

KNOWLEDGE DYNAMICS IN INNOVATION – FROM IDEA TO PRODUCT

Harri Jokela

Oulu Southern Institute, University of Oulu, Finland
harri.jokela@oulu.fi

Eija-Riitta Niinikoski

Oulu Southern Institute, University of Oulu, Finland
eija-riitta.niinikoski@oulu.fi

Matti Muhos

Oulu Southern Institute, University of Oulu, Finland
matti.muho@oulu.fi

Abstract

Purpose: The aim of this study is to describe the progress of an innovation from an idea to the product in a micro company and analyse the knowledge dynamics of the process. This case study seeks to find answers to the following research questions: What is the progress of an innovation from an idea to the product like in a micro company? What kind of knowledge is needed for the innovation and what kind of phases can be identified in the progress? These research questions are answered through a single case study of the innovation.

Method: This is a single case study with holistic strategy. The unit of analysis is the innovation case of a micro company operating in Oulu South Region. At the heart of the case study was the knowledge biography method that is an innovative approach providing a deeper understanding of knowledge dynamics in firms and regions. The empirical data was gathered via semi-structured interviews and public archive related to the case company. The interviews with key informants were mainly conducted face-to-face during fieldwork in 2008 and 2009. In an inclusive and iterative process the data was analysed and the main findings were summarised.

Findings: The progress of a single innovation case and its knowledge dynamics was described by using the knowledge biography method. The phases of the innovation case were analysed through knowledge types and knowledge phases. This study provides an interesting bench-marking case for the managers of innovative micro companies and public development agencies. The findings support public actors to ask essential questions in developing their services.

Value: In the future studies it would be interesting to open more innovation cases using the method of knowledge biography and make comparisons. In this case even the company found the findings useful for its purposes.

Keywords: knowledge dynamics, knowledge phases, innovation, micro company, growth

1. INTRODUCTION

Knowledge is intimately connected with innovations. Changes in knowledge can be seen as the driving force behind innovations. There are multiple ways to divide general product/innovation lifecycle to generic phases, stages or states (See e.g. Dean, 1950, Golder and Tellis, 2004, Markusen et al., 1986, Schutjens and Stam, 2003). The aim of this study is to describe the progress of an innovation from an idea to the product in a micro company in Oulu South region and analyse the knowledge dynamics of the process. The study is based on the work done in the “*Regional trajectories to the knowledge economy – Nordic-European comparisons (REKENE)*” -project funded by Nordic Innovation Centre and in the ERDF funded “*Developing the innovation environment in Oulu South region (OE INNO)*” –project.

REKENE is a Nordic spin-off from the “*Regional Trajectories to the Knowledge Economy: A Dynamic Model (EURODITE)*” project, which was funded by the European Commission and the Directorate for Research under Priority Seven (Citizens and Governance in a knowledge-based society) of the Sixth Framework Programme [1]. EURODITE and REKENE were multidisciplinary projects including researchers from economic geography, organisational theory, economics, management theory, business administration, sociology and other disciplines.

The interest for exploring the dynamics of knowledge arises from the point of view that a knowledge-based economy is considered vital for competitiveness in the global economy. Many regional, national and international policies have been developed to encourage knowledge production and innovation and contribute to economic development. This development is strongly related to the strategic goal of the Lisbon summit: ‘*that Europe should become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion*’ [2]. The progress has been slow, and the challenging goals have not been achieved at the rate that had been hoped. The European Council adopted a new strategy for employment and economic policy in June 2010. The Europe 2020 Strategy’s vision is smart, sustainable and inclusive economic growth (European Commission 2010).

The starting point for the empirical case study was the selection of Oulu South region for the REKENE project among seven regions in four Nordic countries. Sectors were another component of the empirical research. The chosen sectors for the project included sectors with large knowledge content, such as information and communication technologies (ICT), and sectors that have not yet achieved their potential in innovation despite high growth rates, such as food and drink. The sectors include high-, medium- and low-tech companies. The case in Oulu South region provides a perspective on knowledge dynamics in a cross-sectoral focus on ICT and metal industries.

The region of Oulu South is situated in the southern part of Northern Ostrobothnia, 50–150 km south of the city of Oulu. Oulu South is not a governmental unit or area. It was formed to increase inter-municipal co-operation and development and to gain the required critical mass for national and international competition. The region consists of three subregions and 14 municipalities with about 90 000 inhabitants. In the Finnish regional typology, Oulu South is one of the main rural areas. Oulu South could also be considered an industrialised countryside, which refers to its ability to offer sufficient employment for every inhabitant. Furthermore, the unemployment rate is the lowest in northern Finland. The demographic challenge is emigration from the area, while the strength of the region is that the birth rate is

the highest in Finland. Therefore, the proportion of young people will remain high for the near future. The situation in other rural areas in Finland is very different. Oulu South is also an entrepreneurial region. There are about 4600 active companies in Oulu South, the majority of them (95%) are micro-sized companies [3].

Co-operation between the ICT and metal industries is significant for the economy of the Oulu South area. The adaptation of ICT to the traditional business sectors is seen as one response to the challenges of the region. The ability to implement new, technological, wireless IT solutions and automation is considered critical in the mechanical engineering industry. The machinery manufacturers are mainly small companies with limited opportunities to invest in R&D.

