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THE KNOWLEDGE DYNAMICS OF ICT IN SLOVENIA

Case studies

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(CASE STUDIES)*

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Abstract

In the paper, the case studies of firm knowledge dynamics (FKD) in three Slovenian ICT firms are presented: Spica, Smart-Com and Iskratel. For the conduct of the analysis, several in-depth interviews were carried out in each of the firms. The results show that successful firms are aware of the importance of knowledge, and have the capability of combining all different kinds of knowledge. Besides the internal, they value also external knowledge and find different proximate or distant sources of it. They demonstrate mobility, and at the same time are capable of anchoring the knowledge, they produce their own knowledge as well as make good use of the existing knowledge. All levels of personnel in different business functions are included in the FKD, and the transfer of knowledge between them is very good. It is however evident, that less importance is put on symbolic knowledge, compared to other knowledge types. While in Slovenia there is a general problem of cooperation between public and private research sector, the studied FKDs demonstrate an excelent example of the firm – University cooperation.

JEL classification: D83, O33

Keywords: knowledge, knowledge dynamics, ICT, innovation, knowledge based economy

Foreword

This working paper is based on the results of a study, carried out in the context of the EURODITE (Regional Trajectories to the Knowledge Economy) integrated project funded by the EC under the Priority Seven (Citizens and Governance) of the Sixth RTD Framework Programme. The study was conducted in 2008. The EURODITE project seeks to enhance understanding of the nature and dynamics of the knowledge economy and its impact on the development of different European regions.

In the paper, the case studies of knowledge dynamics in three Slovenian ICT firms are presented: Spica International, Smart Com and Iskratel. For the conduct of the analysis, several in-depth interviews were carried out in each of the firms. The data were organized according to a common methodology, in order to enable the international comparison of the case studies.

SECTION 1 – INTRODUCTION

1. Introduction

1.1 The region: SLOVENIA

Slovenia (located in Central Europe and neighboring with Italy - Friuli Venezia Giulia- on the west, Austria - Styria, Kaernten - on the north, Hungary - Western Transdanubia - on the northeast and Croatia on the south) became independent country in 1991 after dissolution from former Yugoslavia. Its population is 2 million inhabitants, the area is 20 thousand square kilometers. According to NUTS classification the whole Slovenia is classified as NUTS 1 region.

Slovenian economy has undergone in the last 18 years radical transformation from relatively closed socialist self management system to open export oriented market economy. In 2004 Slovenia became full fledged member of EU and in January 2007 it entered into euro monetary zone. Due to the above average growth rates (between 4 and 5% per year in the last 10 years) GDP has grown from 15,7 billion euro in 1995 up to 34,4 billion euro in 2007. The average GDP per capita has reached in 2007 17200 euro (i.e. 88 % of EU average). The share of rural population diminished to less than 5% of the total. More than 65% of GDP is exported (main trading partners are Germany, Italy, Croatia, Austria and France). The most important export groups of goods in 2007 were the following: road vehicles, electrical machinery, apparatus, appliances, medical and pharmaceutical products, furniture and parts, general industrial machinery, manufactures of metal etc. Services (tourism, building, road and railway transport, banking and insurance, business services including ICT) have important shares in economic activities totaling over 65% of GDP.

1.2. Regional benchmark

The comprehensive sets of indicators and clustering in different groups of regions (Carrincazeaux, Gaschet, Becue, 2007) enable the benchmarking of East European regions with the western ones. Despite the fact that not all knowledge variables/indicators were used for East European regions Slovenia can be fairly compared with other 129 Western regions and with few Eastern regions.

According to **scientific** variables (public R&D expenditures, R&D employment in public sector) Slovenia can be grouped either in the cluster 4 (average scientific activity, diversification) together with the regions from Germany (Baden Wuertenberg), France (Provence-Alpes-Coter d'Azur, UK, Belgium and Italy or in

cluster 5 (low scientific activity with low publication ratio). Our research indicates that it should be classified in the cluster 4.

Similar classification would be achieved if we take into consideration **technological** criteria (private R&D, patent applications, structure of industrial sectors). In this case Slovenia exhibits average technological activity and dominant role of traditional industrial sectors. This group of regions has important share of patent applications in traditional technology (consumption, mechanics). The analysis of 9 indicators of **education** and formation (share of students in total population, students in primary and secondary educational level, students in tertiary educational level, share of vocational education, upper and post-secondary level, tertiary level attained, life long learning, education level corresponding to occupational level) shows above EU average results for Slovenia. In the last years nearly two thirds of young population (aged between 18 and 25) are enrolled at higher education schools, respectively at universities.

The lack of data about size, distribution of firms, the capital and ownership structure prevent the proper assessment on **industrial specialization.** However, among 8 regional industrial profiles Slovenia should be grouped in the cluster 5 (Manufacturing traditional sectors: mechanical, metal working). It should be stressed that Slovenia has achieved an overwhelming role of service sector.

Some disappointing results considering the influence of knowledge intensity on growth could be explained by temporal effect. Namely, some important time lags exist between the improvement of knowledge in the country and its impact on economic performance (GDP, employment, unemployment).

After checking STIE analysis and regional classification into 4 knowledge profiles (knowledge intensive, medium intermediary, low tech intermediary and low profiles) we came to the conclusion that Slovenia could be benchmarked in the group with “medium intermediary profile”. Taking into consideration 11 regional STIE configurations Slovenia is close to German industrial profiles. Main features in Slovenia correspond to German industrial profiles (industrial specialization, small units, vocational and medium educational level). The regional classification has put Slovenia into “low tech intermediary profile”, more precisely into French industrial food profile. It is difficult to agree with this result as the majority of country’s exports are middle tech industrial goods with very small proportion of food processing.

For deeper analyses additional innovation, demographic and social indicators should be used (daily commuting, immigration and emigration trends) in order to obtain more precise regional profiles (see European Innovation Scoreboard, DG Enterprise and Industry, 2007).

1.3. Brief description of the ICT sector

ICT deserves in Slovenia and elsewhere a continued attention because of its impact on knowledge based society, because of relevant role in manufacturing and service industries and due to its economic and social relevance and not least due to the level of innovation. ICT is important for its inherent cross-disciplinary and cross sectoral nature and for its new ways of producing, trading and communicating.
In the period 1995-2005 Slovenian ICT market has grown considerably (above 11% average yearly growth rate). The share of ICT value added in the business enterprise sector has in 2005 reached 7,2%. According to GVIN, AJPES for 2007 the share of ICT companies in the total net income was 2,6%, in EBITDA 6,1%, in net profits 4,9%, in the capital assets 4,2% and in employment 1,4%. According to EUROSTAT (2006) there were in ICT 2825 firms employing 24 670 people.

Slovenia has from the standpoint of information society reached in 2006 relatively good indicators: 63,3 internet users per 100 populations, 24% use of e-shopping, 61% of households with personal computer and 51% of households with access to the internet and internet bandwidth per 10000 inhabitants 12.6. Our research focus was oriented on the knowledge dynamics in production and use of ICT products and services) as well as on the problems of education and training in ICT sector.

The stakeholders in ICT sector (manufacturers of HW and SW, universities, research institutes, technology centers, centers of excellence, public agencies, telecom operators) have diversified organizational and ownership structure. There is no specific hierarchy relations between stakeholders. National council for science and technology has not in the last 5 years played any role in ICT governance strategic issues. Business enterprises are organized voluntarily in Chamber of economy, in 2 consortiums called “technology networks” (ICT and process controlling), in 4 technology platforms (ARTEMIS - embedded systems, NESSI - software and IT services, NEM – networks and electronic media, e-Mobility). Three public agencies have different roles: ARRS is entitled for funding R&D, technology agency for technology and innovation and Public agency for post and telecommunications has mostly regulatory function.

