Paradox of openness: knowledge sharing-protection tension in ecosystems

Author(s): Paasi, Jaakko; Valkokari, Katri; Rusanen, Helena; Makkonen, Hannu; Laiho, Tiina

Title: Paradox of openness: knowledge sharing-protection tension in ecosystems

Year: 2020

Version: Published version

Please cite the original version:

Paasi, J., Valkokari, K., Rusanen, H., Makkonen, H. & Laiho, T. (2020). Paradox of openness: knowledge sharing-protection tension in ecosystems. In: *The ISPIM Innovation Conference: Innovating in Times of Crisis, XXXI ISPIM Innovation Conference, Virtual, Germany on 7 to 10 June 2020*, 1-12. LUT Scientific and Expertise Publications. Lappeenranta: Lappeenranta University of Technology.

This paper was presented at The ISPIM Innovation Conference – Innovating in Times of Crisis, 7-10 June 2020.
Event Proceedings: LUT Scientific and Expertise Publications: ISBN 978-952-335-466-1

Paradox of openness: knowledge sharing-protection tension in ecosystems

Jaakko Paasi*, Katri Valkokari

VTT Technical Research Centre of Finland Ltd.
P.O. Box 1300, FI-33101 Tampere, Finland
E-mail: jaakko.paasi@vtt.fi, katri.valkokari@vtt.fi

Helena Rusanen, Hannu Makkonen

University of Vaasa
PL 700, FI-65101 Vaasa, Finland
E-mail: helena.rusanen@uwasa.fi, hannu.makkonen@uwasa.fi

Tiina Laiho

CLIC Innovation Ltd.
Eteläranta 10, FI-00130 Helsinki, Finland
E-mail: tiina.laiho@clicinnovation.fi

* Corresponding author

Abstract: The paper describes findings about knowledge management in innovation constellations that are calling themselves as innovation ecosystems. The focus is in tension between knowledge sharing and knowledge protection, i.e. in the paradox of openness. The research asked whether an ecosystemic and open way of innovation differs to innovation in networks in respect to how the paradox appears. The study applied the methodology of qualitative research. Experiences and practices were collected from 13 innovation ecosystems. According to the findings, the paradox seems to be very true in ecosystems and even more pronounced than in innovation networks, because in ecosystems one may not know all actors of innovation. That makes the promotion of knowledge sharing in ecosystems as a multifaceted issue. In addition, the findings suggest that firms in different ecosystem roles have role specific approaches towards sharing vs. protection.

Keywords: ecosystems; innovation ecosystems; innovation networks; open innovation; knowledge management; knowledge sharing; knowledge protection; intellectual property; paradox of openness; industry 4.0.

This paper was presented at The ISPIM Innovation Conference – Innovating in Times of Crisis, 7-10 June 2020.
Event Proceedings: LUT Scientific and Expertise Publications: ISBN 978-952-335-466-1

1 Introduction

Innovations do not arise in isolation, except in a minority of cases. Accordingly, sharing of knowledge (to some extent) is needed for innovation. It seems that it has always been so (DeBresson, 1999).

In the Middle Ages, artisans played the key role in innovation. Their key knowledge was tacit (know-how), and they shared their knowledge to others according to their own will. In the early stage of industrialization, the situation was about the same, but the key actors of innovation were often industrialists. When the volumes of production increased, the protection of innovation and knowledge related to the product being manufactured became more important than promoting innovation by sharing of knowledge across the borders of firm. Patents, trademarks and other legal forms of intellectual property (IP) dominated in the knowledge management of firms in the era of industrial mass production (the 2nd era of industrial revolution). Patenting prevented others of "free riding" by imitating or competing the innovation and, thus, gaining from business benefit in markets (Lemley, 2005).

In the last few decades of the 20th century, many products (as well as their manufacturing systems) started to include electronics, automation and its controlling software (the 3rd era of industrial revolution). The trend just strengthened when entering the 21st century. End products were typically such that no single firm could design or produce them alone. Instead, a value chain or a network of business actors were needed. Accordingly, a "closed" model of innovation, characteristic to the early era of mass production, no more supported innovation. There was a need towards opening of knowledge flow in innovation networks. While patenting remained a valid tool of knowledge management, an emphasis was put on sharing of knowledge among the actors of innovation networks. The knowledge sharing was safeguarded by contracting and various informal methods of knowledge protection (Luoma *et al*., 2010; Paasi *et al*., 2010).