The innovation case selected for the REKENE project in Oulu South represents the cross-sectoral co-operation between ICT and metal industries. The same case studied in this paper is the development of a “*PC-free control system for a forest harvester with remote control possibilities*” from idea to product. The home of the innovation was the micro company *Arsca Electro LP* in 1996-2007 and the micro company *Crelea Ltd* after 2007, both located in Oulu South region.

This study focuses on knowledge dynamics of the innovation mentioned above. The intention is to get information how knowledge is developed and transferred at a firm-level. The aim of studying knowledge dynamics is to unravel the processes of knowledge interactions and to identify types of actors involved in these processes. The research questions of this study can be articulated as follows:

1. What is the progress of an innovation from an idea to the product like in a micro company?
2. What kind of knowledge is needed for the innovation and what kind of phases can be identified in the progress?

The single-case study was selected as a strategy to answer the main research questions. According to (Yin, 1989, p. 23) ‘*a case study is an empirical inquiry that: investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used.*’ An essential part of the research is in-depth interviews with key informants. Because the research deals with interactions and networks among actors and is particularly aimed at identifying knowledge exchange and development, it would not have been possible to discover so much about such processes in any other way. The three key persons of the innovation case were interviewed and obtained information was analysed.

At the heart of the case study was the so-called ‘knowledge biography’. The knowledge biography method is an innovative approach providing a deeper understanding of knowledge dynamics in firms and regions. The knowledge biography method can capture the diversity of the social environment of a firm or organisation, identify knowledge flows and obtain information about partners inside and outside it. (Dahlström and Hedin, 2010, p. 11)

This study may help and support public actors to ask essential questions in developing their services for micro companies in order to foster regional development and economic growth. According to Crevoisier and Jeannerat (2008, p. 8) innovative regions are those that are capable of imagining their local activities within a global environment. In order to be

innovative, a region must be capable of matching its dynamics of the use and the generation of knowledge.

This study consists of five parts. In the introduction the background, motivation, research problem and research questions are presented. In the second, theoretical part of this study, the short introduction to knowledge dynamics, knowledge types and knowledge phases are presented. Third, the method of this study is described. In the fourth part, through description and analysis of the single case study, the answers to the research questions are provided. Finally, in the discussion part the main results, limitations and further research topics are covered.

2. KNOWLEDGE DYNAMICS

The theoretical background of this study lies in the research framework constituted for the empirical case studies of EURODITE project and its Nordic spin-off REKENE project. Those projects looked at the knowledge dynamics at regional and sectoral level (territorial knowledge dynamics, TKD) as well as at individual company level (firm-level knowledge dynamics, FKD). In this study the focus is on the firm-level knowledge dynamics of the chosen innovation case. In this part a short introduction to the knowledge types, phases and processes is given. At first knowledge and knowledge dynamics is discussed, and at the end knowledge anchoring, the concept developed within the EURODITE project, is introduced.

In EURODITE and REKENE projects knowledge is seen as a useful economic resource. It is defined as a learning process in human brains, generated and used in personal and collective interactions in various contexts. It is seen as a process that uses given individual and firm competences to appropriate new and necessary economically useful knowledge (Dahlström and Hedin, 2010, p. 6). Knowledge is therefore seen as both a resource and a process that are linked to the interactions among actors in the concept of knowledge dynamics. According to Strambach (2008, p. 154) visible results of knowledge dynamics are innovations in products, services or processes. Knowledge dynamics can be understood *as the dynamics that are unfolding from processes of the creation, using, transforming, moving and diffusing of knowledge*. Knowledge is not static but constantly changing and dependent on context and application.

2.1. Knowledge types

The concepts of analytical, synthetic and symbolic knowledge were considered the relevant knowledge types for the empirical work of this study. *Analytical* knowledge is understood as research based knowledge, developed through scientific exploration. *Synthetic* knowledge can be seen as a result of a secondary stage combination of analytical and (perhaps) symbolic knowledge. Engineering knowledge is a good example, since it derives from application and from scientific research. *Symbolic* knowledge is largely recognised in research on cultural industries or creative industries. It deals with ideas, symbols and socially constructed commodities. It could be thought of as knowledge about representation (See e.g. Asheim and Coenen, 2006, Strambach, 2008).

Distinction between tacit and codified knowledge is often made. *Codified knowledge* can be transmitted relatively easily to others, because it is understood as knowledge that can be represented in writing or another kind of digital or analogue format. In contrast, *tacit*

knowledge is understood as knowledge that largely comes from practice and is embodied in people. It is articulated through practical skills and cannot be reduced to numbers, graphs, maps, diagrams, texts, etc. Face-to-face contacts or ‘buzz’ are consequently important for transfer of tacit knowledge (Collinge et al., 2008, Halkier et al., 2010).

2.2. Knowledge phases

Knowledge phases form very seldom a linear process. Usually, the development takes places in various phases at the same time, and there might be loops between these phases. In order to understand the complexity of the knowledge dynamics of an innovation, exploration, examination and exploitation are used as knowledge phases in this study.