SECTION 2 - THE CASE STUDIES

2.1 TKD

Overview

In order to study the knowledge dynamics within the ICT sector, we selected three Slovenian ICT firms for the case studies. All three firms are amongst the most successful and innovative representatives of their sector. This means that although on one hand we can find several similarities with the general characteristics of the territorial knowledge dynamics, at the same time the knowledge dynamics in the studied firms is different and can in many views also serve as an example for the (above)average Slovenian ICT firm knowledge dynamics.

i) Producers vs. users of knowledge

According to three hypothetical types of regions (regions focused on knowledge generation, regions focused on use of knowledge, regions with knowledge generation and use interplays) Slovenian TKD is in this project determined primarily as a »region« oriented towards creation of knowledge. Knowledge creation is now perceived as a complex, interactive and open ended process with a collective dimension. R&D and other knowledge institutions, human capital, skill formation, social capital and organizations are crucial to the knowledge creation. Due to the fact that majority of enlargement regions in Central and Eastern Europe have not preserved the linkages between research and training institutions on one side and industrial activities on the other side, they remained lagging behind or catching up regions. Slovenia is on the top of East European catching up regions (Summary innovation index in European innovation Scoreboard, 2007). Slovenia succeeded during the transition period (1991-2004) to retain relatively strong R&D capacities in the public sector (universities and public research institutes). TKD underwent severe systemic changes: from regional to national economy, privatisation, from rigid planning system to viable market economy. The business enterprise sector witnessed the breakdown of the large socialist enterprises and privatisation process in this sector caused that intramural business R&D capacities in the 90s substantially downsized and recovered only later in the middle of this decade. The co-operation between public R&D organizations and the private industry has been during the whole period quite weak and is one of the main reasons for low industrial value added, insufficient technological readiness in the whole economy and consequently lower competitiveness of the Slovenian ICT sector.

Several arguments speak in favour of the thesis that Slovenian TKD in ICT is more oriented towards the creation and generation of knowledge (analytic knowledge) and thus underestimating the role of knowledge diffusion and use of knowledge (synthetic and symbolic knowledge):

- investment in knowledge (higher education, R&D, software) in relative terms exceeds EU level (3%),
- Slovenian economy exhibits relatively high expenditures for education and R&D (over 6% GDP),
- public R&D expenditures are favouring basic science and non market driven research (analytical knowledge) through different financial schemes: programme financing, young researchers programme at universities and institutes, participation in EU framework programmes,
- prevailing share of programme financing in comparison with the project financing,
- low public financing of technology and innovation via Technology agency in comparison with the public financing of scientific research via Agency for scientific research and other public institutions,
- low number of S&T graduates (76% relative to EU in 2005),
- low level of ICT prioritisation and ICT investment (ICT investment in 2007 in Slovenia was 1.9% GDP compared to 2,7% GDP in EU),
- insufficient exploitation of R&D investment and inappropriate specialisation of ICT innovation support network,
- fragmented research teams with subcritical mass of researchers and developers,
- low level of high tech exports including ICT products and services,
- low inclusion into international value chains.

The selected firm cases can also be categorized as knowledge producers, although at the same time, they are also good knowledge users. They know how to combine both in order to come up with the best result. While they all developed the studied products practically by themselves (produced the knowledge) they also generated and used as much external information as they could. The generated knowledge about the market was for example crucial for the decision what product and when to develop. Also knowledge, acquired from different partners was included in the product development process. While the linkages between the academic institutions and firms are generally not good, the selected firms present good exceptions, since they are all included in the networks and cooperate with research institutions as well as University professors and students.

ii) Mobility / anchoring of knowledge

The study and examination of 4 different types of knowledge anchoring (knowledge allocation, assimilation of regional knowledge, contextualisation of mobile knowledge, knowledge reciprocal learning) pointed out two modalities actual for Slovenian TKD. Firstly, assimilation of regional ICT knowledge and secondly, the contextualisation of mobile ICT knowledge.

Large Western ICT firms did not make any significant FDI investment into Slovenian economy in the last 2 decades due to the small domestic market, due to the relatively high labour costs of skilled labour in comparison with other East European regions and due to the unfavourable institutional conditions in the nineties. The presence of the main multinational ICT companies in TKD has been limited to distribution and training functions. However, such situation did not prevent substantial knowledge flows so that that comparisons hierarchies and rankings exhibit diminishing the gap with the developed EU regions.

This situation created specific knowledge trajectory in Slovenia: strong reliance on domestically driven TKD and FKD and very important role of national R&D, technology and public procurement policies related to innovation in ICT.

The following policy measures were set in force in the last years:

- promotion of innovation and knowledge infrastructure (development of new universities, technology centers, 11 CoE, technology networks, support for individual innovators),
- development of knowledge transfer system (specific measure Young researchers for industry),
- promotion of R&D co-operation among enterprises (technology platforms like ARTEMIS –embedded systems) and identification of R&D priorities relevant for Slovenian economy (ICT, biotechnology, advanced materials et.),
- promotion of development cooperation and subsidies for industrial R&D projects and development of new technologies, products and services (strategic R&D projects),
- coordination of the international programme EUREKA, encompassing preparation and implementation of the public call for international industrial R&D projects as well as implementation of the EUROSTARS programme,
- participation in ERA-NET projects (e.g. MANUNET, CORNET, EraSME, COMPERA),
- participation in the establishment of cooperation with ESA – European space Agency coordination of the activities related to the Investment Fund for new technologies in cooperation with Slovenian enterprise fund.

A similar conclusion as for the producers vs. users of knowledge debate, can also be made for the mobility vs. anchoring of knowledge debate. The selected cases are successful examples, and therefore show a better picture of the situation as the Slovenian ICT sector in general. While for the sector as a whole, neither knowledge mobility nor anchoring are very good, the studied cases show a tendency to better knowledge anchoring capabilities. While in all three cases they managed to anchor the regional knowledge (besides knowledge from different partners also most promising human resources) in two of them they also managed to anchor some developmental knowledge from abroad.

iii) Distance-proximity of knowledge sources

The economic geography perspective on knowledge examines the relationship between the economy, knowledge and proximity or more generally space (Burfitt, Collinge, Staines, 2007; Cooke, 2002; Cooke & Leydesdorff, 2006; Malecki 2000, etc)

There are no uniform and simple answers to the question about the geographical and spatial sources of knowledge in ICT sector in Slovenia. Due to the fact, that ICT is more market driven than science driven (Cooke, 2004) we have examined the main sources of knowledge in academic organizations (universities, research institutes) and in the interviewed business firms and their associations. Our findings confirm that the main sources of ICT learning process are predominantly locally based in domestic high education and research institutions combined with the different long distanced international sources (foreign universities, branch offices of multinational companies).

Knowledge institutions (Faculty for Electrotechnics and Faculty for Computer science and Informatics University of Ljubljana and Faculty for electrical engineering, Faculty for Computer Science University of Maribor are the main domestic sources of knowledge. The new academic centers (in Novo mesto and in Nova Gorica) are emerging in the last few years. Centers of excellence and technology networks associated and strongly linked with two main universities have gained importance in the last years. CoE ICT in Ljubljana established partnership between academic institutions and business organizations by trying to form and integrate technical, applicable, innovative, evolutionary and research excellence in the broader multidisciplinary field of information and communication technologies (different areas of activities: multimedia, mobile communication, e-business, e-government, IP services, wireless communications…)

By connecting and networking the critical mass of experts and knowledge, CoE ICT is directed towards joint integrated projects. The main strength and potential of CoE ICT is new organization and conduct of research projects. CoE ICT focuses on generation and distribution of knowledge and on investment in intellectual capital enabling new ways of partnership better adapted to the challenges of present day market needs and opportunities. Important domestic knowledge sources are also two technology networks (ICT and process controlling) and numerous technology centers located in the whole Slovenian territory.

