Analysing innovation-driven enterprises' stakeholders in two spatial ICT ecosystems

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Abstract: Innovation-driven enterprises (IDEs) engage with various stakeholders during new product development and commercialisation. Spatial ecosystems in which these enterprises operate provide them with the local business environment for new innovation development. Our study analyses IDEs' stakeholders in two spatial information and communication technology (ICT) business ecosystems: one in San Diego, California, USA and the other in Oulu, Finland. The study analyses the stakeholders' presence and their roles to support innovation. The critical stakeholders for supporting innovation-driven enterprises, such as providers of different forms of capital and research institutes, are identified. Our findings suggest that IDEs should exploit the spatial ecosystems by interacting with various stakeholders and by gaining access to local resources to create new innovations. The results of the study are beneficial both for managers of new innovation-driven ventures and decision-makers designing and implementing innovation policies.

Keywords: innovation, business ecosystem, stakeholder, innovation-driven enterprise (IDE), spatial context, information and communication technology (ICT).

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1 Introduction

The importance of entrepreneurship and innovation for local economy is undisputable. Entrepreneurship and innovation are also highly affected by different contexts, such as spatial dimension (Autio et al., 2014). While contextual differences are relevant, new ventures all over the world have to address many similar challenges during innovation and new business creation. Especially enterprises that target global markets cannot often succeed on their own in brutal competition; they need to create and maintain relationships with other actors in the networks to create attractive offerings (Majava et al., 2013). The competition has shifted from a company and an industry level towards a business ecosystem level (Iansiti, 2004; Moore, 1993).

While the local economies benefit from entrepreneurship, one must understand that not all new ventures are alike: small and medium enterprises (SMEs) target mainly local and regional

markets, whereas innovation-driven enterprises (IDEs) typically focus on global markets (Aulet and Murray, 2013). Our study focuses on the latter category and elaborates the differences between these two enterprise types in the next section.

IDEs need to collaborate with various stakeholders during the innovation and new product development (NPD) process. The typical stakeholders include customers, suppliers and other partners, competitors, and different institutions, including universities (Belderbos et al., 2004; Un et al., 2010). However, many other stakeholders also contribute to the innovation and NPD.

IDEs are highly important for the local, regional and national economy, because they are capable of generating more new jobs and exports than SMEs (Aulet and Murray, 2013). Therefore, many governments have aimed to create successful start-up ecosystems with innovative firms (Etzkowitz and Leydesdorff, 2000). However, the creation of successful spatial ecosystems has proved to be very difficult in practice (e.g. Kenney, 2000; Saxenian, 1994). The purpose of this study is to address the aforementioned issue by studying the stakeholders in spatial ecosystems from an IDE's perspective in two information and communication technology (ICT) oriented regions: San Diego, California, USA and Oulu, Finland. As Appendix 1 indicates, these two locations are very ICT-intensive based on international patent (PCT) applications per inhabitant. Instead of company-specific customers, suppliers, and partners, we focus on the other stakeholders that support IDEs in new innovation creation and commercialisation. Accordingly, the following research questions are set for our study:

1. What stakeholders - apart from customers, suppliers, and other business partners - support IDEs in innovation creation in spatial ecosystems?
2. What is the stakeholders' presence and how do they support IDEs in the cases under study?

We address the research questions above through a literature and empirical study. In the literature section we discuss stakeholders, business networks and ecosystems, spatial innovation, and IDEs. In the empirical part of the paper we explore the IDEs' stakeholders through a case study. After the analysis, conclusions are made.

2 Literature

2.1. Stakeholders, business networks, and spatial ecosystems

Various definitions for the term "stakeholder" can be found in the literature (Aaltonen and Kujala, 2010; Mitchell et al., 1997). When defined broadly, stakeholder is "any group or individual who can affect or is affected by the achievement of the organisation's objectives" (Freeman, 1984). In narrow definitions stakeholders are described in terms of direct relevance to the company's core economic interests (Mitchell et al., 1997). Stakeholders can be categorised in many ways, such as primary or secondary, owners and non-owners of the company, those in a voluntary or involuntary relationship with the company, resource providers to or dependents of the company (Mitchell et al., 1997). In new product development context, stakeholders enable product delivery to the end users and the support throughout the product's life cycle (Ulrich and Eppinger, 2012).