Currently we are witnessing the 4th industrial revolution, characterised by production in smart factories, in which production systems, components and people communicate via internet and production is nearly autonomous (Kagermann *et al*., 2013). Business offerings in the 4th era of industry are increasingly systemic, integrated solutions of various technologies and services bundled together to meet a customer need. The integrated solution, a cyber-physical system, is such that no single firm could innovate and offer it alone, but an ecosystem of actors is needed to co-create it and deliver it to customers (Moore, 1993; Iansiti and Levien, 2004).

In this paper we will consider IP and knowledge management in innovation in the 3rd and 4th eras of industrial revolution, and study whether ecosystemic and open innovation way differ to innovation in networks? The focus of the research is in aspects of knowledge sharing and knowledge protection among the actors of innovation.

2 Paradox of openness in innovation networks

Co-creation of solutions requires various kinds of interaction and knowledge flows between the actors of innovation network during an innovation process. Here the actors face the fundamental tension between knowledge sharing and knowledge protection in open innovation: knowledge sharing is vital for the co-creation of innovations and

welfare in a network (or ecosystem) of actors, while the sharing of knowledge may weaken firm´s power to capture returns from markets in future. In the literature of innovation management that dilemma has been named as the paradox of openness (Laursen and Salter, 2014; Arora *et al*., 2016; Foege *et al*., 2019). It is a dilemma that every innovation network must face and somehow solve.

Ritala *et al*. (2017) defines the term innovation (R&D) network as a group of contractually and relationally interconnected organizations with common mission and purpose that seeks to gain innovation benefits that could not be achieved independently. It means that actors of a network know with whom they are interconnected and collaborating. They may understand their partners' business models and strategic intents, for example their motivation to collaborate, and by this way to control what knowledge they will share and to whom and what knowledge they should protect and how (Valkokari *et al*., 2012). Balance between knowledge sharing and protection could be found even when there is coopetition in the network (Gast *et al*., 2019). All these require diversity in knowledge and IP management of firms going beyond IP legislation-based approach of knowledge management and including a variety of formal, contractual, and informal methods of knowledge and IP management (Luoma *et al*., 2010; Gast *et al*., 2019).

IP rights are modelled on the idea that one inventive idea or creation correlates to one right to a single product. The concept worked well in the industrial era of mass production, but now in the time of open and networked innovation, there is a substantial gap between the innovation practice and the model that IP law uses in areas where multiple entities are involved in the creation and use of IP and where the coordination is required (Lee, 2009). In innovation networks, where the actors of innovation are known, the problem is solved contractually: joint ownership of IP is typically avoided and IP ownership is addressed to a single actor, but the rights to use the IP may be defined by agreements to a larger group of innovators (Hagedoorn, 2003; Paasi *et al*., 2010). Such an arrangement often helps in decreasing the tension between knowledge sharing and protection in innovation networks.

While the tension between knowledge sharing and protection has been learned to be managed in innovation networks where the actors of innovation are known, we may ask that what is the situation in ecosystem kind of innovation? Ecosystems are more fluid than networks and openness is intrinsically built into the concept (Moore, 1993; Iansiti and Levien, 2004). How will that affect in knowledge sharing if you do not necessarily know beforehand all the actors of innovation?

Foege etal. (2019) studied the paradox of openness in the context of open innovation and how solvers navigate through sharing-protecting tensions in crowdsourcing. They found that the paradox manifests differently to actors of inbound and outbound innovation: firms that source knowledge (inbound open innovation) need to reveal knowledge to articulate their needs, while firms and other actors of innovation that practice outbound open innovation need to reveal knowledge that could be close to the core of actor´s knowledge base. This finding suggests that in the context of ecosystem studies one should pay attention to the role that an actor has in an ecosystem when studying openness and knowledge management in ecosystems. Also, a recent study by Holgersson *et al*. (2019) on the evolution of IP strategy in innovation ecosystems supports the need of having a broad scope in knowledge and IP management considerations going beyond the traditional focal appropriability regime to the larger context of innovation ecosystem.