Multinational companies (IBM, Apple Sisco, Microsoft, Ericsson) and affiliated training institutions are also important knowledge sources. It seems that cross border cooperation (for example with the neighboring Graz and mid distanced Muenchen universities) offers new, so far not enough exploited opportunities for the exchange of ICT knowledge.

As already mentioned in the section about knowledge anchoring, the best firms are capable to surpass their close environment and track and make use also of more distant sources of knowledge. The same goes also for our selected cases, which are not limited to regional borders when looking for R&D knowledge, suppliers, customers, partners, etc.

2.1.1 FKD 1

Introduction

The first selected case was the development of the product SI3000 Call Server, which is a central and most innovative part of the product family SI3000 Control Plane. This product family is designed for various types of telecommunications operators and service providers and is prepared for the convergence of fixed and mobile networks, which is a key telecommunication trend in recent years. The product was developed and produced by the firm Iskratel, which is one of the largest and the most innovative telecommunication firms in Slovenia. The firm is successful on international markets and is one of the top-ranking providers of state-of-the-art communications solutions, with more than 60 years of experience in the telecommunication business. The selected product is practically the core product of the whole company and contributes to the major part of the company's total revenues. The product has considerably increased Iskratel's share on international markets. The main reason for the selection of this case was that the firm as well as the product itself, are good examples of successful cooperation of the private company with the public research sector.

Besides, the case (and therefore also the KD) far surpasses the regional borders development wise as well as market wise speaking.

The very beginnings of the SI3000 CS knowledge biography reach more than 30 years back into the Iskratel history. The knowledge and experience gathered in years of developing and producing computer controlled telecommunication equipment provided the firm with the knowledge base that distinguishes them from competitors with knowledge base merely from the IT field. The changes in of telecommunications in the last years together with the knowledge base enabled the recognition of the opportunity in offering exceptionally economical solutions for the transition from legacy telephone networks to IP-based broadband multimedia networks. The first rough idea appeared in 2003.

Later in 2003, the concept of the IS3000 CS was presented on one of the most important telecommunication fairs in Geneva. This was the beginning of the contemporary CS technologies and products. At the same time, the development of the prototype was already in process. In the end of 2004, the developed prototype was tested on different tests in a technopark in Russia for half a year and at the same time, the pilot version of the product was tested at the first customer in Slovenia. Only after all the tests, the analysis and the development of all the necessary processes for the commercial production has started. The project proposal was presented in July 2005, and the analysis phase lasted until the beginning of 2006. The next phases unwinded very quickly – a month later the design of the product was finished and another month later it was already implemented. In the summer of 2006, the pre-system test of integration was passed and after the verification and validation, the release was available in November 2007.

The knowledge biography is however far from finished with the release of the product. The firm constantly monitors technological trends and acquires new knowledge, and puts much effort into diffusion of that knowledge inside the firm in order to increase the knowledge base. Also the firm's organisation itself supports this goal, and is therefore very flexible so that it enables very good interaction between all internal players on different levels. Much emphasis is put also on the existing customers' feedback and the requirements of the potential customers. Based on that, the development and production processes and the IS3000 CS product itself, have been constantly evolving until the present day, when already the fourth version of the product is being developed.

In order to facilitate the investigation of the FKD, we identified the following phases of the change process:

1. Idea phase
The idea derived from long years of experience and the existing knowledge base and following the ICT development trends. However, the first more concrete idea which lead to further analysis was shaped in the beginning of 2003.

2. Development of the concept
In spring 2003, the first research project has started. This was not yet an R&D project with commercial aims, but a small project with the first intention to develop the product concept to such an extent that it could be presented to public on the Geneva telecommunication fair (October 2003).

3. Development of the prototype
After the presentation of the concept in Geneva, smaller R&D projects have started with the aim to develop a prototype for the testing in Russia (end of 2003, 2004).

4. Testing of the prototype
The prototype underwent some extensive tests lead in a Russian technopark, which were going on for the whole year of 2004. With these tests the Russian authority Svjazinvest institute CNIIS compared the products of different competitors. The test results provided the firm with many valuable information about the potential competition and the strengths and weaknesses of their product. At the same time, the pilot version of the product was also being tested at the first customer (Siol) in Slovenia. For such a product it is very important to test it on the market already in the early stage, since it is very difficult to simulate a realistic environment otherwise.

5. R&D and production processes
In order to ease the development and production of the product for commercial purposes, the R&D and production processes had to be developed. The development of the processes together with R&D and production was going on from July 2005 till February 2006. However, the developed processes still undergo changes based on new knowledge and experience.

6. Verification and validation
In this phase the product is being tested from outside the company The clients are the ones who determine whether the product meets their needs and expectations or does it have to be modified. (2006-2007).

7. Implementation, integration
After the development, each product needs to be implemented and integrated into the client's specific environment. Company has its own tests (performed by developers and the group for developmental integration) to see if the product works as it should and is ready for the next phase. (2006-2007).

8. Modification – further modifications and new versions of the product. R&D is an ongoing process which results in constant improvements, modifications and new versions of the product. (from 2005 on).

In the first 6 phases the researchers from University of Ljubljana (Faculty for Electro engineering – Chair for telecommunications headed by prof. Janez Bešter) and from University of Maribor - Faculty for electro engineering headed by prof. Zmago Brezočnik) closely collaborated with the Iskratel staff. The expertise of Ljubljana team was concentrated in the field of telecommunication and signalization knowledge while the expertise from Maribor team was focused on IP internet knowledge (prof.Slatinek).

Phase 1 – Idea phase

The first idea derived from well-organised monitoring of the environment trends – new technologies, similar companies and market development and cooperation with the University researchers. The most important among directly involved functional knowledge types was R&D and also strategic knowledge. This knowledge, possessed by some of the firm's most valuable human resources was needed in order to be able to understand and interpret all the absorbed external information[1] and to recognize a possible profitable opportunity for the future development of the firm. Besides the external knowledge, also internal knowledge base, deriving from years of experience in the development and production of similar products, was of crucial importance. For the idea phase also the society and culture knowledge contexts had an important influence. Due to its nature, the product was not ready for release or even for development, until the society reached a certain level of acceptance for the new generation of telecommunication. Since the development of the society's acceptance for new technologies is influenced by the products offered on the market, other firms on the market were also a very important knowledge context. Science played a very important role as well, since it offers the foundation for the development of new products and pushes the development of the technologies forward.

Most of the external knowledge in this phase flew into the business process with the help of an organised monitoring process of the environment. Knowledge gathered through the public research system was acquired mostly through co-operation with the university research teams (University of Ljubljana - Faculty of electrical engineering, University of Maribor - Faculty of electrical engineering and computer science). A lot of important knowledge was in the hands of competitors, from which the transfer of knowledge was of course informal, and from distance (geographically

[1] Dankbaar, B., 2004. Embeddedness, context, proximity and control. European Planning Studies 12 (5), 691-701.

and relationally speaking). The interactions with possible clients and end consumers (to gather information about their readiness to accept new technologies) were proximate as well as distant and informal. All gathered information is shared by the internal actors in the shape of informal conversations and meetings at first, until at some point all these information are combined into a formal proposal.

The staff was motivated by the awareness that the technological breakthrough is essential for the survival of the company.

In this phase the key players were internal, since they are the ones who put all the external information together and combine it with the internal knowledge base in order to come up with a good idea. In the first idea phase Iskratel (as typical technology follower in telecommunication business) has not consulted any specific external opinion leaders.

