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## Business and innovation ecosystems: innovation policy implications

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## Business and Innovation Ecosystems: Innovation Policy Implications

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**Abstract:** The concepts of the business ecosystem and innovation ecosystem have become highly utilized in business and innovation studies. However, research on the innovation policy implications of these concepts and the ways ecosystems emerge and evolve is still rather scant. This study utilized a multiple case study approach to study real-life business and innovation ecosystems in an innovation policy context. Based on the case study findings and other empirical data, the key elements of ecosystem-based innovation policy were outlined. Business and innovation ecosystems are strongly self-organizing and the role of the public sector is to support their self-renewal capacity. Ecosystem-based policy approach consists of elements such as a testing and experimentation culture, funding through public procurement and the positive questioning of existing procedures, and it crosses the traditional policy boundaries. Adopting the ecosystem perspective in policy making requires interaction between different policy fields and levels.

**Keywords:** business ecosystem; innovation ecosystem; innovation platform; innovation policy; case study

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### 1 Introduction

The use of the word *ecosystem* outside of an ecological context has increased drastically, especially in the business world (Hwang, 2014; Majava et al., 2013), which perhaps reflects a change in the way we think about business and innovation (Gobble, 2014). Papaioannou et al. (2007) have criticized the increasing use of the ecology approach and ecosystem concept in innovation studies. They argue that since knowledge and innovation are historically developed social processes of cooperation and conflict they cannot be discussed and studied as harmonious processes of natural adaptation to the changing conditions of the environment. Business and innovation ecosystems are by definition self-organizing and emergent systems, which also makes intentions to influence them through public policy questionable. However, the policy problems related to the changes in global as well as national operational environments and modern societies as a whole are extremely complex and call for new policy approaches. Hämäläinen (2015) argues that the complexity gap in policy, which stems from the gap between the complexity of the policy problem and the variety of the corresponding governance arrangements, can be closed with new governance solutions including, for example, participation, collective learning processes, interaction and cooperation among stakeholders, and diversity and experimentation. Innovation ecosystems are highly complex by nature, involving, for example, entrepreneurs, researchers, venture capitalists, and public and civic sector actors. The study of business and innovation ecosystems takes into account this complexity instead of studying ecosystems merely as harmonious processes of natural adaptation. A study by Hämäläinen (2015) focuses on

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the governance solutions to the wicked problems of societies but it also presents a basis for creating an evolutionary perspective on policy that can also be utilized when framing ecosystem-supporting innovation policies. Also, Sotarauta and Srinivas (2006) have shown that economic development (as an emergent process) and policy (as intentional actions) co-evolve and that policy can influence future development through strategic adaptation, instead of only being adaptive and reactionary in nature (as it often is).

In modern business environment competition happens more and more often between business ecosystems rather than between individual firms or clusters (Moore, 1993; Hearn and Pace, 2006). The amount of research on business and innovation ecosystems is rapidly increasing but research on the policy implications of these concepts is still rather scant. We have gained understanding about how business and innovation ecosystems are developed, how they evolve and what type of actors they consist of through several studies, but there is still a lack of understanding about the role of the public sector and public policies and how they can support the birth of new ecosystems and their growth and renewal. The research question set for this study is: How can innovation ecosystem development be supported by means of innovation policy?

The study contributes to current innovation policy theory by bringing a contemporary business and innovation concept to innovation policy research and examining it empirically in an innovation policy context through multiple case studies. Furthermore, the results of the study present the implications of applying the ecosystem approach in innovation policy. These implications are not designed or targeted to a specific national or regional setting – rather, the emphasis has been on providing a basis on which any nation or region can build a policy mix considering their own national or regional context.

The data has been gathered within a research project consisting of several case studies examining spatial business ecosystems and local innovation platforms. The case studies do not focus solely on business ecosystems as, for example, Moore (1993; 2006) has defined them but rather on the spatial, social, economic and political setting wherein business and innovation ecosystems are developed and evolve over time. The case studies do not examine ecosystems at an enterprise level but rather at a system level, which emphasises the role of different connections, interdependence and cooperation between individual enterprises and other stakeholders linked to the knowledge flows and value network of the ecosystem. The case study analyses focus on the observations and findings that have connections to the policy level. Also, additional data has been gathered to complement the case study data.

The purpose of this paper is to present the innovation policy implications of the ecosystem case studies and, based on the case study findings, to sketch a basis for innovation policy that takes into account the nature of business and innovation ecosystem development. After the introduction section, the paper presents a literature review opening up the recent discussion around business and innovation ecosystem concepts in the innovation policy context. The third section presents the research design and includes short descriptions of the case studies. The fourth part summarizes both the case study findings from an innovation policy perspective and the policy implications of these findings. This is followed by the fifth section that discusses the results of the study in the light of previous literature. The last section presents some concluding remarks.

