM	Forestry	24,000	http://www.upm.com/	
Vaisala	Measuring and testing equipment	1100	http://www.vaisala. com/	
Vebego	Cleaning, facility and personnel services	30,000	http://www.vebego. com/	
VTT	Research and development	2700	http://www.vtt.fi/	
Wihuri Oy Wipak	Plastics industry	3600	http://www.wipak.com/	
Xsens Technologies	3D motion measurement systems	40	http://www.xsens.com/	

Table 2. (Continued)

relationships in the phases of exploration and exploitation?; how do you treat the outcome of the collaboration (IP, tacit knowledge)?; and do you perceive any barriers to innovating openly? The empirical material was collected by a group of five researchers (including the three authors of this paper). A typical interview was of about 1–1.5 hours, involving two researchers. Interviews were recorded. At least one of the authors took part in each interview, which made it easier to take a similar approach to all the interviews in both countries. In some cases, the interviewees were also asked additional questions in order to elucidate the company's practices and motives.

The empirical material of the interview study gave lots of data relevant to the first two sub-questions ('What is open?' and 'To whom is it open?'), but little relevant to the third ('How open is it?'). Therefore, a second phase of the study was launched to examine innovation projects in three innovative organizations in depth, still applying the qualitative case study methodology. The case organizations had already taken part in the interview study. Involving actors from industry, universities and intermediaries allowed a triple helix approach to the subject and brought diversity to the study. The case organizations were Sandvik Mining and Construction Oy (a large industrial company), VTT Technical Research Centre of Finland (a large research and technology organization) and Tamlink Ltd (a medium-sized technology transfer company). In Sandvik Mining and Construction Oy there are tens of innovation projects annually that can be categorized as open innovation. Tamlink Ltd coordinates nearly 100 innovation projects annually under the brands of Hermia and Tamlink. Every year, VTT is involved in several hundreds of projects that fit under the broad umbrella of open innovation.

We restricted the study to projects with a clear focus on innovation and left all traditional research projects outside our scope (i.e. we focused on projects having commercial targets and left out projects aiming just to generate new knowledge). In the examined projects, we paid special attention to the form of collaboration and to the contract clauses related to input (background) material, actual innovation activities and results. The study of contracts was supplemented by discussions with project managers, which offered lots of valuable information about the openness of innovation activity. We also studied what it means if the project was said to be open or closed. In this way, we aimed to make the levels of openness precise rather than simply an open or closed designation. We did not look at the actual utilization of the results after the project, only at how the rights and ownership of the innovation outcome were agreed before or during the project.

After receiving preliminary answers to the research questions, we started thematic discussions with project managers from VTT, Sandvik and Tamlink at which we presented the early results in order to test and refine them. Thematic discussions were followed by further study of empirical data and literature. In total, 10 thematic discussions were held over a period of one and a half years with the involvement of about 30 project managers and contract designers (legal counsel and patent engineers) from VTT, Sandvik and Tamlink. A recursive process between the refining of theory and testing of it through thematic discussions in the light of empirical data produced the theoretical and practical findings reported in this paper.

#### **Empirical findings**

#### What is open?

When considering openness in inter-organizational innovation, the interviewed managers spoke, without exception, about actual innovation activity. The actual innovation project, however, included a large variety of activities from informal and exploratory searching of new business opportunities to formal development projects of new innovation and business. Most of the interviewed organizations had practiced inter-organizational innovation, but there were differences in the kind of innovation activity open to external actors. Most of the interviewed organizations have innovation experience in business-to-business relationships, but a few firms had also practiced open innovation with consumers.