Not only R&D personnel but also senior management was involved already in the idea phase. Their motivation was to discover an idea which will enable further development of the firm, increase its market share and profits and retain the dominant role on domestic market. There were no special money incentives at this stage as product innovation is the part of the regular tasks of the employees. Besides the internal also several external actors were very important. The first to mention are University researchers. Their motivation is the exchange and interaction of their theoretical with the practical knowledge of firm's researchers in order to acquire feedback on the usability, advantages and deficiencies of the scientific findings. The collaboration with 2 domestic universities is an integral part of the long term (about 20 years lasting) co-operation based on trust and specific contracts. R&D work of both faculties was financed through continuous contracts and partially with R&D projects co-financed by Ministry for science and technology. As already mentioned, other important external actors were also: other scientists and researchers, competitors, possible suppliers and possible clients and end consumers. They did not actively participate in the exchange of knowledge in the idea phase, so they had no special motivation.

The firm and its culture are oriented towards technological progress, therefore the employees are constantly making market intelligence and monitoring the international and domestic environment and looking for new knowledge and new ideas. Technology watch and monitoring of the competitors is obligatory task of the R&D management and product management. In this phase they have practiced intramural brainstorming sessions. Business model was to some extent designed by help of the partner in a joint-venture company.

The first more concrete idea which lead to further analysis was shaped in the beginning of 2003 at the firm's headquarters in Kranj, Slovenia. The needed initial information were gathered by different sources: international conferences and international annual fairs, market intelligence of own marketing department, competitors, public and private sources. International organisations for standardization were of great importance. The crucial was Geneva conference which is considered as "olimpic competition" in the field. In order to gather all information for the idea the team work was essential.

Phase 2 - Development of the concept

In this phase not only the absorption of knowledge but also the creation of knowledge was most important. The first small group of researchers had to absorb as much additional information as possible and based on that create their own concept of the product. Besides R&D knowledge, also a strategic overview was important. Again, internal (existing knowledge base) as well as external knowledge (additional information about technological trends, market…) was crucial. In the concept development phase a combination of explicit[2] and implicit knowledge was required. Acquired and taken into account were explicit information about the trends and developments, while knowledge about how to combine this information into a good product concept is more of implicit nature.

The knowledge interactions between the internal actors in this phase were formal as well as informal through collaboration of management, R&D and marketing staff. Also the relationship with the university researchers was of formal and informal nature. There were two levels of development of the concept. The high, more general level was developed by the team of prof. Bešter, at lower level the whole internal team from R&D department and other departments participated. The main modes of the development of the concept were learning by doing, trial and error. At this stage the co-operation with Intel was also very important. Intel introduced new standard in specific technology platform and was willing to support the development of the concept.

The internal actors which played the main role in this phase consisted mostly of R&D personnel and also a senior management representative. The main "spiritus agens" was the head of R&D department. The motivation of top management was to find a new way to expand the business and increase the firm's market share and profits. Among the external actors, the University researchers were the most important.

[2] Nonaka, I. ,1994. A Dynamic Theory of Organisational Knowledge Creation." Organisation Science 5:14-37

There were no special motivation (incentive) schemes for personnel at this stage. Very important influence on the internal knowledge dynamics has the fact that senior management cooperates very closely with the R&D personnel and is deeply involved in the whole product development process. This distinguishes Iskratel from other similar firms and most likely, this kind of cooperation and synergy is (besides traditional co-operation with two universities) probably the main reason why the firm is able to compete worldwide although having a much smaller R&D department than its main competitors.

The first research project started in spring 2003 in the firm's headquarters in Kranj and partly also at both universities: Ljubljana and Maribor.

The end of this phase can be marked wit the Geneva telecommunication fair in October 2003.

Phase 3 - Development of the prototype

Most directly involved type of functional knowledge in the third phase was the internal R&D knowledge and marketing experience. Since the developed product was not only new to the company but also new to the market the creation of knowledge was very important. However, since merely the internal knowledge was not enough, also the absorption is again important. In order to develop a prototype, the engineers also needed to have the knowledge about application. In order to develop a marketable product which can be produced by the firm, analytic and synthetic knowledge needed to be combined. The knowledge used for the development of the prototype was explicit (knowledge about programming, hardware…) as well as implicit (how to combine this knowledge in order do develop an adequate prototype).

The transfer of the knowledge among internal actors was formal as well as informal. Very important input for the business process was the knowledge that was embedded in the equipment (computers) acquired from Intel. This knowledge was not yet available on the market at that time and was acquired from the supplier based on the concept presentation on the Geneva fair. At this stage there collaborated with domestic R&D partners from both universities.

The prototype was developed by a small group of R&D people in 6 months. Internal R&D actors were motivated by normal salary schemes. In this phase again the University researchers contributed their knowledge with the same motivation as in previous phases. Involved were no other R&D partners except from the domestic universities.

Crucial external actor was also Intel as a supplier of the advanced equipment which was not yet available on the market. Their motivation was the expectation of promising business deal.

IPR was not the motivation reason.

Business model at this stage included close co-operation between R&D and sales department because of the need to master the new telecom networks and the necessity to predict the volume of sales. The main change in the market was the substitution process of old phone exchanges with the new ones.

The development of the prototype started in Kranj in November 2003, after the Geneva fair. The equipment from Intel (Santa Clara, CA, USA) was acquired in the middle of 2003. The prototype was developed by the end of 2004 (December).

Phase 4 - Testing of the prototype

This phase is all about the knowledge connected to the product prototype which was being tested – its characteristics and possibilities for improvement. Testing provides huge amounts of most valuable information about their product and similar products that their competition is developing. Therefore it is very important for the company to be able to absorb all this external information and later also to be able to apply this knowledge in order to improve the product. Analytic knowledge was most crucial in this phase in order to be able to test all different aspects of the product in the Technopark (Moscow). However, to test the pilot product at the first customer, synthetic knowledge was more important. Explicit knowledge was most important in the testing phase - the performed tests and their results can be documented easily. The prototype was tested in a Technopark run by central Russian authority for testing telecommunication equipment (CNIIS), therefore the governance knowledge context was very important. The product had to meet the requirements of the government in order to get access to the Russian market. Also, at the same time, the pilot version of the product was also being tested at the first customer, which put importance on the firm as well as market knowledge context – the firm's developers had to meet the needs of a specific customer and be able to adjust the product to their specific environment.

The tests were carried out in two stages. In the first stage the testing was done by Iskratel engineering team. The second and most important stage for the approval of the prototype was done by Russian experts. The final report was written by Russian experts.

The transfer of knowledge in this case was formal and the relationship was distant.

In this phase, the most important actor was the central Russian testing authority CNIIS whose researchers tested the prototype in the Technopark. Their motivation was to find appropriate high quality telecom equipment and services for the Russian market. Technopark is financed by Russian government. The Iskratel previous sales experiences on Russian market played an important role.

Besides the feedback information about their product, important knowledge was gathered about the competitors' products (Nortel, Alcatel) as well, therefore other firms also contributed significant information, although not directly. They were of course not motivated to share their knowledge to the competitors, this was more of a side-effect. However, they themselves also benefited from that process, on the other hand we could also say that their motivation for participation was to acquire the knowledge about other firms and possibly expand the business to the Russian market. A very important external player was also a Slovenian firm Siol, where the pilot version of the product was tested at the same time. For the test in Siol, also the internal players (R&D) played significant role, since it was them who actually carried out the testing. Since all the tests were mostly about knowledge generation, it was the internal players (R&D, sales department) who were important in both cases, since they were the ones who at the end had to make conclusions based on the test results and make use of the gathered information. Siol as a friendly buyer transferred some of his knowledge in the testing process.

At this phase we found out also the presence of systematic collaboration between different departments inside of the company (R&D, sales, after sales service). This testing played a new role for after sales service department.