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## **2 Ecosystems and innovation policy**

The rise of the internet economy has led to changes, including those in business logic. The changes in operational environments and competition have shifted from head-to-head competition to competition between different value networks. In the 1990s James F. Moore (1993) was the first to bring the ecosystem analogy over to business and innovation studies. Although the business ecosystem concept has been adopted in academic literature quite recently, it has quickly gained popularity and is increasingly used when discussing business collaboration and the interdependent relations between cooperative actors and different cooperation and value networks (Majava et al., 2013). However, despite of the wide adoption of the ecosystem concept in academic literature, these theoretical underpinnings have thus far failed to construct a coherent theoretical framework (Thomas and Autio, 2014).

According to Moore (1993), firms should not be seen as a part of an industry but as a part of an ecosystem wherein companies cooperate, compete and co-evolve capabilities around a new innovation. He defines a business ecosystem as ‘a type of a business network, a collaboration to create a system of complementary capabilities and companies’ (Moore, 2006). Typically these network relationships are loose, which makes ecosystems adaptable as fruitless connections can be cut and new ones formed at a rather fast pace (Iansiti and Levien, 2004). Basically, a business ecosystem can be opened up to all possible contributors and participants, and thus create an organizational form of distributed creativity. Ecosystems cross a variety of industries and contain several ecosystem domains (Iansiti and Levien, 2004). Ecosystems may also consist of independent niches that can be developed within an ecosystem by specialized new ventures (Moore, 2006; Zahra and Nambisan, 2011).

A business ecosystem has a leader, or as Iansiti and Levien (2004) put it, a *keystone organization*, whose role is valued by the rest of the ecosystem members. The lead firm provides an open platform that offers solutions to other members and on the basis of which other firms can build and innovate in order to increase the customer value of the ecosystem products and services (Iansiti and Levien, 2004; Teece, 2007; Adner and Kapoor, 2010). A substantive subset of the literature proposes platforms as the coordinating artefact that the lead firm uses, but Autio and Thomas (2014) also note that although a successful platform typically has an ecosystem surrounding it, not every ecosystem needs to have a platform at its core. The leadership role of the leading organization enables ecosystem firms to invest in a shared future and common goals bind the ecosystem members together (Iansiti and Levien, 2004; Nambisan and Baron, 2013).

The ecosystem concept differs from the other network-centric constructs – such as clusters, innovation networks and industry networks – by its inclusion of both producers and users, including complementary asset providers and customers (Autio and Thomas, 2014). In addition to its broad-based coverage, an ecosystem is also distinguished by its focus on value co-creation. In an innovation context the ecosystem concept comes close to the open innovation concept in not limiting the actors (the potential co-innovators and co-creators) to internal R&D actors and functions (Durst and Poutanen, 2013).

The business ecosystem and innovation ecosystem concepts are often discussed in parallel and without making a clear distinction between the concepts. Compared to innovation ecosystems, business ecosystems include the customer side that is often absent in innovation ecosystems (Wright, 2014). An innovation ecosystem can be viewed as a

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wider concept that also includes the political, economic and technological environment. The innovation ecosystem concept brings out the dependence on complementary innovations. According to Wessner (2007) an innovation ecosystem is based on the concept of a national innovation system (see e.g. Freeman, 1987; Lundvall, 1992; Nelson, 1993). However, the ecosystem approach takes, for example, market mechanisms better into account than the traditional innovation systems approach, which emphasizes the role of non-market institutions (Papaioannou et al., 2007; Ritala and Almpanopoulou, 2017). Ecosystems are brought to discussions also to emphasize the complex nature of innovations and innovation activities and the interaction and interdependency between different actors. Gobble (2014) summarizes that the central idea of the innovation ecosystem concept is a kind of radical openness to collaboration and sharing, and an awareness of the ecosystem the organization inhabits, which can lead to new opportunities for growth.

Based on their literature review, Durst and Poutanen (2013) state that a better conceptual understanding of innovation ecosystems is essential in order to benefit from the analogy and suggest better conceptual linking between innovation and ecosystem literature in the future.

Regardless of the vast amount of ecosystem literature published during recent years, policy suggestions offered by business ecosystem literature are still rather scant. Moore (1993) pointed out that from the ecological perspective it is not desirable or wise to support failing ecosystems but, rather, it is better to ensure that the competition among ecosystems is fierce and fair. It is fairly obvious that, as ecosystems consist of several (often rather small) firms, policies should draw special attention to the role of small firms in innovation, economic growth and employment. Wessner (2004) lists some innovation ecosystem policy lessons based on experiences from the United States. He advises focusing innovation programmes on the individual entrepreneur, basing government fund granting on a competitive basis, improving markets by encouraging private initiatives, fostering a culture of innovation and matching policies to market realities. Moore (2006) also stresses the importance of ecosystems being able to address new business domains. He argues that helping ecosystems (for example, with financing) to address new 'opportunity spaces' is important for a society that hopes to attract entrepreneurs and be innovative. Mason and Brown (2014) discuss the role of policy in supporting these entrepreneurial ecosystems especially. One of their conclusions is that, despite sharing various common characteristics, every ecosystem is unique and therefore every ecosystem also needs a different policy approach, and policy implementation has to be holistic. Since ecosystems are dynamic and complex by nature, policy approaches also need to evolve over time and according to the maturity phase of the ecosystem. According to Mason and Brown (2014) ecosystem-supporting policies should be a blend of top-down and bottom-up policies, wherein the involvement of major businesses is also important in the bottom-up initiatives.