Many organizations applied openness in exploring new ideas for innovations and business opportunities: 'open innovation is constant fishing for ideas'. After exploring, the design of innovation was typically created in-house without external actors. Some organizations, however, used openness in the development phase of innovation. Examples include software development in open source projects and new product or service development projects tackled by closed bi- or multilateral consortia consisting of actors having complementary knowledge and roles. The following interviewee's response is a modern example of inter-organizational innovation development in customer–supplier relationships where suppliers have an active role:

Yes, of course we work with suppliers. When we introduce something new on a market, it's always done with at least one or two other parties. Until three or four years ago, it was quite a linear process: we had an idea, we organized the partners

and started up the development project. Now it's a little bit different because you start at a very early stage in the innovation process already together with your partner, develop the ideas together and then go into a joint project.

The second issue on which interviewed managers all agreed is that openness is related to knowledge required for innovations and new business. Such knowledge includes ideas, know-how, formally protected IP and formally unprotected explicit knowledge. Sometimes the interviewed managers made a clear distinction between know-how and IP, i.e. between tacit and explicit knowledge. Some managers spoke about IP in a broad sense: 'At our firm we understand IP as intellectual property rights plus the know-how that can be covered by a non-disclosure agreement and other agreements'. Interviewed managers also made a distinction between knowledge in the exploratory phase of innovation, when they are searching for new business opportunities, and knowledge in the exploitation phase of innovation, when they are realizing the opportunity. Both phases are strategically important for the new business of a company but, when it comes to the openness of knowledge, organizations tend to make a distinction between what knowledge is open and what is not in these two phases.

One interviewee gave an example of what is open in innovation for two product companies working together from an IP perspective: 'I have my IP, you have your IP, let's bring them together: a joint IP'. This simplified example hides elements in developing inter-organizational innovation. At first, there is input knowledge for the project on which the actors will build. The input can be tacit know-how or formal IP that is shared with other actors in the innovation in one way or another. These ways are strongly influenced by how open the input knowledge is and to whom it is open. Secondly, the actual process can be open to other actors in innovation, depending on how open the input knowledge is and to whom it is open. The third element is the outcome of innovation. Inter-organizational innovation may result in proprietary knowledge and IP owned by a single actor, or public knowledge, or something between these two extremes. The openness of the innovation outcome seems to depend on the business model applied in the project. If the business model is to sell technology, inter-organizational innovation typically leads to proprietary IP, but if, for example, the business model is to offer services, inter-organizational innovation may lead to a more open approach when that supports the firm business better than a closed approach: 'We publish our software technology because our business model is service-oriented. By publishing, we have found new customers, and, from an IP perspective, publishing gives us freedom of action in the field'.

Some interviewed organizations seemed to be very open when it came to exploration of completely new businesses for the firm, but very closed when it was a question of the current business of the firm. Some firms also shared knowledge relating to running their businesses with other actors. The larger companies in particular tended to search quite openly for new business opportunities, but close their innovation activities when they have found them. Some smaller firms, on the other hand, may need external resources to support the growth of their business, which makes them more open to external actors in the exploitation phase of innovation. But there seemed to be a border that was not to be crossed when innovating openly, information that was not to be shared with other actors, and that related to the core knowledge of the firm: 'The only thing is, which I always point out in the beginning of the cooperation, you have to figure out first what is absolute core, something, which I will never share'. The core knowledge of a firm, however, may not always be obvious. One interviewed IT company shared all the software it wrote with open source communities, but this company realizes that the core knowledge which gives the firm its competitive edge is not in the software technology, but in the processes of utilizing the technology.

## To whom is it open?

As far as openness of the actors in inter-organizational innovation is concerned, two partially overlapping approaches were found, influenced by whether the actors are known and controllable, and by the role the actors play in the value network of the organizations. Several managers underlined how important it is that the actors of inter-organizational innovation are known so that their intentions can be anticipated:

If you are in open innovation, it's more a game. If you do open innovation, it's much more about these other players. What are their strategies? If we'll do this, what will they do and figuring that out upfront. It makes sense only if you really know the different players. If you don't know the player, then you start dreaming.