A lot of research has been done on different collaboration models, networking, and related interactions (e.g. Dermol and Breznik, 2012). While business to business collaboration can simply be buying products or services from other businesses, industry collaboration can reach out to different forms of business networks and ecosystems. Majava et al. (2013) have compared characteristics of different collaboration concepts. The collaboration concepts were noticed to

differ in terms of the following factors: type of members, goal, coordination, boundaries, change dynamism, nature of relationships, role of knowledge, and competitors.

Business ecosystems tie different stakeholders (actors) together through knowledge flows and shared value creation processes (Iansiti and Levien, 2004). Ecosystems' rules result from the coevolution and interactions between the actors. Other actors adjust to the rules set by the lead actors (keystones or platform leaders) that may be replaced by others in the future. However, the other stakeholders, such as niche players and intermediaries, value the leaders that enable the members to move toward a shared future and benefits (Iansiti and Levien, 2004; Moore, 1993; Moore, 1996). Companies in business ecosystems develop mutually beneficial relationships with various stakeholders including, for example, customers, suppliers, and competitors. The co-evolution takes place around a new innovation: organisations cooperate and compete to support new products, to satisfy customer needs, and finally to create succeeding innovations (Iansiti and Levien, 2004). Innovation and coevolution can be considered to be the main factors affecting business ecosystems (Majava et al., 2013).

Due to the importance of innovation to economic development, many regions try to achieve an innovation environment that includes university spin-offs, initiatives for knowledge-based economic development, and boundary-spanning and partnerships between companies, government laboratories, and academic research groups (Etzkowitz and Leydesdorff, 2000). Innovativeness and success of certain geographical regions can be viewed from three different perspectives: having universities as anchors of regional clusters, social networks as enabling factor, and institutional frameworks (Casper, 2013). On the other hand, Hwang and Horowitt (2012) stress talent diversity, trust across social barriers, motivations above short-term rationality, and social norms that stimulate rapid collaboration and experimentation.

2.2. Innovation-driven enterprises and firm growth stages

Aulet and Murray (2013) define innovation-driven enterprises (IDEs) to be enterprises that "pursue global opportunities based on bringing to customers new innovations that have a clear competitive advantage and high growth potential." Furthermore, by innovation they mean new-to-the world ideas in the technical, market, or business model domains. Aulet and Murray (2013) stress not using the term "technology-driven", because in their view, innovation is not limited to technology. Table 1 highlights the key differences between SME entrepreneurship and IDE entrepreneurship.

Table 1. Differences between SME and IDE entrepreneurship (modified from Aulet and Murray, 2013)

SME…	IDE…
focus on addressing local and regional markets	focus on global markets
innovation is not necessary to establishment and growth, nor is competitive advantage	is based on some sort of innovation (technology, process, business model) and potential competitive advantage
create "non-tradable" jobs generally performed locally (e.g. restaurants, service industry)	create "tradable jobs" that do not have to be performed locally
are most often family businesses or businesses with very little external capital	have more diverse ownership bases including wide array of external capital providers

typically grows at a linear rate. When more money is invested, the system (revenue, cash flow etc.) responds quickly in a positive manner.	starts by losing money, but if successful will grow exponentially. Requires investment, but the system does not respond quickly.

Table 1 is beneficial in illustrating the fundamental differences between SMEs and IDEs. However, it should be noted that the characteristics may not be that controversial in practice. For the purpose of our study, we define the most relevant differences to include that IDEs are based on an innovation and a time gap exists between investment and revenue. An IDE typically goes through certain development stages before revenue is gained.

The growth and development of firms have been studied extensively from various perspectives in the last decades (Muhos, 2015). A typical firm development model covers a birth, survival, growth, maturity and stability stages, whereas some models contain the entire lifecycle including a potential decline and death (Illés et al., 2015). One of the most classical growth models was introduced by Churchill and Lewis (1983). This model includes a five-stage framework through which small companies pass. The stages include existence, survival, success, take-off, and resource maturity. In each stage, the organisational goals, business size, diversity, complexity, and management style vary. The purpose of the framework is to evaluate and tackle the stage-specific problems and future challenges for the enterprise. Although the framework is generic, Churchill and Lewis (1983) note that enterprises differ; in case of high-technology start-ups, venture capital is used to accelerate the firm development through the stages.

The five-stage framework described above is beneficial and can still be applied today, but the special characteristics of IDEs (Aulet and Murray, 2013) should be acknowledged. For example, a typical evolution process for IDEs in the life sciences sector starts with a technology based idea, which has originated from government funded basic research at a university or a research institute. Early stage work, such as intellectual property protection, is needed to support the commercialisation of the invention. The invention could then be licensed to an existing company or a new start-up. Accelerators and incubators may support the start-up phase, and seed funding is typically acquired from angel investors. If the company is successful, more funding is acquired from venture capitalists, new employees are recruited, and in the long-term an initial public offering (IPO), a merger, or acquisition by another company may take place (Majava et al., 2016).