Exploration phase is often described as the first step in a knowledge chain. Characteristic to this phase is searching for new knowledge or maintaining and developing existing knowledge. The *examination* phase is understood as a testing phase; veracity and applicability of the knowledge is considered. *Exploitation* can be seen as a phase of ‘selling’ and ‘using’, a phase where knowledge is put to use for financial return or for status, position or recognition (Halkier et al., 2010, Strambach, 2008).

2.3. Knowledge processes

As studying the innovation case empirically a distinction was made between cumulative and composite knowledge processes. A process, in which new knowledge builds upon and depends directly on existing knowledge within the same field or discipline, is called a *cumulative process*. The ‘body of knowledge’ is increased. When knowledge comprises and depends upon several disciplines or functional areas of knowledge, it is called a *composite process*. It is typical that in the process of generating composite knowledge, different and basically separated knowledge stocks are brought together (Halkier et al., 2010).

2.4. Knowledge anchoring

The importance of innovation and knowledge transfer to regional economic development has been increasingly emphasised. The concept of knowledge anchoring was developed in the EURODITE project. As general idea, knowledge anchoring refers to the ability of an organisation or territory to access external knowledge and make use of it in some way.

James et al. (2010, p. 60) give a definition of knowledge anchoring. *It refers to knowledge coming from outside a region, which somehow ‘sinks in’ and is re-circulated within the region. By this we mean processes by which knowledge is used by other firms/institutions within a region (not just the one that found/adopted the knowledge from an external source). This might include developing the new knowledge, or recombining it with existing knowledge, as well as general diffusion within the region.* They also introduce the idea of knowledge anchoring as a useful tool to analyse the different mechanisms by which knowledge flows into regions and is re-circulated within them. They have identified four main ‘channels’ through which knowledge was anchored in the EURODITE case studies: events; work-place or job-related mobility; acquisition of codified knowledge; and firm-level interactions. With a better understanding of knowledge anchoring processes, policies to support knowledge interactions, innovations and growth can be selected to match regional needs as closely as possible.

3. THE METHOD

This is a single case study with holistic strategy. The case study followed the process presented in figure 1.

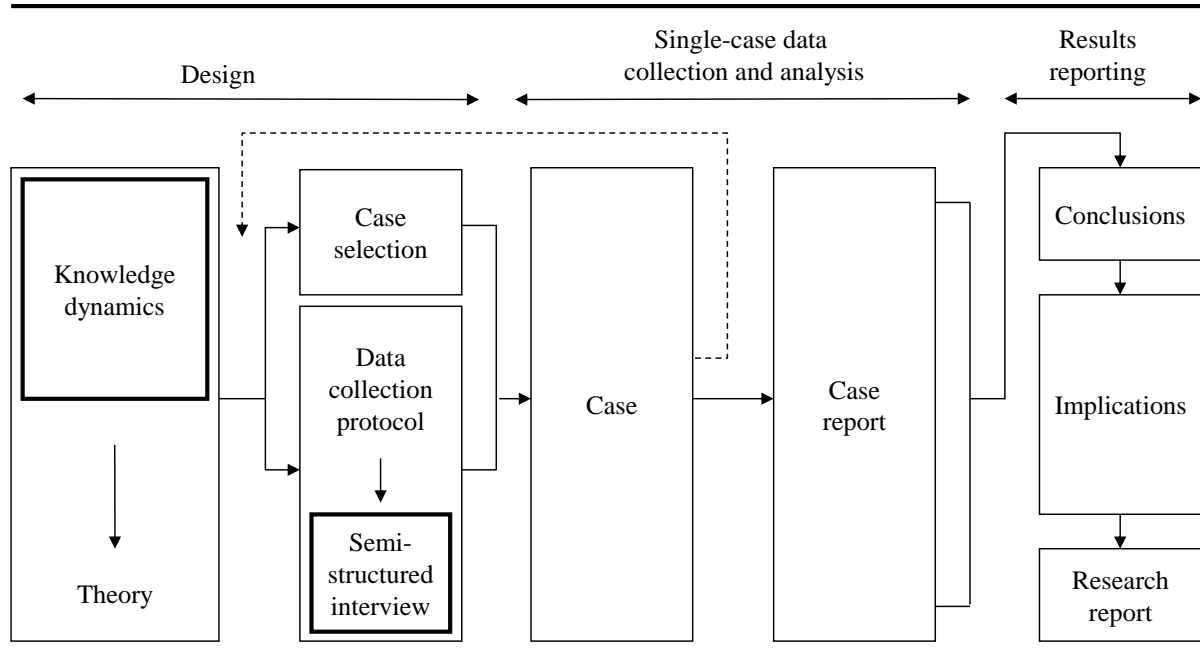


Figure 1: The research process

The unit of analysis in this study is the innovation case of a micro company. The definition of a micro company (and SME) is different in different contexts. The US context, for example, offers many definitions of SME depending on the industry. For example, in some industries, SME is a company having less than 500 employees. In the European context, the SME is a company having less than 250 employees. The same applies to micro companies. This difference on definitions needs to be taken into account when studying the SME related literature. Ayyagari et al. (2007) covers this topic in his globally focused, statistical study on SMEs (p. 416): *The term SME covers a wide range of definitions and measures, varying from country to country and varying between sources reporting SME statistics. Some of the commonly used criteria are the number of employees, total net assets, sales, and investment level. However, the most common basis for definition is employment, and here again, there is variation in defining the upper and lower size limit of an SME. Despite this variance a large number of sources define an SME to have a cut-off of 250 employees.* Because of the case context, the European definition is utilised. Within the SME category, the European Union defines medium sized firms as having 50-249 employees, small firms as having 10-49 employees, and micro firms as having 0-9 employees (Storey, 2003).