Development of inter-organizational innovation is a risk investment and firms like to minimize risks of failures. This is particularly true for projects in the development phase of innovation. Any hidden agendas, such as hidden competitive relationships or intentions, complicate the collaboration and may even ruin the project. In the exploration of new knowledge, firms seem to be less wary about the presence of unknown actors. Often, though, it matters whether innovation activity is bi- or multilateral. This became obvious in the interviews as well as when analyzing the contracts of inter-organizational innovation projects. Firms tend to prefer simple bilateral relationships in innovation, when possible, but these are often not feasible. Complex product and service systems may require knowledge from several actors. Then, instead of bilateral relationships, it is a question of multilateral relationships in networks where you may not know all actors well.

Almost without exception, managers spoke about the importance of trust when innovating openly: 'Trust is necessary for co-creation to allow open sharing of knowledge'. Managers also underlined the role of contracts in building up trust. In many companies, contracts and trust were seen as complementary. Taking all that into account, it is easy to understand why firms prefer known actors in developing inter-organizational innovation. It is much easier to build up trust between actors who know each other than between those who do not. On the other hand, if you know the actor but there is little trust, the prognosis for successful inter-organizational innovation is low: 'If you don't trust your partner, whoever the partner is, it will never work. Forget it. Stop it'. Open source projects and other kinds of open fora are special cases where the presence of unknown actors cannot be avoided. Yet firms pay special attention to what they share in these open fora: 'You must be very careful when operating inside an open source community so that you do not inadvertently share any critical information that your competitor should not know, because they may also be there'.

The second approach to this sub-question ('To whom is the innovation open?') is to consider the roles of the actors in innovation. An actor can innovate with customers and suppliers in the vertical value chain of the actor. An actor can

innovate also with horizontal actors – research organizations, non-competitors (including firms in other fields of business or other markets), and individual innovators, competitors and communities. The innovation network can also be a mixture of vertical and horizontal actors. In all cases, there should be a good fit of roles and interests in order to innovate successfully. The actors should also understand the basic principles of collaboration:

You can start collaboration with anybody, but I think where it's gonna be a success is really a matter of give and take, and I think you'll find that out relatively early. I mean, if you are in a collaboration and you have to look at the contract each day and see all of the actions of my collaborator in the context of the contract, that is probably not gonna work. But if you can put the contract in the drawer, then it's probably a good collaboration, because implicitly you have given and you have taken, and it's all about that balance, I think.

If there is a good fit in the roles of the actors in inter-organizational innovation, it is much easier to reach a good give-and-take relationship between the actors than when the fit is poor. The customer–supplier relationship is a typical example of good fit, but horizontal actors can also have a good fit in specific innovation activity. For example, managers said that competitors may fit well into the same open innovation project when they are working towards an industry standard that benefits all actors in the field. Based on the interviews, we conclude that what is a good fit depends on the goal of collaboration.

## How open is it?

The third sub-question relates to knowledge sharing in actual inter-organizational innovation activity: 'How open is the innovation?' Many managers pointed to a basic dilemma of openness in inter-organizational innovation: 'On the one hand you should be open and share your knowledge, on the other hand you should keep the knowledge proprietary in order to run a successful business later on'; 'Open innovation and IP contradicts a bit'. According to IP laws, the creator of a work has the right to exclude others from its use until the limited term of protection ends. Such a work would be considered largely closed, although some limited access to the work may be permitted under exceptions to IP protection.

In order to manage the dilemma, firms typically control the degree of openness in inter-organizational innovation by contracts (see Luoma *et al.*, 2010a). Contracts that formalize inter-organizational innovation give supplementary control for the innovation project in aspects not covered by IP laws: in a contract one may set up secure conditions for the opening of knowledge to the other innovation actors, and specify their rights to the results. In order to go deeper into the sub-question, therefore, we looked at actual inter-organizational innovation projects in three case organizations and analyzed their project contracts. The contracts, supplemented by discussions with project managers, provided much valuable information about openness in innovation.