The testing in Moscow Technopark was done because of the long lasting presence on Russian market and because this market was considered as strategic orientation.

The testing by Siol was understandable because of good previous co-operation with this company in Slovenia.

The prototype testing was a lengthy process, which lasted the whole year of 2004. At the same time as the tests in Technopark (Moscow, Sankt Petersburg) the pilot version of the product was also being tested at the first customer in Slovenia (Siol, Ljubljana). Indirectly, through the Technopark, by testing its own product, the firm also received knowledge from the testing of the products of other competitors (from France, from Germany, from Sweden).

The knowledge was acquired also from international analytic firms, from internet.

Phase 5 - Development of R&D and production processes

In this phase the knowledge about the organization of R&D and production function was very important. A lot of the processes were established following the lead of most successful companies regarding the quality of processes (e.g. Nokia), therefore the absorption of knowledge was crucial, combined of course also with the skills of knowledge application in order to be able to adjust and implement the solutions. Synthetic knowledge was more important in this phase than analytic, since most of the knowledge derived from own experience and experience of others. There had to be many explicit knowledge components available in order for Iskratel to be able to absorb it easily, while on the other hand, in order to apply this knowledge, also implicit internal components were important. In order to start commercial development and production, besides the internal knowledge also external knowledge about development and production was important which was acquired from partner firms. A very important influence had the firm's internal knowledge context, but also other firms with their successfully implemented processes – the market context. Most important role at this stage played also the governance knowledge context with the development of the standards. At the beginning of this phase there were practically no set standards in this field to follow, and also later, these standards were changing, so it was very important to get information about them and adapt as soon as possible.

The R&D and production processes were developed based on the trial and error method. The internal actors cooperated in a formal and informal way in order to develop the processes. They used existing processes from previous generation of products in adjusting and complementing the products of new generation.

Very important knowledge was acquired also from other firms through distant and informal relations, by absorbing the available information. The external knowledge about R&D and production was acquired with outsourcing (both Slovenian universities, several Slovenian ICT companies like MG Soft, Cosylab, IC technologies, Metal lab, Tehnološki park Ljubljana etc.). Later, based on the experience from the applied R&D and production processes, also the processes were improved to better fit the firms' needs.

Because of the development of new standards, important actors were also the governments of different countries, which are in charge for the enactment of the standards. Most of the information was gathered informally.

Internal and external actors played an important role in this phase. The main motivation is the efficiency of the whole process. There were no special motivation incentives at this phase as the variable part of personal income is linked on the future

sales performance of the product. The R&D and production processes were developed by the firm's employees through formal interactions. The most important players were R&D department, product management, sales, after sales, logistics.

The inspiration for the development of these processes however came from external actors, specially from the connection between Siemens (Iskratel's joint venture partner) and Nokia. However, the relationship with Nokia as the leader in the quality of processes was informal and distant. It was also important to gather information from other leading firms in the wider ICT field (such as Alkatel, Ericsson, Cisco, etc.), since Iskratel had to generate knowledge about the development and use of new technologies in these firms. Namely, the leading firms are the first and the most important indicators which help predict the development of the new standards. At the time, the standards in the field were not developed yet, so it was crucial to gather information about them as quickly as possible. The relationship of Iskratel with these firms was distant and informal. Because of the development of new standards, another important actors were also the governments of different countries, which are in charge for the enactment of the standards. In the execution of the R&D and production, besides the internal actors, also different partner firms played a very important role (MG Soft, Cosylab, Tehnološki park Ljubljana, customer partners from Russia). The exchange of knowledge with domestic partners was formalized. Their motivation was mostly the transfer of knowledge and additional profits. However, specially for the small firms, the cooperation with big partners means also much faster conquer of new markets.

Beacause of limited internal human resources and lack of specific skills it is important collaboration with external R&D and production partners.

The first development of the processes lasted from June 2005 till February 2006. However, the processes still undergo changes based on new acquired knowledge and experiences. Therefore, this phase is not finished yet, as it is an ongoing process. Important information were gathered from all over the world (Nokia - Finland, Alcatel France, Nortel….), indirectly through conferences, publishing articles, contractual co-operation, interoperability testing. However, they were all put together at the firm's headquarters in Kranj.

The delivery of several data bases was prepared in Russia by firm Uraltel.

Phase 6 - Verification and validation

In this phase the clients are the one who are assessing the product, therefore it is crucial for the firm to be able to absorb their feedback and to apply the necessary adjustments. The relevant knowledge is therefore synthetic, not analytic. The

knowledge, given by the client's, can sometimes be more implicit than explicit. In such cases it is important for the company to know how to convert it into explicit knowledge, which can then be used in order to provide solutions. Since this phase is about the clients, the market knowledge context is most important. However, also firm knowledge context is important in order to gather and interpret the client's feedback correctly and make the most use of it.

As already mentioned, the knowledge in this phase flew into the business process from the customers. The relations with them can be proximate or distant, depending on the location of the client, formal and also informal.

Clients as external actors are the most important in this phase. Their motivation is to get a product which will best suit their needs. Besides the clients, the internal actors (sales and marketing personnel) are those mostly motivated for the delivery of the high quality product. Their motivation is to satisfy the customers. This is the only way that leads to the long term profits and directly for higher personal remuneration.

Commitment to the collaboration with company's customers and to the quality of products
were the main reasons for business model which remained the same as in prevous phases.

Again, this is a phase which takes place over and over again with each new customer. The location of course depends on the location of a specific customer (Slovenia, Russia). However, the first validation and verification started in the middle of 2006 in Kranj and lasted several months. After that, the first release was available.

Phase 7 - Implementation, integration

In this phase the knowledge of the product developers in combined with the generated knowledge about the client's specific environment and its requirements. This results in many adjustments of the product. Since the tests performed at this stage are carried out mostly by the firm, the application of their knowledge in the specific environment is most important. Synthetic knowledge is crucial, since this phase is about the implementation and integration. Most of the relevant knowledge is explicit. The firm's knowledge context is most important in this phase. It is the firm's developers and developmental integrators who have the knowledge to perform different tests in the client's specific environment to ensure the proper implementation and integration of the product. The governance knowledge context needs to be taken into account also, since in different countries, different legislation and standardisation present different challenges for the firm.

When implementing and integrating the product the combination of existing development processes from previous generation of products, trial and error, learning-by-doing approaches were used. As they are implementing and integrating the product, the engineers adjust it to the new environment as it goes, and apply new solutions if they encounter some problems. Practically it is the combination of existing development processes from previous generation of productsThe relation between the involved actors is proximate, and formal as well as informal.
The most important here are internal actors – firm's developers in interaction with group for developmental integration, because they are the ones who perform all the necessary tests and ensure proper implementation and integration. They have common motives in order to finish the process because their variable personnel income is conditioned by the financial and marketing success of the product.

A standardised product practically does not exist in this case, since each client's environment and specifications are slightly different. The nature of the product itself therefore demands close cooperation with each client in order to achieve the client's satisfaction and good performance of the product.

The firm implemented and integrated its product at the first customer (customer from Russia) in 2006 (implementation in March 2006, integration in June, 2006, the end of verification of the second version of the product 11th November 2006). This phase however takes place each time a new customer is acquired and lasts for about 8 to 12 months, even though the time needed decreases as the firm gathers more experience, and as it approaches a more or less "standardised" version of the product. The aim is to shorten this phase to 3 months in the next implementations.

The new customers were sought in Kazahstan, Ukraine and Macedonia.