In this study, the empirical data was gathered via semi-structured interviews and public archive related to the case company. The interviews with key informants were mainly conducted face-to-face during fieldwork. The interview was formed to find answers to such questions as: How did the innovation case proceed from idea to product? What important knowledge interactions occurred in the development of the product? Who were the actors? Where were they located? What type of knowledge did they contribute? What was the core

knowledge of the innovation case? How is the core knowledge of the innovation arisen and developed? During the interview the interviewer summarised the explanation provided by the interviewees in order to avoid a biased or incomplete interpretation. The case study evidence was saved to the database. The case study evidence was collected by a researcher trained for data collection procedures and theoretical background of this study. The data collection process took place in 2008 and 2009. In an inclusive and iterative process the data was analysed and the main findings were summarised.

At the heart of the case study was the so-called ‘knowledge biography’. The knowledge biography method is an innovative approach providing a deeper understanding of knowledge dynamics in firms and regions. The development of a product was traced and interviews were used to obtain basic information about the space and time dimensions of knowledge dynamics. The knowledge biography method can capture the diversity of the social environment of a firm or organisation, identify knowledge flows and obtain information about partners inside and outside it. (Dahlström and Hedin, 2010, p. 11).

4. THE CASE STUDY – KNOWLEDGE DYNAMICS IN INNOVATION PROCESS

The innovation case studied here is the development of a “PC-free control system for a forest harvester with remote control possibilities” from idea to product. The home of the innovation case was micro firm Arsca Electro LP in 1996-2007 and micro firm Crelea Ltd after 2007 both located in Oulu South region.

Because of the specific nature of the case studied here, the knowledge biography of the case has been divided into three knowledge phases described in the theoretical part. On the basis of data obtained from the interviews the phases of this case can be described as 1) *establishing and developing the idea*, 2) *product development*, 3a) *commercializing and marketing of the product* and 3b) *changes in network*. The phases are somewhat overlapping, which should be taken into account when reading the description.

4.1. Phase 1: Establishing and developing the idea (1996-2002)

The origin and routes of the core knowledge of the phase 1 are described in Figure 2. The main part of knowledge came to process with the main innovator who is the entrepreneur of Arsca Electro LP. He has significant working experience related to planning and engineering different kinds of electricity, electronics and control systems. The main innovator has a long experience as an entrepreneur (years 1978-2007). He has e.g. planned and engineered over 1000 control systems for wood processing firms. Besides working, the main innovator has self-studied electrical engineering, electronics and data communication. The main innovator has for example self-studied material that he got from his brother about the data communications engineer education programme at Oulu Technical Institute. The main innovator has also self-studied the material about fuzzy logic that he bought from one teacher at the Jyväskylä Technical Institute. The main innovator has accomplished the education of auto mechanic and the education of technician in electronics installation.