A typical project agreement describes the goals and main practices of the innovation activity. It also defines issues related to input (background) knowledge and to innovation outcome. Openness in innovation depended largely on whether the innovation activity was based on the transaction of existing knowledge or required the co-creation of new knowledge. If the former, the actual innovation project was quite or totally closed and the openness was restricted to formal knowledge transactions through licensing or purchase. In the co-creation of new knowledge, there were various degrees of openness applied in projects. At a minimum, there was access to background knowledge for all actors, and this access was typically free of charge during the project. Often the actors were allowed to observe each other's work or even to take part to each other's development work (co-development). In co-development, there were large differences in how deeply the actors revealed their knowledge (tacit and explicit) to each other and in how nested and frequent the interaction between the actors was. Openness practices seemed to be very case dependent and there were large variations even within an organization.

Openness related to input knowledge and results was simpler than openness during the actual innovation work. For the input (background) knowledge, three different levels of openness were identified in inter-organizational innovation projects: (1) input knowledge readable by other actors; (2) input knowledge usable by other actors; and (3) input knowledge modifiable by other actors. The ownership of input knowledge typically remained with the original owner of the knowledge (IP), and conditions for its utilization were agreed among the actors, but there were exceptions. Open source projects are a good example of an exception where the ownership of input knowledge is donated to the open source community in question.

Three distinctive levels of openness were also identified for the innovation outcome: (1) proprietary IP owned by a single actor; (2) ownership and utilization of IP agreed among the innovation actors (a mixture of proprietary ownership and shared rights to utilization); and (3) joint IP (joint ownership of knowledge and equal rights over utilization and modification). Sometimes, however, a variety of options was available for the ownership and use of the results indicating that openness in innovation outcome is rather more complex than openness in input knowledge.

To summarize the empirical findings: where collaboration was restricted to the transaction of existing knowledge, openness was restricted to inputs to the project, the project itself being more or less closed. In cases where the focus of collaboration was on the co-creation of new knowledge, openness was a very complex issue, going far beyond the open *vs.* closed dichotomy.

## Discussion and theoretical implications

The empirical findings confirm what became obvious from the literature review: openness in developing inter-organizational innovation is a multifaceted issue. When approaching the subject of openness in developing inter-organizational innovation from the standpoint of R&D and innovation management, the answer to the first question ('What is open?') is quite obvious. Openness here means the whole of innovation activity: input, process and outcome (see Figure 1).

The input to innovation covers both tacit and explicit knowledge specifically used for the development of innovation. Accordingly, it covers the use of external and internal ideas, know-how and transactions in existing IP as an input for innovation. The openness related to the input has a strong connection to the open innovation ideas of Chesbrough (2003) and Lichtenthaler and Lichtenthaler (2009). It is also associated with models of co-creation with customers (von Hippel, 1988) and suppliers, e.g. models of extended enterprise (Dyer, 2000). The knowledge open to



Figure 1. Dimensions of openness with respect to what is open

the other actors of innovation is predominantly knowledge that is non-core for the organization. Any deeper analysis about the openness of innovation input calls for answering the sub-questions 'To whom is it open?' and 'How open is it?'. Similarly one can say little about the openness of innovation processes without considering how open the process is and to whom it is open. Although the process may be different for projects exploring new knowledge than for those exploiting existing knowledge, intrinsically there is no difference in the openness between these two kinds of projects during the innovation process. Any differences are case dependent. Analysis of openness related to innovation outcome comes close to the analysis of openness goes far beyond formal IP, to which the analysis is sometimes limited in the literature of open innovation (see Chesbrough and Crowther, 2006; Lichtenthaler and Ernst, 2007). It also includes other explicit knowledge than that formally protected by IP laws, as well as tacit knowledge that can be exploited in one way or another.