3 Research question and methodology

The research aims at investigating openness and knowledge management in innovation networks (characteristics to the 3rd era of industrial revolution) and ecosystems (related to the 4th era of industrial revolution). The study has two main research questions:

1. How knowledge and IP management have changed in different eras of industrial revolution?
2. What will be requirements of knowledge and IP management in innovation ecosystems?

The first research question studies the continuum how knowledge sharing vs. protection among the actors of innovation has been considered from the past to present by taking into account the context of business in question. This leads to the second research questions that addresses to the future.

The approach of the research is exploratory in nature, and, therefore, a qualitative case study methodology was chosen. As the ecosystemic way of innovation is just about coming, we have accepted the fact that not all findings could be validated in a same manner than in studies focusing on historic data. Therefore, some discussion on the findings will remain on an indicative level.

The case studies were done in two phases. The first phase was a part of a large research on management practices in innovation constellations that call themselves as ecosystems. The research covered 13 innovation ecosystems in Finland, Sweden and Belgium (10 ecosystems and most of the actors were Finnish), see Table 1 for more details on the ecosystems. The interviews were done between October 2019 and April 2020. In total 35 individual theme interviews and three round table discussions, each comprising of members of one innovation ecosystem, were conducted. The interviews and round table discussions covered a broad range of management themes related to the birth, building and growth of ecosystem. From the viewpoint of this study, the most important themes were contracting, IP management and knowledge sharing. The interviewees included leaders and facilitators/coordinators of ecosystems, developer firms, universities and research institutes, and ecosystem consulting companies. Each interview lasted around one hour. All the interviews were recorded and transcribed. The interview data analysis followed the thematic analysis method and was made with NVivo12 qualitative data analysis software. The variety of informants' roles in innovation ecosystems enabled complementary viewpoints adopted in data analysis. This first phase of the study gave answers to the first research question (when combined with the literature findings given above).

In the second phase, we focused on one ecosystem in more depth and searched for answers to the second research question, An ecosystem called Smart Energy Åland (SEÅ) was chosen as the case ecosystem, because it is an established ecosystem who has passed its initial innovation phase (as a traditional innovation network) but who has recently changed its operating mode and is now turning into an open ecosystem. SEÅ is large enough ecosystem (including 40-50 organizations) so that there are multiple of actors for most ecosystem roles, and it includes actors from different fields of business and with different firm sizes bringing diversity for the study. The name, SEÅ, refers to its initial mission, but they changed their target markets from local to global at the same time when their turned their operation mode from a network (cluster) into an open ecosystem.

Table 1 Information on the studied innovation ecosystems and conducted interviews

Ecosystem	*Year founded*	*Area of innovation and targeted business*	*No. of members*	*No. of informants*	*Informants*
Bio Hub	2014	advancing life sciences by combining biotech and medtech with pharma	~ 30	1	CEO of the ecosystem
Circular economy	2016	new waste and resource management concepts	30	1	project manager of the ecosystem
Circular economy service platform	2017–18	new business for industrial side streams through a digital service platform	10–15	18	representatives of the coordinator and firms
Consumer goods solutions	2013	new, disruptive experiences to consumers	~ 2000	1	R&D manager of the ecosystem
Digital economy	2008	tools required by the Internet economy	~ 400	1	former president of the ecosystem
Digital weather and air quality services	2016	digital services and products to support decision making	~ 15	3	representatives of the coordinator and firms
Energy and environment	2013–14	new business to energy and environment sector companies in the region	~ 50	4	representatives from the ecosystem leader and firms
Energy ecosystem A	2017-18	flexible energy system based on renewable energy production	25–30	20	representatives from the coordinator, firms, RTDs and regulation
Energy ecosystem B	2018	smart energy technology models and concepts	~ 100	6	representatives from the ecosystem leader and firms
Energy ecosystem C	2017–18	enhancing the export of local firms	~ 200	1	managing director of the ecosystem
Health ecosystem A	2017	health service innovations utilizing artificial intelligence and robotics	15	1	project manager of the ecosystem
Health ecosystem B	2017	solutions based on data, cognitive capabilities and artificial intelligence	~ 50	1	development director of the ecosystem
Smart city	2017	a digital backbone for a smart city	30–35	5	representatives from the ecosystem leader and firms

Twenty active members of SEÅ ecosystem were interviewed by a questionnaire where we asked about the role or roles they have in the ecosystem, what kind of knowledge they have brought into the ecosystem, what have been their requirements for knowledge, IP and data management, and what have been their expectations for collaboration and business? Answers to the questionnaire were supplemented by a group discussion, covering topics such as the vision, targets, and governance of the ecosystem. That information was needed to put the answers of questionnaire into the right ecosystem level context of business.