Clarysse et al. (2014) have studied knowledge and innovation ecosystems in Flanders, Belgium, and provided policy implications based on their study. First, their analysis suggests that policy has overall focused too much on bilateral links rather than on an ecosystem approach. They also suggest that public procurement policies may provide an important stimulus to the creation of business ecosystems and that, since the importance of a leading anchor company is acknowledged, large public companies could be encouraged to play more of a leading role in nurturing ecosystem development in the region. It is important to bring and attract large corporations into the ecosystem and

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collaborate with innovative start-ups because a healthy business ecosystem requires both a healthy keystone organization and healthy innovative start-ups (Clarysse et al. 2014). They also suggest developing policy initiatives and incentives to stimulate the development of financial support networks.

Durst and Poutanen (2013) have reviewed research on innovation ecosystems in order to derive success factors supporting the implementation of them. The success factors are related to resources, governance, strategy and leadership, organizational culture, human resources management, people, technology, partners and clustering. These success factors concern the innovation ecosystem as a whole, not just individual organizations. The factors include, for example, continuous investments in infrastructure, systematic risk assessment, clear role assignment, and openness to failure and chaos, which can also be seen as relevant for innovation policies supporting innovation ecosystem development. Despite these success factors, Durst and Poutanen (2013) do not present further innovation policy implications of their results.

A critique of the ecosystem analogy to innovation has been presented by Papaioannou et al. (2007) in their evaluation of the knowledge ecology concepts and the related implications for innovation systems theory. They remind us that knowledge and innovation need to be looked at in the context of the historically founded processes of economic and social development. However, as presented already in Moore's (1993) work the ecosystem perspective takes into account the different historical evolution phases and ecosystem life cycle perspective. Also, through the aspects of for example interconnectedness, open innovation and co-creation the social context becomes relevant also in ecosystem thinking. Oh et al. (2016) argue that in most cases in the business and innovation ecosystem literature the 'eco' prefix could be removed without changing the content, which indicates that the ecosystem analogy is merely metaphoric and doesn't add anything new to innovation and business research. Papaionnou et al. (2007) also argue that the innovation ecosystem concept fails to capture the complexity of the socially dynamic environment of knowledge and innovation, and therefore merely provides a simplistic explanation of economic and social evolution. As a response to the presented criticism, Ritala and Almpantopoulou (2017) note using examples from innovation and management studies, that borrowing from biology need not always replicate the original term in detail in order to be useful for academic purposes in another domain. They also suggest utilizing some useful features of ecological thinking and systems thinking in order to embrace the research objects of innovation ecosystem studies more holistically and more realistically.

Table 1 summarizes the business and innovation ecosystem characteristics detected based on the literature review. This summary works as a starting point for the analysis of the case study findings.

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Table 1. Innovation ecosystem characteristics

<b>Innovation ecosystem characteristics</b>
Complex and self-organizing
Niche development
Finding innovation potential from interfaces and unexpected combinations; complementary innovations
Ecosystem management; the keystone organization's role; peer-to-peer management
Global business ecosystems based on local/regional innovation ecosystems
Open innovation; co-creation; users
Trial-based; experimental; rapid prototyping in the real world
Rapid changes; new courses of action

### **3 Research design**

The study utilized the multiple case study approach. The case studies formed a larger project wherein the aim was to study different types of ecosystems as seedbeds for new innovations and to study their formation, functioning and evolution. The purpose of the multiple case study approach was not to use the cases for comparison between different types of ecosystems but rather use them to complement each other in order to gain a wide enough view of the phenomena. The case studies approached the phenomena from three different perspectives that complemented each other: successful spatial innovation ecosystem, sectoral business ecosystem and successfully diffused technology platforms. Business ecosystems can have multiple different forms as can the ecosystem platforms. The case studies were chosen based on the criteria that they represent the same ecosystem phenomena but from different angles when reflecting the business and innovation ecosystem theory. For the research purpose it was essential that all the cases focused on science and technology based evolving ecosystems that consisted of actors contributing to the creation of customer value. The focus was on the ecosystem phenomena, not the specific industries that these ecosystems evolved around. Figure 1 presents the framework of the study and the linkage between the chosen case studies and the business and innovation ecosystem theory presented in section 2.