Phase 8 – Modification

To be able to make the modification, the gathered explicit or implicit new knowledge must be applied to the product with the help of the engineers' knowledge. This means that also in this phase synthetic knowledge is the most important. Practically all knowledge contexts play an important role in this phase, since the triggers for modifications derive from many different sources, for example from inside the firm, from the market (competitors, customers…), governance (change of standards), society and culture (new needs, acceptance of new technologies) or science and education (new developments). Therefore, R&D is an ongoing process in the firm and several modifications of the product (new functions) have already been made.

The information for modification is gathered systematically by R&D, sales and after sales department. The information circulates internally (meetings of all involved

departments) in order to give support to the information system according to the product life cycle.

The knowledge for modifications flows into the business process in different ways. The external information is gathered systematically from all the different sources in a similar way as the information for the new ideas. Inside the firm it is than transferred in the formal as well as the informal way.
Internal actors (R&D, technical sales staff and product management) play the most important role here. They are the ones who not only give ideas and use their knowledge for further modifications, but they also generate all different information which point at the need or opportunity for further modifications of the product. This kind of information can derive from customers, competitors, public research system, partner firms, governance actors etc., which shows that besides internal, all different external actors can be very important at this phase as well.

Modification is part of the normal business process and there are not special incentives for internal actors at this phase.

The firm's culture is committed to innovation and technological progress. They practice learning by doing and collect knowledge information from all possible sources. Knowledge management is supported by newly established training center located in company's headquarters in Kranj.
Modifications of the product are also an ongoing process in the firm. Much before even the first version of the product was fully released, the project proposal for the second, improved version of the product was already put in in October 2005. The project proposal for the third version of the product was put in 2007.

Overall summary of knowledge biography

The studied knowledge biography is a very good example of the cooperation between a company and the public research sector in practically all phases. It shows that motivation and effort from both sides can indeed produce mutual benefits and profitable results. Besides the university researchers who participated in practically all phases, also many other actors were directly or indirectly, formally or informally included in the studied knowledge dynamics, which far surpasses regional borders development wise as well as market wise.

Although it is based on the internal knowledge base of more than 30 years, the studied knowledge biography started in 2003. Since the beginning, the senior management with its vast expert knowledge was deeply involved in the development process. The internal R&D team played the main role in it, however, also many external partners were included. Besides the University of Ljubljana and University of

Maribor professors and students and many other Slovenian players (partners and clients), also several Russian actors played a very important role (Uraltel, Technopark, several clients). A turning point in the development of the product presents also the knowledge from the US firm Intel, which was embedded in their equipment provided to Iskratel before it was available on the market. Much process knowledge was acquired from Nokia (Finland). A close relationship with national and international clients was necessary in order to receive crucial feedback information. From the knowledge biography it is obvious, that the firm is capable of anchoring not only proximate, but also distant knowledge.

In all of the phases, the successful combination of internal and external knowledge was a key success factor. For that, besides creation, also the absorption of knowledge is necessary. This means that the internal actors need to be able to recognise important external information, than to transfer and combine it with external knowledge, and finally apply to a profitable idea/product. The external knowledge can also be of implicit nature and therefore needs to be converted into explicit knowledge, before it can be used. The important step was made in 2005 by the appointment of knowledge manager in the company.

The studied knowledge biography presents a successful case of combining knowledge form different kinds of actors and locations, knowledge types, ways of knowledge acquisition, etc. The motivation for the knowledge dynamics derives from the firm's culture, which emphasises constant learning, progress and development. This also means that the studied KD is not finished yet, but is an evolving process that still produces new results.

Gender

In Iskratel the percentage of women among the employees is 25%, which is s lot, considering that this is the ICT sector. Many women are also in the second or third management levels (the percentage is about 10%). The chances for promotion do not differ according to gender, meaning that gender is neither an obstacle nor a reason for promotion (not trying to keep a certain quota of women). Knowledge and motivation are the only criterions for promotion. As usually in the ICT, more women can be found in the support functions, however, there are also 2 women in the R&D and 2 in the support and maintenance group. A specific problem for women is part of the firm's the market, where women in business are not treated equally (e.g. Russia, Ukraine). Due to that, it is more difficult for the women to conduct business in those countries, and they also have no desire to. Some of the markets are however problematic also for men, since they are perceived as foreigners. For women it is even more difficult which is why there practically aren't any, except for one. The gender does not affect the salaries in the firm, but the position does. More then the

gender, the important thing is the compatibility with the firm's culture – team spirit, cooperation, etc. The firm can be considered a family firm, which is reflected also in the amount of children, that the employees have. The fluctuation statistics shows that women stay in the firm longer than men generally do.

2.1.2 FKD 2

Introduction

The second studied FKD is the development of the product Frontman by Spica International (a small, innovative firm, collaborating in Slovenian Process control technology network).

Due to its past, Spica had an extensive knowledge base and experience in the field of automatic identification technology. The company has been active in this field since 1992. Even though the company was successful, they soon realised that their desire is to develop a final product for the end consumer, instead of staying in the segment of technology suppliers for other firms, which then provide system solutions for the end consumers. They recognised their opportunity in developing a product which would focus on tracking the products in their distribution phase.

Frontman is a product which today enables much more than just tracking of the products or collecting orders on field. It can also be used for merchandising, gathering information about competitive products, carrying out surveys, etc. It is connected with the client's business support system (for example Navision or SAP), and transfers all the gathered information straight to it and also receives feedback, which enables also instant decisions on the field. It can also be integrated with many different peripheral devices (such as printers, pay terminals, meters…) in order to best fit the clients specific needs. The product is most suitable for the segment of fast moving consumer goods and specially for field sales. It is very important for the firm, since it enabled the shift of their position from the supplier to the end consumer market, and establish their position there also internationally.

The beginnings of the product date back into the year 2000, when some version of the product was already developed, even though at the time several important technologies which enable important added value were not included yet (such as GSM, GPS…), the operational system was still DOS, the equipment was much more robust, etc. They found the first customers for this product and then in cooperation with them tried to develop an improved solution that would fit their needs in the best possible way.

After that, more and more improved versions of the product were developed as the available technology advanced. Another important breaking point in the development of Frontman was the year 2004, when the operational system was changed from DOS to Windows, which at first resulted in a step back from the DOS solutions that were already well accepted and stable.

In 2005, as a Process control technology network project, Frontman was succesfully integrated with SAP, which is one of the most important business support softwares. The project provided a more standardised solution for food and drink industry and opened many new opportunities.

The company soon transcended the national borders, and in 2007 also part of the Frontman's R&D was transferred to Serbia. The development of the product still continues as new technologies, which can be incorporated into the product and contribute to its added value, are being developed.

In order to facilitate the investigation of the FKD, we identified the following phases of the change process:

1. Opportunity recognition
Based on the existing knowledge base and experiences since 1992 in the field of automatic identification technology the company realised it would be a good idea to try, and switch from the segment of suppliers of technology to the segment of producers of system solutions for the end consumers. The opportunity was recognised in developing a product, which would focus on tracking the products in their distribution phase.

2. Development of the basic product
The beginnings of the product reach into the period 1996. The first versions of the product were developed in 2000 in close cooperation with the first clients. However, due to the technology and hardware available then, the product offered fewer options and lower value added and was not as user-friendly and mobile because of the robust components. Also, the first versions of the product tackled more with specific problems of a certain client and were not as easy applicable to others.

3. Upgrades and modifications
Through the years, the product was constantly evolving. The available hardware was getting more and more mobile, and possibilities to integrate new technologies into the product offered new opportunities. The operating system was changed from DOS to Windows, gsm and gps technologies were used, Frontman was connected to different peripheral devices to suit specific client's needs… As a result of a network project, in 2005 Frontman was integrated to SAP, which is which is one of the most

important business support softwares. Although flexible, the product is at the same time getting more and more standardised, which enables easier and quicker applications to a specific client's business environment.