3. Method

This study utilises a holistic research strategy based on literature findings and the case study method (Yin, 2009). As the phenomenon under study is within the real-life context and the boundaries between phenomenon and context are not clearly evident, we utilise multiple sources of evidence. The empirical data was collected from two spatial business ecosystems: San Diego, California, USA and Oulu, Finland. While these two locations differ in terms of population size and business environment, they also share many similarities. These include being part of developed economies, having a remote distance from their capitals, and very strong information and communication technology (ICT) sectors. Thus, these ecosystems were considered to provide interesting points of similarities and juxtapositions.

The data collection in both cases involved field research, using online resources, participating in events, following local media, and meeting local incubators, accelerators, and entrepreneurs. The analysis of each case as a separate entity was followed by a cross-case analysis. The data

analysis was conducted by using qualitative approach (Eisenhardt, 1989). The literature findings and the data collected were utilised to create a conceptual framework that is presented in the results section.

4 Results

4.1 San Diego innovation ecosystem

The city of San Diego is located in Southern California, USA. With approximately 1.4 million people, San Diego is the eighth largest city in the United States and the second largest in California. By 2020, the city's population is forecast to be over 1.5 million, with 3.5 million people in the entire county (The City of San Diego, 2016).

San Diego started to focus on research and development in the 1960s and this development was supported by federal government investments. In the mid-1980s, the region's research institutes had created a critical mass of R&D capacity and international firms and venture investors became attracted to the area. Additionally, three pioneer start-ups that included Linkabit (wireless), ISSCO (computer graphics), and Hybritech (biotechnology), had a key role in San Diego's development. In the mid-1980s San Diego suffered from reductions in the military sector, and local leaders recognised the need to accelerate innovation; an intermediary organisation called CONNECT was established. The CONNECT organisation has been very successful in catalysing local innovation. (Walshok and Shragge, 2014).

Currently, San Diego is especially strong in wireless technology and life sciences sectors (Walshok and Shragge, 2014; Walshok and West, 2014). The largest research and education institute, University of California San Diego, has over 31 000 students (UCSD, 2016). The lead company in the ICT sector is Qualcomm that employs approximately 10 000 people locally (Majava et al., 2016). According to CONNECT (2015), 248 software and 86 communications, computer and electronics start-up companies were established in San Diego county in 2014. Local companies in the aforementioned fields employ approximately 70 000 people, whereas the total number of high-tech employees in San Diego is 148 000.

4.2. Oulu innovation ecosystem

The city of Oulu is located in Northern Finland. Oulu region includes seven municipalities with approximately 242 000 inhabitants and the region has committed stakeholders to support innovation. The University of Oulu was established in 1958. Oulu Innovation Alliance (OIA) was established in 2009 and includes the city of Oulu, University of Oulu, Oulu University of Applied Sciences, VTT Technical Research Centre of Finland, Technopolis Plc, and Finnish Environment Institute (OIA, 2016).

The strongest industry sectors in the region include electronics, information technology (IT), software, and technical services (BusinessOulu, 2015). Oulu region has 15 000 high-tech jobs, 7500 research and development (R&D) experts, and over 400 information and communication technology (ICT) companies. University of Oulu has 16 000 students, whereas Oulu University of Applied Sciences has another 8000 (Lehikoinen, 2015).

The economic development in the region, as well as in the whole Finland, has been weak in recent years (BusinessOulu, 2015). One of the main reasons for this is the downsizing of Nokia's mobile phone business, which employed approximately 2500 people in Oulu region in 2010. The mobile phone business was sold to Microsoft in 2014; today, Microsoft employs significantly

less people in Finland and none of the employees are based in Oulu. However, the problems of Nokia's mobile phone business has led to an increase in the number of start-ups in Finland, as talented employees have begun their own businesses. In Oulu region, there are around 300 start-up companies and several international ICT companies have established R&D sites in Oulu in 2014 and 2015; Nokia's mobile networks business has also very strong presence in Oulu with its 2500 employees (Lehikoinen, 2015).