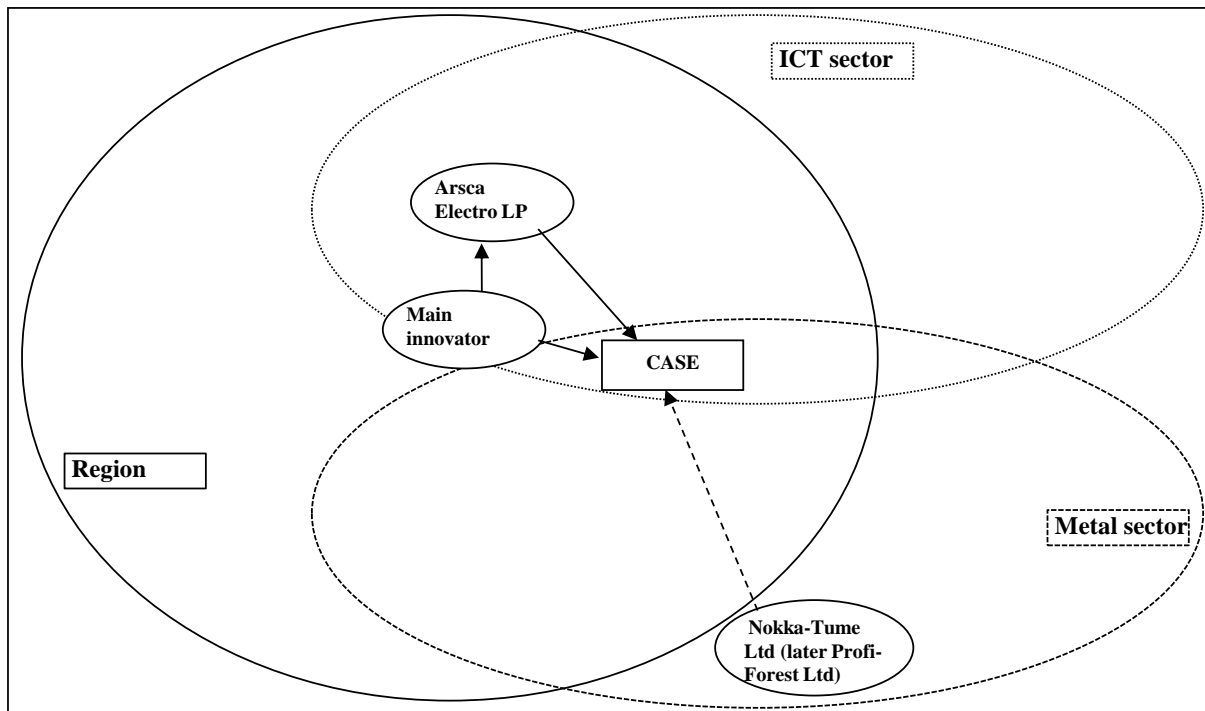


Figure 2: A condensed graph about knowledge dynamics in phase 1

The main innovator has also significant knowledge about forest machines because his firm Arsca Electro LP had done electronics installations on forest machines since 1986.

The main innovator got the idea when he was making electricity installations to forest harvesters. He thought that the electronics system was too complex, too vulnerable to faults and too laborious to make. He thought that perhaps numerous amounts of hand-adjusted functions could be replaced by a centralized adjustment and control system. One feature of the new control system is a much lower need of electrical wires: while the old system needed about 3.7 kilometers of wires per forest harvester, the new system needed only 600 meters.

The innovation process began at the METKO Trade Fair [4] in 1996 when Arsca Electro LP's entrepreneur, the main innovator, first told to the forest harvester manufacturer Nokka-Tume Ltd. about his idea. The main innovator asked Nokka-Tume to start product development of a control system of the forest harvester together with Arsca Electro, but Nokka-Tume decided that the idea was at that moment too challenging and risky. Arsca Electro could not start product development by its own because it had a difficult financial situation at that moment. Between the years 1996-2002 the main innovator developed his idea further during his leisure time and at his own risk. Finally after 6 years in 2002 Nokka-Tume decided to take the risk and started the development process together with the main innovator.

From the innovation's point of view it was decisive that the main innovator's firm Arsca Electro and the forest harvester manufacturer have had a long cooperation relationship. A confidential relationship is needed when a new idea is going to be processed. The main innovator had been working with different versions of the same forest harvester for three different firms which have owned intellectual rights of the harvester (Nokka-Koneet Ltd., Nokka-Tume Ltd., Profi-Forest Ltd.) during the years.

4.2. Phase 2: Product development (2002-2007)

The actual product development started in cooperation between Arsca Electro and Nokka-Tume, which named its long-term employee (Co-innovator 1) to join to the development process. Co-innovator 1 has an education in information technology engineer and in this case he acted mainly as an expert of programming and software. Co-innovator 2, who worked in Omron Ltd., joined to the process also at the beginning and in this case he acted as an expert in electronics. Co-innovator 2 has an education in electricity and automation technician. The main innovator knew both co-innovators already before the beginning of the development process on the basis of his earlier cooperation with them.

In 2003 Nokka-Tume sold its forest harvester manufacturing to Profi-Forest. Because Co-innovator 1 moved from Nokka-Tume to Profi-Forest and Arsca Electro continued to do electricity installations to harvesters, the product development could continue without any break. Also co-innovator 2 remained in the development process, because there was no need to change electronics supplier. The origin and routes of the core knowledge of the phase 2 are described in Figure 3.