4. Knowledge for future developments
Since the product is very flexible and allows integration with many different (existing and forthcoming) technologies, it is very important that the company keeps track of the developments and tries to foresee future trends. This way, it can offer more value to the consumers and stay one step in front of the competition. Since the product depends on the changing characteristics of the distribution it is also crucial to keep track of the market changes. Due to the diminished role of mere distribution (which is getting more and more automatised, except in southern European countries), the firm seeks opportunities to adapt the product towards providing more value for merchandising and CRM. In order to gather as much relevant knowledge as possible, the firm constantly trains its personnel and puts its efforts into the organisation (e.g. competency centres in different countries for different products) and stimulation of the knowledge dynamics (formal and informal).

Phase 1 – Opportunity recognition

The most important among directly involved functional knowledge types was R&D and also strategic knowledge. In order to recognize the opportunity for the desired shift to the end-consumer market, the company had to systematically absorb knowledge from the external environment by monitoring technological and economical trends, competition and the market. However, it was of course also important for the company to be able to apply the absorbed knowledge to their internal environment in order to come up with a profitable idea. At the same time, they had to know the capability and limitations of the company to follow the recognized opportunity. Most of the externally acquired relevant knowledge in this phase was explicit – knowledge about technological developments, activities of competitors, market needs… However, the internal knowledge about how to put this information together in order to come up with a potentially profitable idea, is more implicit. Besides the firm and market knowledge contexts, the culture knowledge context played an important role for the opportunity recognition phase, since the culture significantly influences the acceptance of field sales and negotiations with the distributors which can be well supported by Frontman. Slovenia has the position between Western Europe, where the delivery process is more automatised, and Southern Europe, where negotiations are still common.

Most of the relevant knowledge in this phase already existed in the firm's knowledge base, since the opportunity recognition came out of combining and upgrading the existing knowledge. The necessary new knowledge for the upgrades flew into the

process with the recruitment of young experts who just finished education and have many fresh ideas, and with monitoring the market. Additionally, new knowledge was obtained through distant flows (fairs and exhibitions) and through principal Symbol, which was later bought by Motorola.
Špica's special organisational model (division T&S- time and space and division AIDC - automatic identification of data collection) alleviated a certain degree of emancipation from the dependancy from the principal partner. The business operations were based on project management.

In this phase, the key player was the managing director who was motivated by the strategic decision to expand the business operations and shift to the end-consumer market, and by that acquire greater recognition and stronger ties with important customers and increase the profit. Important players were also newly recruited young experts with fresh ideas and the whole R&D and sales force. Besides that, also external actors (competitors, existent and potential clients, partners, suppliers), were important, since the firm acquired important information from them, even though they were only passively included in the knowledge dynamics.

The relevant knowledge base which lead to the recognition of opportunity was shaped throughout the firm's 20 years history with the experience gained in the field of identification technology - R&D knowledge as well as knowledge about the market. After recognizing the need to shift to the end-consumer market in the year 2000 additional information about this option was acquired and accumulated in the firm.

Phase 2 - Development of the basic product

Besides the knowledge about the technology, which was already possessed by the firm's human resources, most important in this phase was the absorption of information from the customers about their needs and desires. Also, the knowledge for the application of this information into the first attempts of the development of the product was crucial. The technical knowledge was explicit, however, knowledge about the customers' needs was often also implicit. Since the customers did not know the technology, they could not fully realise how it could best fit their needs. Therefore, the firm needed to acquire as many information about the customers as possible, and have the ability to transform their implicit knowledge into explicit knowledge.

The firm realised the importance of the customers very early and started the R&D process in connection with them. The first potential clients were acquired and a very close relationship with them was developed with the aim to develop a product that would best fit their specific needs. Much effort was put into acquiring as much information from the customers as possible and to interpret it correctly. For this

purpose, special workshops with the potential clients were organised. The technical knowledge base in the firm is constantly upgraded by training and also recruiting. Networking with universities is very helpful for ensuring early access to young experts who best fit the needs of the firm. The transfer of knowledge inside the firm is easier, since the sales personnel also has technical education and acquire business knowledge by training and learning-by-doing. Formally, the internal knowledge is transferred mostly through a specially developed intranet system. Between the firms in the group the Sharepoint services technology is used for knowledge sharing. Besides that, also regular meetings are held due to the importance of personal relationships.

Besides the management, which was motivated by the expansion of the business and the R&D personnel, the key players were the potential clients, first of them being Ljubljanske mlekarne, followed by Perutnina Ptuj, Žito, Mercator Emba, Ledo Zagreb, etc. All these clients operate in the field of fast moving consumer goods, which presents the key target market for the product. The clients were motivated for the cooperation since they expected a product which would best fit their needs and solve their specific problems, which would reflect in a competitive advantage and subsequently in an improvement of business results. In the firm, a special consultant was delegated the role of being in charge for the communication with the clients. The suppliers of HW had a minor role.

The Ljubljana University (Faculty for computer sciences and informatics and Faculty for electro engineering) was also an important player, since it not only provided expert knowledge from professors (who are motivated by the practical use of their knowledge), but also fresh ideas from the students, who are motivated by the possibility for the employment.

Most of the second phase took place at the firm's headquarters in Ljubljana, in the year 2000 (from March until – November). The first clients were also located in Slovenia (Ljubljana, Ptuj). One of the first clients was also a Croatian firm Ledo, located in Zagreb. Special workshops were organised , firstly at Špica's headquarters and later by clients (Perutnina, Žito, Mercator, Ledo.

Suppliers played a role in knowledge transfer according to the rule that good software sells hardware.

Phase 3 - Upgrades and modifications

In this phase, different functional types of knowledge were important, above all knowledge about R&D and the product, knowledge about the customers (their needs and desires), about the suppliers (new available hardware). The technical knowledge

was explicit, however, knowledge about the customers' needs was again partially also implicit, since they did not fully realise the possibilities offered by this technology. Again, the firm had to convert this knowledge into explicit knowledge. The absorption of external knowledge (from clients, suppliers) as well as the application of this knowledge onto the product was needed.

The supplier partner Symbol should be exposed, since it provided Spica with a lot of different knowledge. Through Symbol Spica gained access to know-how (specifications, needs…) about many Symbol's multinational clients (e.g. Coca-Cola, Kraft…), and tried to use this information to modify the product concept accordingly, and then approach with an improved offer the local branches of these firms. The close relationship with Symbol also enabled Spica access to hardware before it was available on the market, which means that Spica's developers could adjust the product very quickly. Technical software knowledge is easy accessible and was upgraded on different trainings, offered by the software providers. Due to its vast experience with big clients, Symbol is however very important to the firm also as a provider of business knowledge, which is otherwise much less accessible to the firm. In this phase should be acknowledged a good co-operation with neighbouring company SNT in making important interfaces.

Among the knowledge contexts, the firm and market knowledge contexts were the most important. In order to upgrade and provide different modifications of the product, besides technical knowledge also the knowledge about networking was very important, since it enabled the firm to find the right partners with the knowledge that they themselves were missing.

Most of the technical knowledge for the upgrades and modifications of the basic product was already possessed by the firm and acquired by recruiting experts in the field and also regularly upgrading their knowledge with training. The transfer of knowledge inside the firm is easier, since the sales personnel also has technical education and acquire business knowledge by training and learning-by-doing. Again, the internal transfer was formal (intranet, meetings) as well as informal. A lot of technical knowledge was however also externally acquired by outsourcing and networking. Most of the activities were outsourced due to the great extent of work, not the lack of knowledge. Due to personal relationships and trust, this transfer of knowledge did not need to be arranged in a very formal manner. However, some activities were outsourced also due to the specific knowledge of the partners that the firm did not possess. As already mentioned, a lot of information had to be acquired from the customers as well, which was possible only by maintaining a very close relationship with them, gather their feedback and transfer this information inside the firm. Symbol provided Spica with a lot of different knowledge through its training courses, internet training and documents available on intranet partner sites. A lot of

very important information was however transferred also informally and in person. On the other hand, the firm also spreads its knowledge not only to its partners, but also wider. The sales personnel spreads the knowledge by writing articles and speaking on conferences and other events.