Inspired by the recent works of Foege *et al*. (2019) and Holgersson *et al*. (2019), we wanted to go beyond the hub-spoke model of network roles (Doz, 2001) and consider functionally, what are the strategic intentions, business undertakings and processes in which an actor engages in building the systemic solutions of ecosystem (Valkokari *et al*., 2017), and by this way to define actor roles in ecosystem to be used in analyzing knowledge sharing vs. protection strategies of actors in the ecosystem. Accordingly, we defined four categories for ecosystem actors having specific interests towards knowledge and IP management: 1. solution integrators, meaning firms who aims to bring a systemic solution of ecosystem into markets, 2. solution developers, meaning firms developing new solution to be integrated into the systemic solution of ecosystem, 3. solution providers, meaning firms offering an almost ready and generic solution into the systemic solution of ecosystem, 4, R&D intermediaries offering special expertise needed to innovation & development work.

4 Findings

Case findings from the general management issues of innovation constellations that call themselves as ecosystems reveal that a large majority of them actually work like innovation networks: their inter-organizational relations of innovation are backed by contracts, including clauses of IP management. Contractual bindings also form a frame that supports the sharing of knowledge needed for innovation between partners. Informal methods of knowledge protection, such as secrecy, were also common, in line with earlier findings in literature related to networked innovation (Luoma *et al*., 2010; Gast *et al*., 2019). In short, knowledge sharing as well as knowledge management followed guidelines characteristic to the 3rd industrial revolution.

Then, there were a few innovation constellations who have realised that their challenging business targets are not in line with their current networked mode of innovation. A quotation of an interviewee representing a large technology firm: *"When we have a large and complex problem to be solved - a problem for which we don´t have ready solution models, we don´t know all affecting issues, nor actors to be needed for solving it - then the work should be done in an ecosystem"*. Another interviewee from the same constellation (ecosystem) said *"We intend to have clear consortium agreements before starting the work, but in an ecosystemic way of working it is not always easy as we may not know beforehand with whom to innovate. Therefore, we have also other agreements, a kind of rules, following which firms can share knowledge and data to each other"*. There were also few other interviewees from other ecosystems that mentioned the challenge if one should collaborate with an actor that you don´t know beforehand: how to be open and share knowledge and data in such a situation? This goes beyond traditional

practices of innovation networks and seems to be one of the main challenges of knowledge management in innovation ecosystems.

The coordinator of the same ecosystem than the interviewees above said, *"Building of trust in all levels of communication is in the core. It must cover both the communication with those who are not yet in and with those who are in the actual projects (of ecosystem). It starts from how we facilitate the meeting and matching of people"*. A coordinator of another ecosystem mentioned, *"It will take time and hard work before firms in an ecosystem will go into a mode of open sharing. One has to tell on and on success stories from other cases to convince the actors from the benefits of sharing"*. On the other hand, another ecosystem coordinator said, *"perhaps there are now in this ecosystem such people that see more value in sharing of their knowledge to each other than in sitting on their knowledge"*. Sharing of knowledge clearly depends on person.

One characteristic of innovation ecosystems seems, according to the study, to be that the presence of direct competitors may not be avoided in the ecosystem. The possibility of competitor presence sets limits to what a firm could share to others in the ecosystem. Like an interviewee from a technology company said, *"You cannot bring trust to such a high level by any IP rules or contract clauses that you will be fully open also with your competitors…And when you are doing something completely new, it is hard to set limits of what to share and what not."* A quotation of a manager of another technology company *"I would have to say that this kind of open kind of ecosystem, it doesn't support bringing any new ideas or technology openings"* captured feelings of several interviewees related to innovation ecosystems. The paradox of openness seems to be very true in innovation ecosystems.

Another characteristic of innovations ecosystems seems to be stratification, meaning that an ecosystem consists of active and less active actors, kind of "hang rounds". Like an interviewee stated, *"There are also people here that are pretty quiet and are exploring whether there would be something interesting for them and where to step in, if things go on"*.