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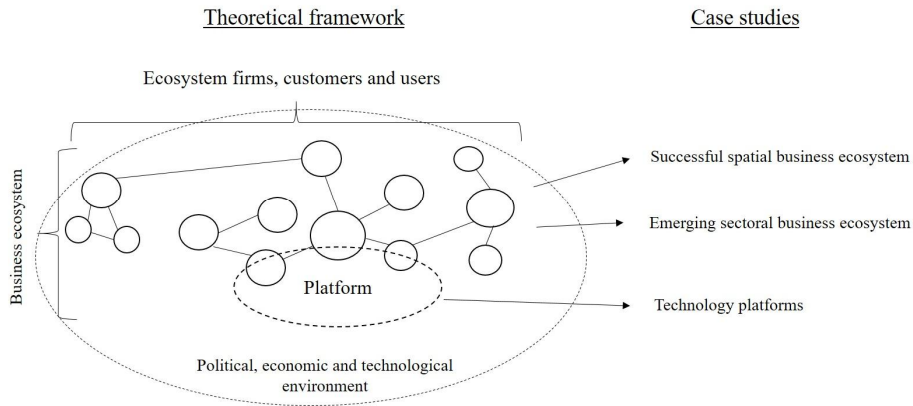


Figure 1. Framework of the study

The innovation policy related research was part of this project ensemble and utilized the data and results gained from the case studies. The case study approach allowed the investigation of real-life ecosystems, retaining a holistic view to the problem and utilizing multiple sources of evidence. The case study approach is found especially appropriate in new topic areas (Yin, 2009; Eisenhardt, 1989). One criticism of the case study approach is related to generalizing on the basis of an individual case or a few cases. It might also seem difficult to summarize and develop general propositions on the basis of specific case studies. However, Flyvbjerg (2006) argues that the case study may in fact be central to scientific development, via generalization, as a supplement or alternative to other methods.

The research process is presented in figure 2. The case studies were conducted between January 2014 and July 2015. The case studies, and their data and results were discussed among the research group throughout the research process, but the more thorough innovation policy – focused on analysis of the case studies – was conducted between June 2015 and September 2015.

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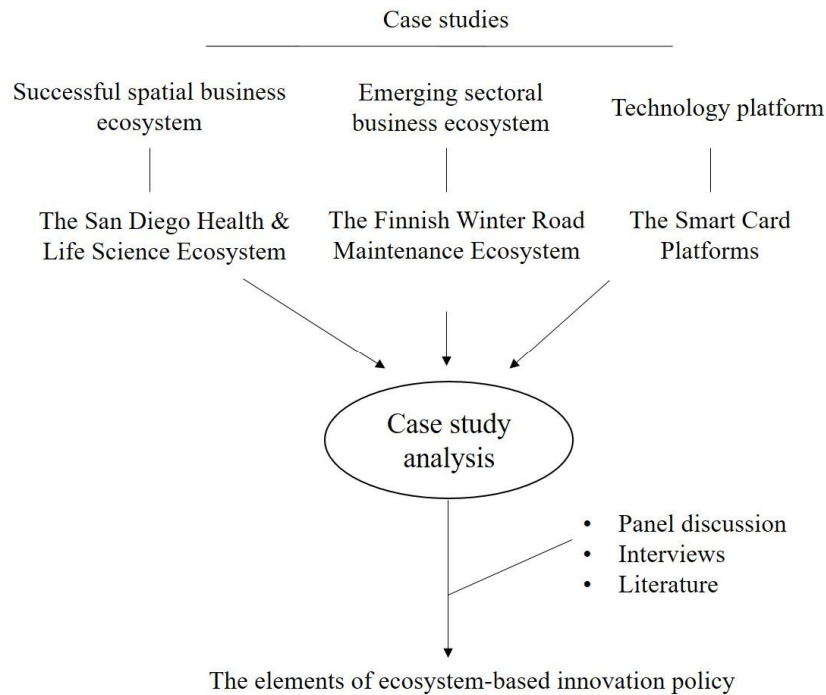


Figure 2. The research process

The lessons learned from the case studies and their policy implications were also discussed among the research group in a workshop organized in June 2015. The case study data was supplemented with interviews of Finnish innovation policy experts and a panel discussion among five innovation policy experts. This additional data helped to put the case study results into a Finnish innovation policy context as the interviewees and panellists represented different policy level expertise and organizations closely related to Finnish innovation policies. The case studies are not elaborated on in detail here as it is not the purpose of this paper and additional information about the case studies can be accessed through other research papers. However, as our study is based on these empirical case studies and the analysis of the case study results, the cases are presented very briefly below to get a grasp of the case ecosystems.