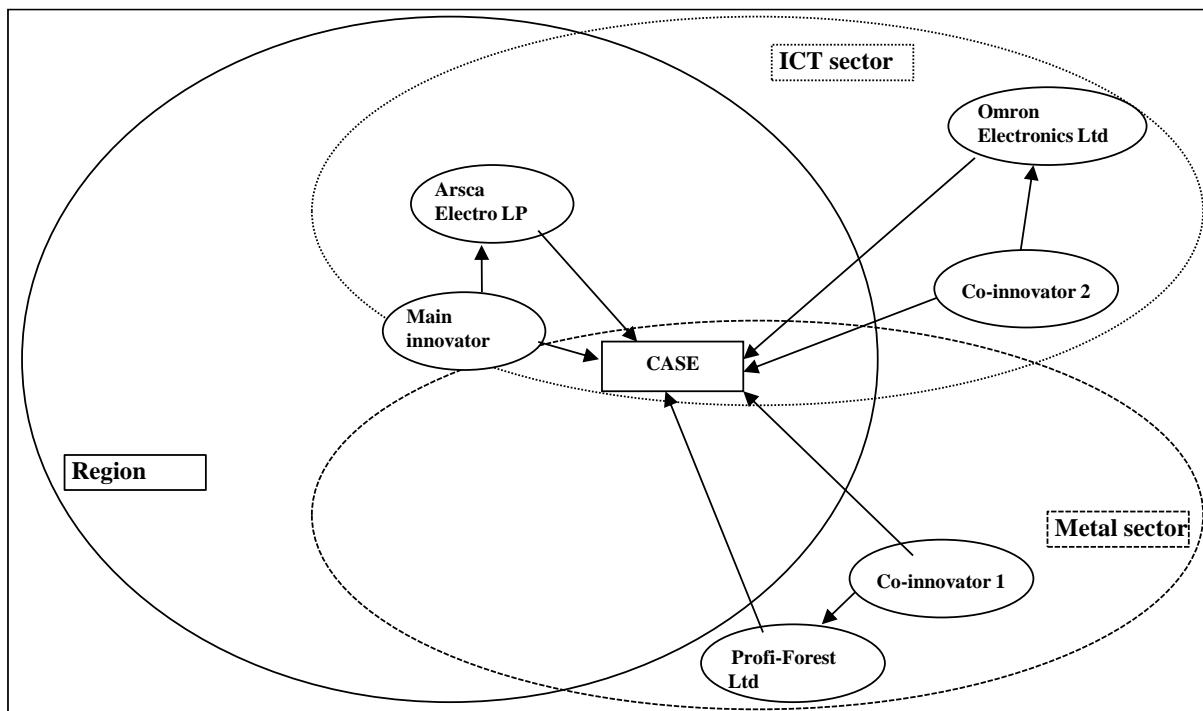


Figure 3: A condensed graph about knowledge dynamics in phase 2

The prototype of forest harvester with a new control system was finished in 2005 and presented at ELMIA [5] Trade Fair in the same year. Arsca Electro produced the control systems to Profi-Forest's forest harvesters between 2005-2007.

4.3. Phase 3a: Commercializing and marketing the product (2005-)

From the forest harvester manufacturers point of view it was important to get feedback from harvester users about the new control system as soon as possible. The key persons worked hard and the prototype of the forest harvester with a new control system was finished in 2005 and presented at ELMIA trade fair in same year. The prototype was presented at trade fair

even though the developers did not have time to test the harvester before the trade fair. Because the feedback was positive, the prototype was finished to a ready product quickly, and the manufacturer was able to start using the characteristics of the new control systems in marketing. The origin and routes of the core knowledge of the phase 3a are described in Figure 4.

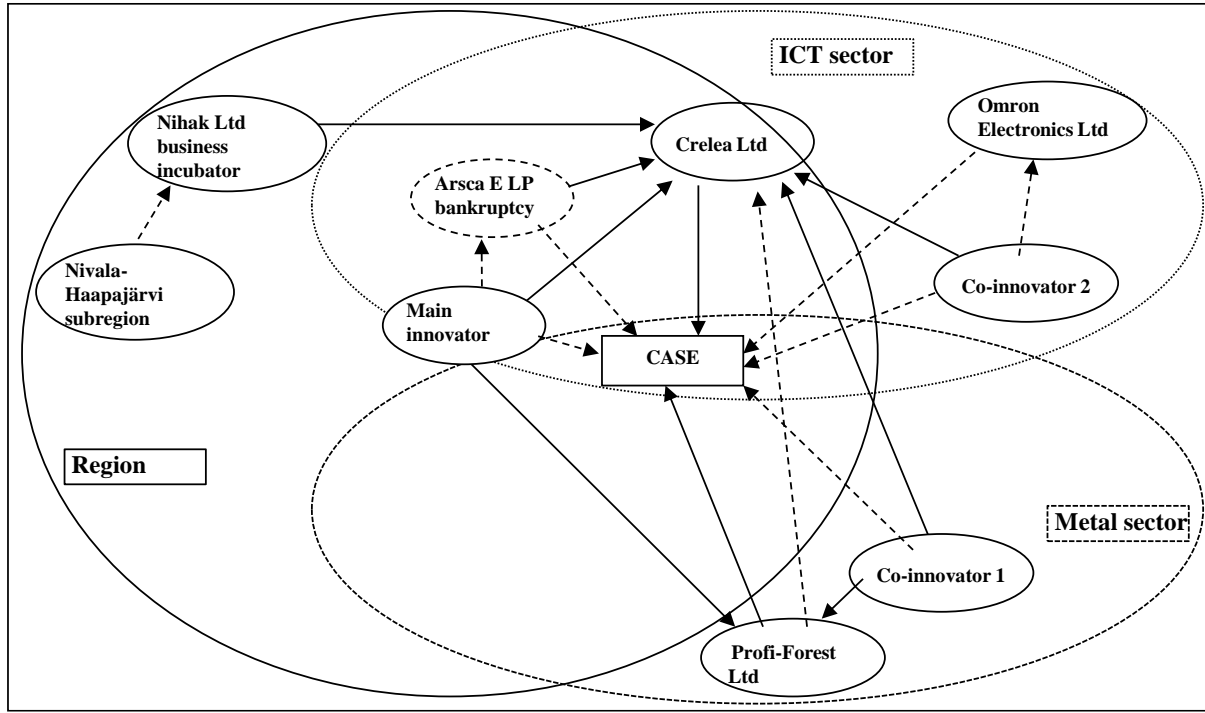


Figure 4: A condensed graph about knowledge dynamics in phase 3a

Arsca Electro had earlier been participating in two other cooperative projects involving control systems for wood processing industry and automatic traffic control systems. Those projects did not succeed and they caused significant financial losses to Arsca Electro. As a result of Arsca Electro's economic problems, tax debts accumulated and the tax authorities bankrupted the company in 2007.