4.3. Ecosystem stakeholders that support IDEs

The literature findings and the data collected during the case studies have been synthesised in Table 2 below. The purpose of the Table 2 is to illustrate the phases through which new innovations are developed, the typical stakeholders that are involved, as well as to provide concrete examples of stakeholders in San Diego and Oulu innovation ecosystems.

Table 2. Ecosystem stakeholders that support IDEs in the innovation process

Phase	Description	Stakeholders	San Diego examples	Oulu examples
1. Idea generation and technology development	Basic research Applied research	Universities Research institutes Large companies and SMEs R&D funding bodies	University of California San Diego (UCSD) San Diego State University (SDSU) Qualcomm Federal and state governments	University of Oulu (UoO), Oulu University of Applied Sciences (OUAS),VTT and other OIA members Nokia TEKES, EU
2. Early stage work to support commercialisation	IP protection Exploring potential applications	Innovation service offices Incubators Pre-accelerators	UCSD Office of Innovation and Commercialization EvoNexus CyberTECH iHive Von Liebig Center Rady StartR and my startupXX	UoO innovation services Yritystakomo Business Kitchen
3. Start-up establishment	Business model development and firm establishment Acquisition of pre-revenue (pre-seed) funding	Business angels Incubators Pre-accelerators Business services providers	Friends, family, and fools (FFF) Unorganised angels Rady Venture Fund EvoNexus CyberTECH iHive Von Liebig Center Rady StartR and my startupXXProcopio Knobbe Martens DLA Piper	Friends, family, and fools (FFF) Unorganised angels Business Kitchen Yritystakomo Oulu region enterprise agency Castren & Castren Kolster
4. Seed / early stage funding	Acquisition of the seed and early stage (1st	Business angels VC firms Funding agencies	San Diego Tech Coast Angels Rady Venture Fund Avalon Ventures	FiBAN Butterfly Ventures TEKES, EU ELY centre

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	stage/2nd stage) funding	Business services providers Accelerators	Federal government (SBIR & STTR) Co-working alliance CONNECT Springboard Procopio DLA Piper	Finnvera Njetwork Inn Technopolis BusinessOulu Nestholma Fidescon Castren & Castren
5. Growth phase / later stage funding	Commercial success Later stage funding rounds (3rd stage/pre-IPO) More people are recruited	Funding agencies Investors Local talent pool Trade associations & services organisations	Finistere Ventures Investors from San Francisco Bay Area and New York Qualcomm, UCSD, SDSU CONNECT	TEKES Finnvera Investors outside of spatial ecosystem Nokia, Tieto, UoO, OUAS Business Oulu
6. IPO, acquisition or merger	Initial public offering, sale of the company or merger with another entity	Large investors & financial institutions Legal services Large companies	Stakeholders mainly from San Francisco Bay Area and New York	Stakeholders mainly outside of spatial ecosystem

As can be seen in Table 2, the first phase of the process can include basic or applied research that is typically publically funded and carried out at universities and research institutes. Local companies may also conduct private research or be involved in open innovation projects. In San Diego's case, the public funding often comes from federal (National Science Foundation) and state (e.g. California Institute for Telecommunications and Information) sources and the research is carried out at, for example, UCSD. Oulu ecosystem, in turn, receives research funding from TEKES (Finnish funding agency for innovation) and EU programs including Horizon 2020. The research work is typically carried out at University of Oulu (UoO), VTT Technical Research Centre of Finland, or Oulu University of Applied Sciences (OUAS). Other OIA members and companies may also contribute to research projects.

The second phase involves exploring potential applications and intellectual property (IP) protection if necessary. In this phase stakeholders in San Diego ecosystem include UCSD Office of Innovation and Commercialization, incubators (e.g. EvoNexus and CyberTECH iHive), and pre-accelerators, such as UCDS's Von Liebig Center and Rady StartR and mystartupXX. The Oulu ecosystem contains similar stakeholders: University of Oulu innovation services and incubator and pre-accelerator programs at Yritystakomo and Business Kitchen, which is UoO and OUAS' joint entrepreneurship hub. However, it should be noted that phases 1 and 2 of the process are optional, since innovations can also be process- or business model-based and/or utilise existing technologies.

In the third phase, a business model is developed further and a company is established. Pre-seed funding for the new start-up is typically acquired from individuals and business angels. Incubators and pre-accelerators may support the process. Legal services including the formation of legal entity and funding and IP related services are also needed. In addition, stakeholders, such as Oulu region enterprise agency, may be involved in helping with the practical arrangements of firm establishment. The third phase of the process can be considered to correspond with Existence stage in the small company model developed by Churchill and Lewis (1983). In this stage the

organisation is very simple and the founder is involved in all activities, such as identifying potential customers and investors.