### *3.1 Case study 1: The San Diego Health and Life Science Ecosystem*

The first case study focused on the study and analysis of the health and life science ecosystem of San Diego in the US. The San Diego ecosystem was studied as a spatial innovation ecosystem focusing on the different actors and their roles within the ecosystem, ecosystem growth drivers and growth inhibitors, the role of trust among the ecosystem actors and the evolution of the ecosystem. The ecosystem boundaries were defined based on spatial boundaries (ecosystem actors and functions based in San Diego)

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and structural elements (actors and platforms) which were defined during data collection. The San Diego health and life science ecosystem case was chosen as it represents a science-based successful innovation ecosystem, evolution of which could be traced to its early development phases. This case study provided valuable information about the change dynamics and success factors of a spatial innovation ecosystem. The ecosystem consists of more than 600 companies operating in San Diego. An important part of the ecosystem is the regional programme called CONNECT that was originally founded as a part of University of California San Diego (UCSD) in 1985. The programme is designed to catalyze the creation of innovative technology and life sciences' products by linking innovators, investors and entrepreneurs with the needed resources. The case study results that are especially related to the role of CONNECT in the ecosystem are presented in an article by Majava and his co-authors (2015).

### *3.2 Case study 2: The Finnish Winter Road Maintenance Ecosystem*

The second case study focused on the road maintenance service and technology provider network (structural boundaries) in Finland (geographical boundaries). This case provided rich information about the emergence of a sectoral business ecosystem based on technology-based service concept and value co-creation. The core of the ecosystem consists of a group of Finnish companies and their expertise and know-how related to winter road management. The ecosystem actors cover a variety of companies, ranging from meteorological observation technologies to winter maintenance equipment supply, and meteorological services and service concepts. Along with the different ecosystem actors and their roles, the case study focused on the risks and revenues of sharing, collaboration and the possibilities of accessing new markets and on whether public innovation support mechanisms play any role in these. The case and its results have been opened up in more detail by Leviäkangas and his co-authors (2014; 2015).

### *3.3 Case study 3: Smart Card Platforms*

The last case study focused on the actor-connecting element of business and innovation ecosystems, a common platform and examined four smart card platforms in public transportation. These technology platforms were examined as sources of innovations and in terms of diffusion and externalities. The study included four different smart card platforms: Octopus (in Hong Kong and parts of China), Oyster (in the Greater London area), EasyCard (in the Greater Taipei area and other parts of Taiwan) and OV-chipkaart (in the Netherlands). These platforms provided examples of four successfully diffused technology platforms in public transportation context, two pioneer platforms (Octopus and Oyster) and two early followers (EasyCard and OV-chipkaart). The study on these smart card platforms provided new knowledge on the development, successful implementation and diffusion of technology platforms for innovations in a spatial context. As new business ecosystems are built around new platforms – like these technology-based smart card platforms – understanding the success factors, and growth enablers and growth inhibitors is also important for policies aiming at supporting new-platform development

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and growth. A more detailed description of the case study and its results is presented in an article by Kinnunen et al. (2015).

## **4 The innovation ecosystem concept in innovation policy framework**

### *4.1 Case study findings*

The case studies presented above examined spatial business and innovation ecosystems and platforms. The case study findings presented here are a summary of all four case studies and present the findings relevant from an innovation policy perspective. The findings based on additional data (interviews, the panel discussion and the literature) are merged to these case study findings in the next section.

Ecosystem enterprises form the basis of all business and innovation ecosystems. The role of a lead firm / keystone organization is significant, especially in the beginning of the ecosystem's development. In more mature spatial innovation ecosystems the ecosystem is still formed around a central actor that can, in addition to a large firm, be another type of organization (like the CONNECT programme in San Diego). The following are essential for ecosystem evolution and growth: fostering an entrepreneurial culture, accelerator and incubator organizations, gaining access to venture capital and angel investors, and providing mentoring programmes for start-ups. An incubator organization can also work as an important trust enabler among ecosystem actors.

Much of the case study research focused on innovation platforms within ecosystems – on one hand on wider innovation platforms within spatial innovation ecosystems and, on the other hand, on innovation platforms within business ecosystems. These platforms can be seen as a 'common space' – usually provided by local company or organization – that brings local actors together, promotes networking and works as a base for ecosystem development. The platform is built around a certain node in the network whether it is a private firm, development organization, university or a research institution. It is essential to get the key players to commit to platform development from the beginning. In the case studies, and especially in the health and life science ecosystem, universities and research institutes often act as the ecosystem platform provider due to the nature of the knowledge needed in these ecosystems. These platforms work as seedbeds for ecosystem growth and new start-up activity. Universities and research centres are some of the most important growth drivers of an ecosystem and platforms for new discoveries that acquire research funding, create new knowledge and technologies, and train new talent.