In 2007 Arsca Electro sold the intellectual property rights of the control system to the newly-founded Crelea Ltd., that was founded to take care of the innovation and its further development. Two sons of the main innovator became the main stakeholders of Crelea. The main innovator wanted to ensure the commitment of co-innovators in the long term and asked them to become stakeholders of Crelea, in which co-innovators agreed. The main innovator himself did not become a stakeholder because of the economic problems mentioned above. He acted as an important expert and advisor to Crelea. The main innovator knew also all the other stakeholders. They were invited because of their knowledge that was to be necessary in the development of the control system. One of them works as an industrial designer in an international machine manufacturer. The other is responsible for international marketing affairs for another machine manufacturer. In fact, all stakeholders act as part-time experts for Crelea in addition to their other duties. In 2007, the main innovator started working as automation manager at Profi-Forest, which has since then sold his know-how (remote monitoring and repairing) to Crelea. Since 2007 Crelea has produced the control systems for forest harvesters of Profi-Forest.

Development company Nihak Ltd's (owned by Nivala-Haapajärvi subregion) Business Incubator has supported Crelea since 2007 in its start-up phase and in applying public financing for the development actions. The main innovator had no significant local business partners from the innovation's viewpoint. The main innovator has not actively sought partners from the Oulu South region. He thought that there was no such knowledge that would have added value to the idea. The significance of public organizations in the region has been minor in the case. Nihak Ltd's Business Incubator was the only public organization with influence to the case.

4.4. Phase 3b: Changes in network (2009)

In 2008 economic depression caused problems in forest sector and year 2008 was difficult especially for small machine manufacturers as Profi-Forest. As a result of economic problems, the harvester manufacturer Profi-Forest went bankrupt in 2009 and at the same time a new company Profi-Pro Ltd. was established to continue manufacturing. Profi-Pro bought the whole harvester manufacturing from Profi-Forest and moved the production from Muurame to Crelea's home town Nivala. Nihak's business expert, who earlier had helped Crelea, became one of the Profi-Pro's stakeholders. Other stakeholders were two employees of Profi-Forest, both specialized in international marketing. The Crelea Ltd. became a stakeholder as well.

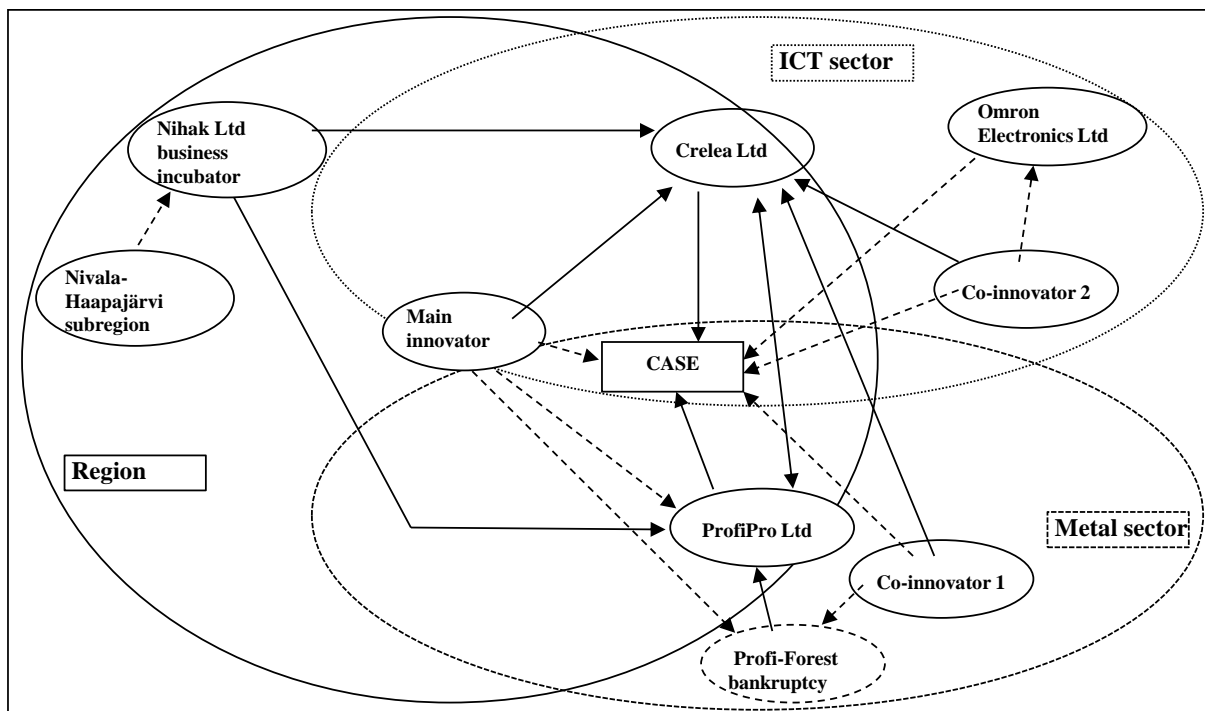


Figure 5: A condensed graph about knowledge dynamics in phase 3b

As a result of above described organizational arrangements, the main innovator changed his position from Profi-Forest to Crelea, which started to sell his knowledge to new manufacturer Profi-Pro. The origin and routes of the core knowledge in the phase 3b are described in Figure 5.