In order to better understand practices of knowledge sharing vs. knowledge protection in innovation ecosystems, we selected one open ecosystem, namely Smart Energy Åland, for a closer study. We made more specific questions related to knowledge and IP management to the active members of the ecosystem and addressed the interview answers with the role that they have in the ecosystem. The answers clearly indicate that the actors in different roles of ecosystem do have role dependent strategies towards knowledge sharing and knowledge protection in the ecosystem. There were even a few actors whose ecosystem role was business case specific, and they followed different IP strategy for knowledge sharing and protection depending on the role in question.

In the SEÅ ecosystem there is one actor who has been established for the role of solution integrator. This firm tend to enhance openness and sharing of knowledge in the ecosystem. That is natural as the business target of the solution integrator is to bring a systemic solution, containing special knowledge and IP of several other ecosystem actors, into markets.

The ecosystem includes several actors who could be considered as solution developers. Solution developer firms emphasize formal protection of IP they are developing or have developed, but, on the other hand, they are open to find out new business models for bringing their solutions into markets. That is understandable as they have high need to find paying customers to cover their development efforts.

Then there are actors who are in the role of solution providers. Solution provider firms typically enter the ecosystem with existing IP, and their main concern related to knowledge and IP management is possible leakage of their know-how during co-creation activities of ecosystem. Solution providers are actors who are easier to be replaced in an ecosystem than e.g. solution developers are. Providers may face competition within the ecosystem, all which reduce their willingness to open and share their knowledge in the ecosystem. However, there is a difference on approaches between small and large companies. Small companies are more open because the competitive situation is different to big companies (i.e. small companies have less market share to defend and more to gain).

There are a few research actors (research institutes and universities) in the ecosystem. They may bring background IP into the ecosystem work, but in relation to the outcome, their characteristic interest is to publish their results (i.e. to write scientific publications). This interest towards publications may conflict with business interest of some other ecosystem actors.

The ecosystem also includes facilitators, but they typically do not have specific interest towards knowledge and IP management. What other actors expect from them is confidentiality and ability to support each participant impartially.

5 Discussion

In the first research question of the study we asked, how knowledge and IP management have changed in different eras of industrial revolution, with an emphasis on aspects related to knowledge sharing and knowledge protection. Answers related to the first three eras are easy to give and already discussed in Chapters 1 and 2 of the paper.

Knowledge (know-how) of individuals, e.g. key persons of factory, was characteristic in the first steps of industrialization. Those persons could control what to share and to whom. Innovation was quite open because competition in markets was not hard, if compared to competition in markets of today. An interesting finding of the empirical part of this research suggests that the knowledge of individuals seems to play a more important role in the ecosystemic way of innovation than in the past century. This is related to high role of trust in personal level in ecosystems. Trust plays important role also in networked innovation (Paasi *et al*., 2010) but it seems to have a pronounced role in the opening of knowledge sharing in ecosystems.

Patents and other formal methods of knowledge management dominated in the era of mass production. It is easy to understand, as patenting is a very effective tool to safeguard value capturing in the markets of mass production. Patenting is still a valid tool in the era of ecosystems, but alone it gives far too narrow perspective on knowledge management in the 4th era of industrial revolution.

The 3rd era of industrial revolution, and the networked way of innovation related to its business offerings, is characterized by the diversity of methods for knowledge and IP management, including a variety of formal, contractual and informal methods. According to the case studies of the research, all these are in use also in innovation ecosystems.

What is then a difference in knowledge sharing and knowledge protection between the 3rd and 4th eras of industrial revolution? Is there any difference at all? Answering to these questions is not straightforward. To consider these questions, we took another approach and used a recent work of Ritala *et al*. (2017) on knowledge search and

integration in R&D networks and compared their empirical findings to our findings in innovation ecosystems. They found that firms in R&D networks made deliberate decisions with respect to the degree of openness (open vs. closed) and inclusiveness (inclusive vs. selective) of knowledge that they share and integrate in the network. According to our case findings in innovation ecosystems, we see no difference between networks and ecosystems on the behaviour of firms in those aspects of knowledge management. Furthermore, they found that in R&D networks actors´ innovation goals are an important driver for knowledge search and integration process, and that coopetion tensions are often present in large R&D networks with lots of members. All that arise also from our empirical findings in innovation ecosystems. Based on these aspects, we cannot find any difference between networked and ecosystemic way of innovation, as it comes to knowledge sharing vs. protection.