Health and life science ecosystems are based on analytical knowledge (Asheim et al., 2011) that is produced in universities and research institutions. However, as these high-tech fields are dependent on basic research and scientific knowledge, many innovation ecosystems (like the winter road maintenance ecosystem in the case studies) are based on synthetic knowledge that refers to activities wherein innovation takes place through the application or novel combinations of existing knowledge. The university–industry links are also highly relevant for synthetic knowledge but they are more in the field of applied research and development than in basic research (Asheim et al., 2011). Know-how, new technologies and innovations – and especially their utilization and application – are at the core of these innovation ecosystems. Cooperation with and between firms could be encouraged and promoted, for example through public procurement models as these currently (at the moment in Finland at least) do not encourage firms to collaborate, co-

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create and share information. The innovation aspect could be better connected to procurement models and processes, and innovative procurement models could also be financially supported and risk-taking enabled within these models. Rewarding new ideas and trials could also be included in the procurement models.

For spatial innovation ecosystems a well-functioning top-down led triple-helix cooperation (that brings together universities, industrial actors and the government) is needed to enable a bottom-up quadruple helix (see e.g. Carayannis and Campbell, 2009; McGregor et al., 2010; Lindberg et al., 2014 Markkula, 2014) that is based on individuals. Quadruple-helix cooperation also involves citizens as users and innovators in development and innovation work. Public service providers, such as hospitals, schools and public transportation, can provide test beds and piloting platforms for firms and access to end-users.

In the case of ecosystems, the public sector acts as a gatekeeper that sets the rules for ecosystem operations and competition through laws and regulations. In ecosystem studies it was noticed that it is important for ecosystem development and evolution that each member of the ecosystem identifies its role within the ecosystem and acts accordingly. The public sector and policy actors can act as enablers, facilitators, sponsors and regulative actors but not as a business actors, which ought to also be taken into account in public-private cooperation. Public actors and organizations can provide a platform for cooperation and development – as well as other bases for ecosystem development and start-up activity – but the business actors, start-ups, SMEs and large enterprises are the ones driving the business side as the ecosystems start to emerge.

The case studies also bring out the importance of entrepreneurial culture and cooperation culture in the region, as well as the importance of the quality of life as an important factor that both attracts a highly-skilled workforce and entrepreneurs to the region and makes them stay in the region, thus helping to maintain the entrepreneurial 'buzz'. Trust is an important enabler of cooperation and therefore also very important for the ecosystem's success.

Table 2 presents these case study findings in the context of business and innovation ecosystem literature.

Table 2. Case study findings in business and innovation ecosystem literature context

<b>Business and innovation ecosystem characteristics</b>	<b>Case study findings</b>
Complex and self-organizing	Public sector role as an enabler, facilitator, sponsor and regulative actor
Niche development	Research funding
Finding innovation potential from interfaces and unexpected combinations; complementary innovations	Synthetic knowledge; applied R&D
Ecosystem management; the keystone organization's role; peer-to-peer management	Central actor; large and/or successful firm or organization; commitment and trust
Global business ecosystems based on local/regional innovation ecosystems	Strong entrepreneurial culture
Open innovation; co-creation; users	Platforms as 'common space'
Trial-based; experimental; rapid prototyping in the real world	New knowledge; knowledge production (universities and research institutes) and diffusion; test beds and piloting platforms
Rapid changes; new courses of action	Innovative procurement models; enabling risk-taking; rewarding new ideas and trials

#### 4.2 The elements of ecosystem-based innovation policy

The elements of ecosystem-based innovation policy were sketched based on innovation ecosystem literature and the analysis of the case study findings (table 3). First, as presented above, business and innovation ecosystem characteristics were listed by using literature, and the case study findings were analysed in the light of these characteristics. Finally, based on the literature and the analysis of case study findings, the elements of ecosystem-based innovation policy were sketched.

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Table 3. The elements of ecosystem-based innovation policy

<b>Business and innovation ecosystem characteristics</b>	<b>Case study findings</b>	<b>The elements of ecosystem-based innovation policy</b>
Complex and self-organizing	Public sector role as an enabler, facilitator, sponsor and regulative actor	Innovation orchestration & facilitation; funding; leaving room for serendipity; flexible projects to ensure dynamism; Prioritizing the fields from which innovative collisions are expected but without defining what those collisions are and who collides
Niche development	Research funding	The flexibility to directly support fields showing potential and growth
Finding innovation potential from interfaces and unexpected combinations; complementary innovations	Synthetic knowledge; applied R&D	Intentional mixing; looking for the unknown and unexpected
Ecosystem management; the keystone organization's role; peer-to-peer management	Central actor; large and/or successful firm or organization; commitment and trust	Providing platforms for cooperation and development; fostering ecosystem formation through public procurement
Global business ecosystems based on local/regional innovation ecosystems	Strong entrepreneurial culture	Access to successful global ecosystems, accelerators and incubators, venture capital an angel investors, mentoring programmes
Open innovation; co-creation; users	Platforms as 'common space'	Providing platforms for cooperation; fostering Quadruple Helix cooperation
Trial-based; experimental; rapid prototyping in the real world	New knowledge; knowledge production (universities and research institutes) and diffusion; test beds and piloting platforms	Experimentation culture; offering platforms; supporting pilots; trials and demo phases
Rapid changes; new courses of action	Innovative procurement models; enabling risk-taking; rewarding new ideas and trials	Constant feedback mechanisms; cutting off failing trials and feeding the successful ones