The second sub-question of the study ('To whom is it open?') can be approached in two ways (see Figure 2). The most common is to consider actors in vertical and horizontal dimensions of a value network (i.e. suppliers and customers in the vertical network, and non-competitors, competitors, research organizations and communities in the horizontal network). Multidimensional projects that include actors from both vertical and horizontal dimensions are becoming increasingly common. The second approach considers whether the actors of inter-organizational innovation are known or not. The approach seems to play a critical role among practitioners of R&D and innovation management. Firms tend to open up to and share different things with known actors than with unknown actors in open innovation. Innovation relationships between known actors in open innovation can be further divided into bi- and multilateral relationships. In large corporations, one can also consider in-house development between different business units of the



Figure 2. Dimensions of openness with respect to whom it is open

corporation as a special case of inter-organizational innovation, which, however, should according to its openness be considered as closed, following the work of Chesbrough (2003). Inter-organizational innovation with unknown actors is always multilateral in nature.

The third sub-question of the study ('How open is the innovation project?') is very complex. The question can be approached from so many standpoints and cannot be considered independently from our other two sub-questions. The openness approach of Maxwell (2006) is helpful. Maxwell listed availability, accessibility and responsiveness as the key attributes determining a project's degree of openness. We also find three levels of openness in inter-organizational innovation: we name the lowest level of openness as 'readable', the second level as 'usable' and the highest level as 'modifiable' (see Figure 3). At the first level, the input knowledge is made readable to other actors of innovation; at the second, the input knowledge is made usable to other actors, and at the third level, the input knowledge is modifiable by other actors of innovation. Similar descriptions apply for the outcome of innovation: the outcome can be made readable, usable or modifiable to the other actors in innovation. In practice, what is made readable, usable or modifiable, to whom and under which conditions (compensation, time, etc.) is defined by agreements.

The openness levels of the innovation process cannot be defined as clearly as the levels for the input and outcome of innovation because the sort of collaboration matters (whether the collaboration is based on transactions in existing knowledge or co-creation of new knowledge). If the transactions in existing knowledge are in the core of the collaboration, the actual process can be quite closed and the openness restricted to the input knowledge that is made readable, usable or modifiable through a closed transaction in knowledge (IP, other explicit knowledge, know-how, etc.). On the other hand, if the collaboration is characterized by co-creation among the participants in the project, the three levels (readable, usable and modifiable) apply. Here 'readable' corresponds to cases where the actors can observe each other's work, 'usable' means that the actors can use each other's work to reach common objectives, and 'modifiable' means that the actors can modify each other's work to attain these objectives. All this happens under bi- or multilateral agreements specifying the conditions of collaboration. In communities that include unknown actors, agreements are typically replaced by community rules that specify the conditions under which the actors can use and modify the project, which rules the actors in innovation must accept before joining the innovation community.



Figure 3. Dimensions of openness with respect to how open it is

#### **Conclusions – practical implications**

The theory suggested by this study may help R&D, innovation and project managers to understand better openness in inter-organizational innovation projects. Managers of inter-organizational innovation projects may value a framework linking the different dimensions of openness. This may provide practical support in defining appropriate forms of collaboration, in managing knowledge sharing and IP during and after the collaboration, in writing contract clauses to formalize the collaboration, and in coordinating the actual innovation project. In Table 3, we have interlinked different approaches towards openness in developing inter-organizational innovation. The table summarizes the main conclusions of the study from the standpoint of practical implications for R&D and innovation management. The rows of Table 3 correspond to the 'What is open?' question. In addition, there is one row that relates to the key openness characteristics of the forms of collaboration. The columns of the table correspond to the 'How open is it?' question.