In order to find differences between networked and ecosystemic way of innovation, we must come back to the structural differences between networks and ecosystems. While network refer to a group of contractually interconnected actors, ecosystems are intrinsically open in a sense that an ecosystem actor may not know all the other actors of innovation network. This is the main difference between networked and ecosystemic way of innovation. Both models call for openness and knowledge sharing in order to support innovation, but in ecosystems the promotion of sharing is a multifaceted issue once you may not know all actors of innovation. In other words, the borders of innovation ecosystem are open, whereas innovation networks are quite closed. Furthermore, the findings suggest that actor roles in innovation ecosystem could be more dynamic than in innovation network, where the roles are largely based on established positions in value chain.

The answer to the first research question can be now summarized as presented in Table 2. Here we have adopted the way of naming the eras from the German strategic research agenda “Industrie 4.0” (Kagermann etal., 2013).

Table 2 Characteristics of knowledge and IP management in different eras of industrial revolution

Industry 1.0	*Industry 2.0*	*Industry 3.0*	*Industry 4.0*
First steps of industrialization	Mass production	Rise of electronics and automation	Cyber-physical systems
End of 18th century	Start of 20th century	Start of 1970s	Today
Knowledge of individuals (know-how)	Knowledge management by patenting (IP laws)	Diversity in knowledge and IP management	Multifaceted management of openness and IP

In the second research question of the study we asked that what will be requirements of knowledge and IP management in innovation ecosystems? Answers to this question were mainly given in the discussion above. Basically, we could say that all what is relevant in innovation networks is relevant also in innovation ecosystems: protection of IP, contracting, promotion of openness and knowledge sharing to support innovation, consideration of what to share and with whom. But that is not everything. In open ecosystems one may not know all the actors of innovation. Hence, hard contracting is not in the same role as in networks. Instead one needs in ecosystem legally less binding arrangements, a kind of ecosystems rules, to promote openness and set a frame for trusted

sharing of knowledge with other ecosystem actors. Building of trust is important in networks, but it seems to be even more important in ecosystemic innovation where contractual bindings between organizations may lay behind personal level of knowledge sharing.

While in networks the roles are often crystallized around the concept of hub and spokes where the central actor has more power to control knowledge management of network than the peripheral actors (Ritala *et al*., 2017), in ecosystems the situation is not so straightforward. Ecosystems typically innovate and deliver systemic solutions, where one may identify, by using a functional approach, three characteristic firm roles, namely solution integrators, solution developers, and solution providers. In addition, there can be R&D actors in the ecosystem. All these four types of ecosystem actors have different kind of strategic approaches for knowledge sharing and protection in ecosystemic innovation, the approaches being connected to business interests and business models related to the ecosystem role. From the viewpoint of knowledge and IP management in an ecosystem, it is important to understand and take into account the role dependent strategic approaches of ecosystem actors. Knowledge and IP management in ecosystems is a multifaceted issue.

6 Conclusions

As the existing studies as well as company practices have pointed out the need for new forms of innovation and the concept of innovation ecosystem has emerged, the aim of this study was to explore the changes of knowledge and IP management and their new requirements in innovation ecosystems. Our contribution to academic discussion is two-fold. First, based on empirical evidence of 13 innovation ecosystems, this study offers important new insight about characteristics of knowledge and IP management in different eras of industrial revolution (the summary presented at Table 2). Secondly, the more detailed study of one innovation ecosystem highlights that actors in different ecosystem roles face the needs for knowledge sharing and protection very differently. Approaches of actors in different roles towards openness as well as protection are closely related to business expectations they have in the ecosystem.

The study has also practical implications. Findings give understanding for the knowledge and IP management of innovation ecosystems concerning both the sharing and protection of knowledge in ecosystem work. The results of the study state that actors in different ecosystem roles have intrinsically different approaches and interests towards knowledge and IP management that must be matched in a way that supports reaching ecosystem targets. Furthermore, the study highlights that in open innovation ecosystems the contracts are not as significant tool for knowledge and IP management as they are in innovation networks.