The most prominent characteristic of innovation ecosystems is their complex and self-organizing nature. This has several innovation policy implications. First, the complexity and self-organizing nature of ecosystems requires that policies orchestrate and facilitate innovation through, for example, funding, public procurements, providing development platforms, and through laws and regulations. In the past, innovation policies have striven to avoid a 'picking-the-winners policy', which has led to developing rather

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dispersed funding mechanisms that provide a little for many but often not enough for anyone to be able to do long-term work and develop radical innovations. Ecosystem-based innovation policy is able to prioritize the fields from which innovative collisions are expected but without defining what those collisions are and who collides. Also legislation can be used to help develop successful ecosystems around certain fields, such as green energy and cleantech.

Innovation policies have traditionally used vast amount of resources in ex-ante and ex-post evaluation. As ecosystems change rapidly and take new courses of action, traditional heavy evaluation is mostly ineffective. From the ecosystem perspective more flexible and constant feedback mechanisms are needed in order to be able to cut off failing trials and feed the successful ones in time. This also signifies the end of traditional and (in the current environment) ineffective planning culture, project culture and roadmap culture. Ecosystems evolve through trials and experimentation, which requires a new kind of experimentation culture. Policies can enable and support the adaption of this culture by offering platforms in which these trials can be carried out and that support the pilots, demo phases and rapid prototyping that lead to new innovations.

Characteristic of innovation ecosystems is their ability to produce new niches. Niches are developed by unexpected collisions producing serendipity. Therefore an ecosystem-based innovation policy calls for the intentional mixing of different fields and looking for the unknown and unexpected, and as a result it also calls for the flexibility to directly support fields (and mixes of different fields) showing potential and growth.

Cooperation in, for example, regional innovation systems has been based on triple-helix cooperation bringing together organizations and representatives from universities, industries and the government. However, for ecosystems, users – alongside the other firms, research organizations and public sector representatives – are also an important group from a cooperation perspective as the roles and boundaries of producers and users have been obscured. Overall, for ecosystem development the formation and acknowledging the importance of complex network of actors is important. In policy terms, encouraging to “quadruple helix” cooperation – where the fourth helix includes users and citizens - instead of triple helix cooperation can be seen relevant, whilst bearing in mind the wide spectrum of potential and needed cooperation partners.

Although ecosystems are first and foremost global, their basis often lies in spatial local or regional innovation ecosystems. Developing innovations that have scalability is important in order to gain access to global ecosystems. Keystone organizations are often the key to these ecosystems, which makes it important to nationally and regionally develop innovation ecosystems that also attract large foreign enterprises in the sense of investments and cooperating partners.

The role of the public sector is to help develop activities that lead to the birth of commercial business ecosystems. Ecosystem management differs from, for example, traditional cluster management. Innovation ecosystems are not top-down, managed hierarchical systems, although the role of the leading/keystone organization or company is prominent. The management of the ecosystem is more of a peer-to-peer type of management wherein the leading organization sets the direction and formats the common strategy. The role of innovation policy in this is to help provide platforms for co-development and foster ecosystem formation through, for example, public procurement. It is not the role of policy to manage ecosystems through funding mechanisms or public organizations or programmes. The development of new innovations happens on different kinds of development platforms within the ecosystems. In this context the role of policy



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is not direct steering through, for example, traditional cluster programmes but orchestrating and enabling innovation, for example, by directing public procurements to enable the birth of new ecosystems and by strengthening the self-renewal capacity of existing ecosystems.

### **5 Discussion: The ecosystem perspective on innovation policy**

The findings and research results presented in this paper support many of the policy conclusions of ecosystem research presented in literature. First, our study suggests a new approach to innovation policy that focuses on supporting innovation ecosystem development. Though our study focuses on innovation policy, it should be noted that (as Mason and Brown [2014] also note) policy implementation has to be holistic and that the ecosystem-based policy approach, as a wider policy approach, encompasses all policy fields, instead of only encompassing traditional innovation policy. Also Clarysse et al. (2014) call for an ecosystem approach to policies supporting the development of new business and innovation ecosystems. Hämäläinen's study (2015) focuses more on this wider perspective and the overall governance challenges wherein the evolutionary perspective on policy could be found useful. However, Hämäläinen's suggestions for governance solutions are also very applicable to the basis of ecosystem-based innovation policy and our study can be viewed to contribute to this previous research by presenting an ecosystem-based policy framework specifically in an innovation policy context.