Instead of the three columns suggested by Figure 3, there are five because we have divided the openness levels 'readable' and 'modifiable' into two categories. In the readable openness level, we have distinguished between projects where openness means just a contractual and closed transaction of IP, and projects where openness means that input knowledge is readable to the actors of innovation without contractual acquisition of the input IP. In the latter case, openness may mean nonpecuniary sharing of input knowledge, while pecuniary acquiring of knowledge is typical in the former (see Dahlander and Gann, 2010). We see the former level of openness as closed, and one may wonder why this category is included in Table 3 at all. It is included because much of the discussion in early open innovation literature focused on IP transactions by licensing and purchasing (see Chesbrough, 2003; Chesbrough and Crowther, 2006; Lichtenthaler and Ernst, 2007). In the modifiable openness level, we distinguish between projects that take place within closed bi- or multilateral relationships with known actors, and those that include unknown actors and are public in nature. In this way we have integrated the 'To whom is it open?' question into the table.

The usable and modifiable openness levels represent a large variety of collaboration both for the exploration of new knowledge and the exploitation of existing knowledge. These can all be characterized as open innovation within closed relationships. At both levels, the actual process is open for the other participants in collaboration, the difference between the levels being in the responsiveness of the activity. At the usable level, the actors in innovation can use the results of one actor under mutually agreed conditions, but they are not allowed to further develop the result independently. At the modifiable level, the results can be modified by the other actors of closed collaboration during and after the activity, which means that the actors can take part in each other's development work and the results are joint. Innovation activities at the usable level do not lead to joint IP, but the ownership structure and conditions under which the results can be used are agreed between the partners. Although the five levels of openness in developing inter-organizational innovation shown in Table 3 were derived from our theory, real case examples of all five levels of openness of inter-organizational innovation were identified from our empirical data.

The project has internal and external limitations to its validity (Gibber *et al.*, 2008) that must be taken into account when applying the theoretical and practical

Name of level	Closed	Readable	Usable	Modifiable	Public
Key characteristic of openness	IP transaction only	Open innovation within closed relationships or open networks	Open innovatic closed bi- o (network) re	on within r multilateral elationships	Open innovation within open networks
Input for innovation	Acquired knowledge and IP by contractual transaction	Shared (readable) during the development	Freely utilized within the partners during the development work	Freely modifiable within partners or consortium	Public (open, modifiable and exploitable by all)
Innovation process	Closed development	Closed own development	Co- development between some or all partners, partners have right to observe each other's development work	Results of co- development work will be shared, partners take part in each other's development work	Participation open but typically controlled (may include unknown actors)
Innovation outcome	Proprietary IP	Proprietary IP	Ownership and utilization of IP agreed between the partners	Joint IP (ownership and rights to utilize)	Public

Table 3. Levels of openness in developing inter-organizational innovation

implications of the study. Firstly, openness is a multifaceted term. It can have very different meanings in different contexts. In this study we have not covered all aspects of openness relevant to inter-organizational innovation. Moreover, in the aspects that we covered, we have had to simplify. Thus, openness in real innovation projects may not be as straightforward as conceptualized in the theoretical and practical conclusions of this study. Secondly, the study was focused on inter-organizational innovation. Although the interviews in some organizations also covered business-to-consumer activities, innovation activities and evolving innovation practices with consumers may well include important aspects of openness not covered in the paper.

Thirdly, openness in inter-organizational innovation may be culture dependent, an aspect not covered in the study. The organizations in the interview study all operated in Western culture. The conceptualization of openness presented in the study may not be applicable to organizations operating in other kinds of cultures, such as Arabian, Asian or African. In the globalized world, there is an obvious need for a study where linkages between culture and openness in innovation are investigated. Fourthly, the study considered the subject in a quite general manner. For example, we considered only input, process and outcome without going into more details about the innovation process. In further studies, it would be interesting to go deeper into inter-organizational innovation development and study how openness (or closeness) is manifested in the variety of activities within an innovation process. Finally, while the qualitative business research approach used in the study is good for early building of theory, it does not allow the quantitative comparison between levels of openness that would increase our understanding of openness in inter-organizational innovation. We suggest that further studies on the openness should apply the results of the present study, but use quantitative business research in the study of a number of organizations from various fields of industry.

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