As with any research effort, there are certain limitations that deserve further discussion and may provide avenues for further research. The study has looked at the emerging phenomenon of open innovation ecosystems and with limited case material. Therefore, conclusions should be considered as indicative. The time will come in a few years to strengthen them, as we have more experience and longitudinal studies within open innovation ecosystems. Our empirical data was mostly limited to Finnish innovation ecosystems and therefore one interesting avenue for further research would be the broader geographical comparison of innovation ecosystem practices.

Acknowledgements

The work on this conference paper has been undertaken within the projects: B2B Ecosystem Playbook and Solid Value of Digitalisation in Forest Industry (SEED) at VTT, University of Vaasa and CLIC Innovation. The authors wish to thank all innovation ecosystem representatives, their willingness to share their insights enables the research work. The financial support of Business Finland is gratefully acknowledged.

References

Arora, A., Athreye, S., Huang, C. (2016). The paradox of openness revisited: collaborative innovation and patenting by UK innovators. *Research Policy*, Vol. 45, pp. 1352–1361.

DeBresson, C. (1999). An Entrepreneur Cannot Innovate Alone; Networks of Enterprises Are Required. DRUID Conference on Systems of Innovation, Aalborg, Denmark, June 9-11, 1999.

Doz, Y. (2001). Clubs, Clans and Caravans: The Dynamics of Alliance Membership and Governance, *in Trick, M.A. (Ed.) Growing the international firm: Success in mergers, acquisitions, networks and alliances*. Carnegie Mellon University Press, Berlin.

Foege, J.N., Lauritzen, G.D., Tietzec, F., Salged, T.O. (2019). Reconceptualizing the paradox of openness: How solvers navigate sharing-protecting tensions in crowdsourcing. *Research Policy*, Vol. 48, pp. 1323-1339.

Gast, J., Gundolf, K., Harms, R., Matos Collado, E. (2019). Knowledge management and coopetition: How do cooperating competitors balance the needs to share and protect their knowledge?, *Industrial Marketing Management*, Vol. 77, pp. 65-74.

Hagedoorn, J. (2003). Sharing intellectual property rights – an exploratory study of joint patenting amongst companies. *Industrial and Corporate Challenge*, Vol. 12, pp. 1035-1050.

Holgersson, M., Granstrand, O., Bogers, M. (2018). The evolution of intellectual property strategy in innovation ecosystems: Uncovering complementary and substitute appropriability regimes. *Long Range Planning*, Vol. 51, pp. 303-319.

Iansiti, M. and Levien, R. (2004). *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability*. Harvard Business School Press.

Kagermann H, Wahlster W, Helbig J. (2013). *Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0*, Stifterverband.

Laursen, K. and Shalter, A. (2014). The paradox of openness: Appropriability, external search and collaboration, *Research Policy*, Vol. 43, pp. 867-878.

Lee, N. (2009). Exclusion and coordination in collaborative innovation and patent law. *International Journal of Intellectual Property Management*, Vol. 3, pp. 79-93.

Lemley, M.A. (2005). Property, Intellectual Property, and Free Riding, *Texas Law Review*, Vol. 83, pp. 1031-1076.

Luoma, T., Paasi, J., Valkokari, K. (2010). Intellectual property in inter-organizational relationships: Findings from an interview study. *International Journal of Innovation Management*, Vol. 14, pp. 399-414.

Moore, J.F. (1993). Predators and Prey: A New Ecology of Competition. *Hardward Business Review*, May/June 1993: pp. 75-86.

Paasi, J., Luoma, T., Valkokari, K., and Lee, N. (2010). Knowledge and intellectual property management in customer-supplier relationships. *International Journal of Innovation Management*, Vol. 14, pp. 629-654.

Ritala, P., Huizingh, E., Almpanopoulou, A., Wijbenga, P. (2017). Tensions in R&D networks: Implications for knowledge search and integration. *Technological Forecasting & Social Change*. Vol. 120, pp. 311-322.

Valkokari, K., Paasi., J., Rantala, T. (2012). Managing knowledge within networked innovation. Knowledge Management Research & Practice. Vol. 10, pp. 27-40.

Valkokari, K., Seppänen, M., Mäntylä, M., Jylhä-Ollila, S. (2017). Orchestrating Innovation Ecosystems: A Qualitative Analysis of Ecosystem Positioning Strategies, *Technology Innovation Management Review*, Vol. 7, pp. 12-24