Clarysse et al. (2014) present several of the policy implications of their study on business and knowledge ecosystems. They bring out the possibilities of public procurement to provide important stimulus to the creation of new ecosystems and also the importance of a leading anchor company in ecosystem development. Our study supports these conclusions. Public procurement can act as an important push for ecosystem development if procurement models are built to support cooperation and co-development. Although an ecosystem can also be built around another type of a node than a large enterprise, the role of large enterprises in ecosystem development is still prominent. Seeing their role more as a part of wider ecosystem(s) might help develop new business ecosystems around them. However, this is often more of a management issue rather than policy issue.

Connecting the ecosystem concept to innovation policy has been criticized based, for example, on the idea that if business and innovation ecosystems are by definition self-organizing and self-sustaining systems, then no government intervention is needed for them to survive and succeed. However, we argue that the role of the public sector in ecosystem development is not trivial or diminishing but in fact it can be significant or increasing, for example, through public procurements. Supporting ecosystems does not mean supporting ecosystems that do not seem to make it on their own and keeping alive dying industries but rather it means speeding up ecosystem development, feeding activities that produce raw material for new ecosystem beginnings and supporting early stage success. The criticism has its point in that when an ecosystem works well on its own, policy interference is not desirable. Policy tools can be useful in providing platforms for co-development and co-creation, speeding up the growth and development of successful new ecosystems and supporting ecosystem renewal.

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It should also be noted, that the elements of the ecosystem-based innovation policy presented in table 3 are also often interlinked. For example, fostering the creation of an experimentation culture can require real-life test beds and piloting platforms but also flexible funding that accepts occasional failures that experimentations sometimes result in. Accepting failure and learning from it encourages to new and better which can lead to new radical innovations instead of only rather safe incremental improvements.

Although ecosystems are not as bound to a certain location or region as, for example, industrial clusters are, the importance of proximity has not died out. Regions create and provide the basic circumstances and a springboard for ecosystem birth and early development. Mason and Brown (2014) state that, as every ecosystem is unique, the policy approaches targeted to ecosystems should be tailored according to each individual ecosystem. It is fairly obvious that it is not always easy or even possible to tailor national-level policies for each existing and emerging ecosystem. The role of regional and local level policies could be significant for ecosystem development as they can be more easily adapted to ecosystem needs.

## **6 Conclusions**

The main contribution of this study to previous works and theories is that it narrows down the gap between business and innovation ecosystem research, and innovation policy research by presenting the elements of ecosystem-based innovation policy. Based on our research, the trend of competition happening more often between business and innovation ecosystems, instead of between individual firms, does not mean that the role of public policies is diminishing. When supporting ecosystem development, the prior role of the public sector is to act as an orchestrator, facilitator, enabler and platform provider. This role is carried out through different policy tools including, for example, funding, public procurements, providing development platforms, and also through laws and regulations that can help develop activities that lead to the birth of commercial business and innovation ecosystems.

The birth and evolution of business and innovation ecosystems can be supported by adopting a new type of policy approach that takes into account the nature and characteristics of innovation ecosystems that do not match with, for example, traditional cluster development. Although the focus in this ecosystem approach is on innovation policy, the ecosystem approach extends to several policy domains and should therefore be regarded as a cross-cutting policy approach. The core elements of ecosystem-based innovation policy differ in many ways from the traditional innovation policy elements. Ecosystem-based innovation policy is more about:

- funding through public procurement than individual projects
- orchestrating, enabling and facilitating than direct steering
- network facilitation than traditional cluster or network management
- quadruple-helix cooperation than triple-helix cooperation
- experimentation culture than planning culture

A lot of academic papers on business and innovation ecosystems have been published during the past decade or so. Some previous papers (see e.g. Wessner, 2004; Clarysse et al. 2014; Mason and Brown, 2014) present implications from the policy perspective also. However, a framework for innovation policy supporting innovation and business

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ecosystem, based on empirical research is yet missing. The study contributes to both theory and practice. It furthers the somewhat underdeveloped theory on innovation ecosystems by widening the perspective to an innovation policy context and at the same time bringing a new perspective to innovation policy research. Although the elements of ecosystem-based policy presented here are more general guidelines and principles rather than detailed tools and advice for policy planners and practitioners, they still work as guiding information and advice for policy planning and practice at different policy levels.

Though the multiple case study approach offers a wider perspective to business and innovation ecosystems than, for example, a single case study, the used research approach limits the generalizability of the results. Also, in practice the used policy approaches should take into account the context in which it is applied (including the history, unique regional characteristics, current policy etc.). This is why future research should further test the presented policy ideas using also quantitative data and in different contexts, for example in the European Union's supranational innovation policy and in a funding context. From the policy-makers' perspective it would be useful to examine what could be the most effective policy tools for different types of regions or nations in order to implement ecosystem-based innovation policy.

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