Nihak Ltd's business expert had an important role in this phase adding business experience and expertise to the process. The bankruptcy of the harvester manufacturer made the future of

the innovation case very uncertain. From the innovation’s point of view it was strategically significant that the business expert already knew Crelea quite well when he started to search possibilities to start a new manufacturing firm. He was one of the founders of the new manufacturing firm Profi-Pro and he became also a stakeholder.

5. DISCUSSION

As a result of this study, the progress of a single innovation case from idea to product and the knowledge dynamics of the process are described. In the description the knowledge types and knowledge phases, presented in the theoretical part of the study, are essential. The answers to the research questions 1 and 2 can be condensed into the following Figure 6.

Knowledge phases \ Knowledge types	Exploration (Search, including research)	Examination (e.g. Trialling, testing, standard-setting or benchmarking)	Exploitation (Commercialisation of innovation, sale on market, or socially useful & used)
Analytical (Science-based)	Phase 1		
Synthetic (Engineering)		Phase 2	
Symbolic (e.g. Advertising)			Phases 3a, 3b

Figure 6: The phases of the innovation case placed in a table of knowledge types and knowledge phases.

The phase 1 of the innovation case (*establishing and developing the idea*) is clearly an explorative knowledge phase. During the phase the analytical and synthetic knowledge were essential. The main innovator gained needed knowledge for the innovation by self-studying and testing different components and couplings.

The phase 2 (*product development*) in this case is more complex. During this phase the innovation process was intensive. In this phase of innovation all the knowledge phases (exploration, examination and exploitation) were identified. All the key persons were involved, which accelerated the development process. The focus of the process was narrowed to planning and producing the prototype and testing the needed components. After the presentation of the prototype, the innovation process continued by further development of the product. The knowledge needed for the innovation during the phase 2 was analytical, synthetic and symbolic.

Phase 3 includes two sub-phases (*commercializing and marketing of the product and changes in network*), which represent exploitative knowledge phase. In this phase the symbolic

knowledge was decisive, especially when the prototype was introduced at the trade fair. Symbolic knowledge in this phase was needed for planning and attending the fair. It was mainly based on the actors' previous experience of trade fairs and the knowledge of the market of the forestry branch.

When analyzing the phases from the viewpoint of tacit and codified knowledge, it can be said that the codified knowledge was important especially in phases 1 and 2. In this case codified knowledge consists of common manuals about electricity, electronics, programming and software, that the key persons studied and used. Also the standards can be seen as part of the codified knowledge in this case. Tacit knowledge was important in all phases. Personal contacts have been crucial in this case. The most important knowledge behind the innovation was strongly personalized. Despite the key persons were working in different parts of Finland, they were able to share their tacit knowledge, because of their reliance on each other.

As looking at the knowledge process in different phases, it can be said that the cumulative knowledge was dominant in the phase 1 and the composite knowledge in phase 3. During the phase 2 both kind of knowledge processes can be identified.

In this case the question of knowledge anchoring is very interesting. The core knowledge is anchored mainly in the key persons and their personal relationships. The main innovator had no significant local business partners from the innovation's viewpoint. He did not actively seek private or public partners from the Oulu South region. The significance of public organizations in the region was minor in the case. Even though, this study provides an interesting bench-marking case for the managers of innovative micro companies and public development agencies. The viewpoints identified in interviews of the key persons of this case support public actors to ask essential questions in developing their services for micro companies. The results of this study represent the viewpoint of micro companies functioning with fewer financial and human resources – this viewpoint is often different from a viewpoint of large enterprises.

A construct validity of this case study is based on a research plan that has worked as a road map through the study. The case study used multiple sources of evidence such as interviews and public archive documents. The chain of evidence was preliminarily defined in a research plan to strengthen construct validity. The internal validity of the study relies on the research design. In theoretical part, the theoretical background was presented and in empirical part the knowledge dynamics of the innovation case was carefully described. The test of external validity shows that the findings of the study cannot be widely generalised because of the uniqueness of the case. Although different actors were interviewed and several people's views were obtained, it is important to notice that their experiences were handled as such. The research findings depend on the period when data is collected. Evaluation of the reliability highlights the following points. A case itself has a significant role when the case study research method is used. In addition, researchers' own paradigm or point of view may affect the findings.

This kind of entrepreneur provides a challenge for the regional innovation system. In the future studies it would be interesting to use the method of knowledge biography to open more innovation cases. The method will be further developed and used in the future studies. It would also be interesting to compare the results of similar analysis made in micro companies located in other European countries or elsewhere. The role of intermediaries in the support of micro companies in this challenging area requires closer look. Our future aim is to investigate

how the public business services and developing activities of technology parks providing support to micro companies and SMEs in rural and sparsely populated areas confront the challenges. Future studies could focus on public business services and on how these services meet the needs of the companies.

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Endnotes

[1] Read more about the REKENE project at: <http://www.nordregio.se/en/Nordregio-Research/REKENE/> and about the EURODITE project at: http://ec.europa.eu/research/social-sciences/projects/321_en.html.

[2] The Lisbon European Council 2000.

[3] Statistics Finland 2011.

[4] METKO is a professional fair in the field of heavy machinery and arranged in Finland.

[5] ELMIA Wood is one of the world's largest forestry fair and arranged in Sweden.