The fourth phase of the process involves acquisition of the seed and early stage funding from business angels or venture capital firms. Examples of these stakeholders in San Diego ecosystem include San Diego Tech Coast Angels, the largest organised angel network in USA, Rady Venture Fund, and Avalon Ventures. The corresponding stakeholders in Oulu ecosystem include Finnish Business Angel Network (FiBAN) and Butterfly Ventures. Public funding may also play a role; the IDEs in San Diego ecosystem may become supported by federal government's Small Business Innovation Research (SBIR) and Small Business Technology Transfer programs. In Oulu ecosystem the IDEs can apply public funding for example through TEKES Hilla (High-tech ICT Leverage from Long-term Assetization) program and the EU SME instrument. ELY centre (Centre for Economic Development, Transport and the Environment) and Finnvera (a specialised financing company owned by the State of Finland) may also become involved. The company typically needs business services, such as legal and financial services and office facilities that are available through various stakeholders. In the seed stage, the IDE has a product or concept under development, but is typically not fully operational. In the early stage, the company often has a product or service in testing or pilot production. The product may even be commercially available but the revenues are limited. In order to attract angel and VC investments the business model and operations can be developed further with accelerator programmes, such as CONNECT Springboard in San Diego and Nestholma in Oulu. This phase can be considered to correspond with Existence stage and in some cases Survival stage, where the still simply-structured organisation has demonstrated a potential for being a workable business entity and the focus starts to shift from the existence to managing revenues and expenses (Churchill and Lewis, 1983).

If the success continues, the IDE enters the fifth phase where more funding is acquired from investors and funding agencies. In the growth phase, the company's offering is commercially available. In spite of growing revenues the company may be unprofitable. In the later stage, the offering is widely available and the cash flow often becomes positive. New employees are recruited from the local talent pool that includes large companies and universities. The company's market interests and export efforts may be supported by stakeholders, such as CONNECT in San Diego and BusinessOulu, the City of Oulu's organisation that is responsible for industry policy implementation and development services for companies. The fifth phase can be considered to correspond with Success and Take-off stages (Churchill and Lewis, 1983). In the Success stage, the owners must make decisions between growth and profitability, whereas in the Take-off stage the key issues include how to grow rapidly and finance the growth.

In case the business continues to grow, the IDE enters the sixth phase, and an initial public offering (IPO), a merger, or acquisition by another company may occur. This phase can be considered to correspond with Resource maturity stage in the model by Churchill and Lewis (1983). The key issue in this stage is how to sustain the advantages of flexibility and entrepreneurial spirit while making the operations more efficient through management systems typically used in large companies. The stakeholders supporting the last phase of the process are typically located outside the spatial ecosystems. In case of San Diego, the stakeholders are often located in the capital rich San Francisco Bay area and New York.

5 Discussion and conclusions

Innovation-driven enterprises (IDEs) must engage with various stakeholders to create new products and commercialise them, and different spatial ecosystems provide these firms with local

conditions for innovation creation. This study explored IDEs' stakeholders in spatial business ecosystems. The required stakeholders' presence and their roles in supporting innovation were analysed in a case study that included two spatial ICT ecosystems: San Diego, California, USA and Oulu, Finland.

It should be emphasised that the IDE evolution process described in the results section is only a generic conceptualisation. Furthermore, due to a large number of stakeholders only some examples of them were included in Table 2. However, the conceptualisation presented in the results section is beneficial for analysing the existence and roles of different stakeholders in the innovation process. IDEs need to combine many skills and resources (Aulet and Murray, 2013); thus, they should exploit the spatial ecosystems through interacting with various stakeholders to benefit from the local resources. However, not all the required resources may reside spatially.

It should also be noted that both of the studied ecosystems have some weaknesses and risks in terms of stakeholders. In San Diego's case the main weakness is the fact that the vast majority of financial resources in USA are mainly located outside the spatial ecosystem. In addition, one could argue whether Qualcomm with its 10 000 employees is too a dominant player in the ecosystem. Despite the benefits of having a successful lead company the big size of one actor may also be a risk for the spatial ecosystem, if it hinders the growth of other companies. The worst case scenario is that the lead company suddenly fails and ceases to exist as happened for Nokia's mobile phone business in Finland. However, in San Diego the growing presence of industry venture funds and the convergence of ICT and life sciences do mitigate the weakness and risk noted here. Major pharmaceutical companies including Pfizer, Novartis, Janssen (Johnson & Johnson) are present in San Diego with venture and incubator activities. In addition, Qualcomm has established The Qualcomm Life Fund that focuses on investing in wireless health start-ups. While Qualcomm is a major influence in San Diego, other prominent ICT players such as ViaSat, Kyocera Americas, and SAIC are also present.

Oulu ecosystem also includes some weaknesses in terms of stakeholders, especially in phase 2 (early stage work and technology transfer) and phase 5 (later stage funding) of the process. Activities to strengthen the phase 2 have already been initiated. For example, TellUs innovation arena was recently established in Linnanmaa campus of University of Oulu. This will increase the presence of important stakeholders, such as BusinessKitchen, at the university campus. The weakness in later stage funding is a generic weakness of Finland. As concluded in a recent study, "Finland's weak point is lack of a functioning venture capital (VC) market and ecosystem especially in the later-stage VC in terms of quality and investment volumes" (Saarikoski et al., 2014). The bottlenecks include lack of commercialisation know-how, small investment sizes, large share of public sector, and illiquidity of exit markets. With regards to risks, Oulu ICT ecosystem is still highly dependent on Nokia. Despite the increase in the number of start-ups after Nokia discontinued its mobile phone business, Nokia's mobile networks business with its 2500 employees is still by far the largest private employer in Oulu.

While the studied spatial ecosystems differ especially in the size of population and domestic market they also share similarities. In addition to the similar stakeholders that were identified in our study both of the ecosystems have strong R&D resources and a solid track record in creating new inventions. Furthermore, both San Diego and Oulu must compete with locations that can provide greater R&D and financial resources, i.e. San Francisco Bay area (Silicon Valley) and Helsinki, respectively. Both San Diego and Oulu have succeeded fairly well in this competition, which indicates that spatial ecosystems in remote locations can also be viable.

Finally, it should be stressed that this study focused on specific ecosystem stakeholders only. In addition to the stakeholders that were analysed in the study, many other factors contribute to the creation of successful ecosystem. The holistic entrepreneurship ecosystem domains can be

considered to include policy, finance, culture, supports, human capital, and markets (Hwang and Horowitt, 2012; Isenberg, 2011). The results of this study include the identification of important stakeholders for supporting IDEs, such as providers of different forms of capital, universities, and research institutes. This study contributes to the existing body of knowledge by presenting an analysis of innovation-driven enterprises' development phases and typical stakeholders involved, as well as providing concrete examples of these stakeholders in San Diego and Oulu ICT innovation ecosystems. Furthermore, the innovation development phases were compared with the small company model developed by Churchill and Lewis (1983).

IDEs are recommended to exploit the spatial ecosystems by interacting with various stakeholders and by gaining access to local resources to create new innovations. The results of this study are relevant both for managers of new innovation-driven ventures and decision-makers responsible for local innovation policies. This research includes typical limitations of a case study, which makes generalisations difficult. Thus, further research in other spatial contexts is recommended to compare and validate the findings. For example, conducting a similar study in Asia could be a potential research topic in the future.

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Appendix 1. PCT patent applications in Oulu region, San Diego area, and Silicon Valley (OECD, 2014)

Variable	Region	2006	2007	2008	2009	2010
PCT patent applications per million inhabitants (fractional count; by inventor and priority year) - level	Northern Ostrobothnia (Oulu and surrounding region)	404,4	401,6	363,3	418,7	412,6
	San Diego-Carlsbad-San Marcos, CA	763,0	847,2	910,4	916,8	665,4
	San Jose-San Francisco-Oakland, CA (Silicon Valley)	674,6	663,4	576,6	565,5	543,4
PCT patent applications - count	Northern Ostrobothnia (Oulu and surrounding region)	153,4	152,9	139,3	161,7	161,8
	San Diego-Carlsbad-San Marcos, CA	2248,6	2520,9	2751,3	2806,5	2066,7
	San Jose-San Francisco-Oakland, CA (Silicon Valley)	6352,0	6294,1	5535,6	5492,2	5334,6
PCT patent applications in ICT - count	Northern Ostrobothnia (Oulu and surrounding region)	120,1	99,4	88,9	90,4	84,0
	San Diego-Carlsbad-San Marcos, CA	1201,6	1356,4	1448,1	1539,3	1058,1
	San Jose-San Francisco-Oakland, CA (Silicon Valley)	3780,9	3721,9	3190,6	3171,3	3273,1