The important step forward in this phase was the approval of applied project co-financed by European structural funds and organised within Slovenian technology network “Process control technologies”.

The knowledge dynamics among Spica and all her different partners was influenced mostly by the trust among them, which was based on personal and long-term relationships.

In this phase all key players were involved (R&D, salesmen and top management). In order to motivate the whole staff special incentive schemes were introduced. For instance, for R&D staff besides usual quantitative criteria also qualitative critera were introduced (time to market, quality of the product). Finally, also buyers and salesmen evaluated the quality of R&D department.

Internal as well as external players were important in this phase. Inside the firm, practically everybody played an important role in the knowledge dynamics – from the management, who took the strategic decisions, to the development team, who possessed the crucial technical knowledge, to the deployment&support and sales teams, who provided them with feedback information from the market. Among the external players, again the clients were important. Their motivation was again to get to know new technology and learn how to make the best use of it by acquiring a superior product who would solve their problems better, and therefore increase their competitive advantages. In this phase, besides them, also different partners played a very important role. Some of the smaller partner/competitor firms (Europlus, Miga) were motivated by the agreement to share the excessive work on bigger projects and of course also by the extra earnings. Their motivation was to expand their business and also acquire new knowledge. The integration of the product with the SAP business support software, which was a very important step for the firm, was achieved with the cooperation on a Process control technology network project on which also a client – Ljubljanske mlekarne, development partner – S&T were involved. The main motivation for different partners to be involved in the network is the knowledge dynamics and the possibilities for the business expansion. The cooperation with S&T was important not only in the sense of providing technical knowledge, but also enabled Spica access to their clients outside Slovenia. Of special importance was also the knowledge dynamics between Spica and its hardware supplier Symbol, who was motivated by the long-term and close business relationship, and their awareness that software is the thing that sells the hardware.

Software providers, such as Microsoft or Oracle, constantly offer trainings to their clients. The R&D personnel was crucial for transferring the technical knowledge to their partners, whale the sales personnel was most active at transferring the knowledge to the public. Their motivation was to establish their position as experts for the specific fields of knowledge and subsequently also gain more trust of the potential clients.

Frontman had many modifications. First of them dates in 2002. Later in 2005 Symbol realized that there is no need for further co-operation with Špica, when a more mobile hardware was available on the market.

Despite the ambitions to penetrate West European market the main focus was on eastern markets were the tradition of mobile, “face to face” selling is very actual: Middle East, Russia, Turkey, Romania, Mediterranean countries and the countries of former Yugoslavia. In this phase it had to be admitted the exploitation of broad SW knowledge obtained from Microsoft and Oracle.

Again, it should be stressed the avoiding of IPR due to the fast development of products and relatively expensive and long lasting procedures for the protection and maintenance of patents.

In one parallel project they patented innovation together with the Institute Jožef Stefan.

Phase 4 - Knowledge for future developments

The firm has to constantly upgrade its knowledge in order to be prepared and able to quickly adapt to changes in the future and stay competitive. For that purpose it has to monitor the external environment systematically (market trends, technological developments…), absorb information from many different sources (clients, suppliers, competitors, science…) and transfer the gathered knowledge successfully among its employees and partners. This is important for all types of functional knowledge – product, marketing, suppliers, business model, strategic overview and direction… Besides the absorption of information, the firm also has to upgrade their knowledge in order to be able to apply all this information to the product/business process. In this phase a combination of explicit and implicit knowledge is required. While information about the trends and developments are mostly explicit, the knowledge about how to combine this information into a profitable idea is more of implicit nature. Practically all knowledge contexts need to be taken into account in this phase in order to capture as many relevant information as possible – firm knowledge context (awareness of the firm’s knowledge base and capacities), market knowledge context (suppliers, competition, clients…), network knowledge context (the existing and

potential network partners), society and culture (the acceptance of field sales and negotiations is different among different cultures and is changing through time)…
The necessary knowledge comes from all the different external sources. Technical knowledge mostly by recruiting (importance of maintaining close relationship with the University) and training, which then enables also a better absorption of relevant information from passive sources such as competition, science publications, etc. Important knowledge flows into the business process also from the clients – the firm keeps track of their changing needs, and potential competitors – about the available hardware and technologies that can be integrated into the product.

The knowledge dynamics among Spica and all her different partners was influenced mostly by the trust among them, which was based on personal and long-term relationships. The transfer of knowledge in this phase is most influenced by the commitment of the firm to the constant development.

The key player in this phase is the management, who is oriented towards constant progress and development and motivated by the expansion of the business, increase of market share and profits. Besides the management, also all the R&D and sales personnel is important, since they are the ones who monitor the external environment, absorb and transfer information.

The knowledge for possible modifications has been gathered constantly, since the beginning of the product development in 2000. The knowledge is being accumulated in the firm's headquarters in Ljubljana, to where it flows from different sources all over the world (for example Serbia and USA). However, in 2007, part of the Frontman R&D was transferred to the subsidiary in Belgrade, Serbia.

Overall summary of knowledge biography

The beginnings of the second studied knowledge biography date into the year 1992. The studied case is not only about the development of a new product, but also about the shift from the technology suppliers for other firms to the end consumer market. The decision for such a change was based on the internal strategic knowledge and also external information acquired with monitoring of the technological and economic environment.

For the development of the product, besides the technological knowledge, which was already possessed by the firm's human resources, the most important was the absorption of information from the clients about their needs and desires, for which a very close relationship with them was needed. Some of this information was implicit and therefore it had to be transformed into explicit in order to be used. The technical

knowledge base in the firm is constantly upgraded by training and also by recruiting of young experts, for which the cooperation with the university is very helpful.

Besides the University and clients, the close relationship with the supplier/partner Symbol needs to be emphasized. Symbol provided Spica with a lot of different knowledge, most importantly with know-how about its multinational clients and early access to the hardware. Pretty particular is also the relationship of Spica with some of its competitors, which in fact became partners. Their relationship is based mostly on trust and is about sharing the excessive work when one of them is lacking time or capacities.

Due to the nature of the product, the culture knowledge context had to be taken into account when thinking about upgrades and new markets for the product. A very important breaking point for the product was the integration with one of the most important business support systems – SAP. This integration was a result of a cooperation of different actors within the network project.

Also the second selected knowledge biography can serve as an example of good knowledge dynamics compared to an average firm in the ICT sector in region. It presents a case of good cooperation with many different actors, including the public research sector. The knowledge dynamics also transcends regional borders and shows that the firm is capable of knowledge anchoring. An important part of Frontman's R&D was transferred to Serbia in 2007. The idea is to establish partner regional competency centres according to the specialised knowledge available in different regions.

Gender

Also this case study reveals a clear imbalance between male and female employees. In the whole firm's history, there were only two women in the R&D. Besides the known problem of the lack of qualified women in the ICT sector in general, the problem is also the very stressful and demanding working environment in a small innovative firm like Spica. Most of the employed women in Spica can be found in the support services (2 in sales, 1 in accounting, 1 in secretariat, 1 in support).

However, the presence of women in the firm is perceived as an advantage by the firm's top management. It has been recognised that women think different than men do, and therefore act very good in meetings, brainstorming sessions, etc. For the similar reasons, the firm also puts effort into employing people with different nationalities to ensure a creative mixture of employees.

2.1.3 FKD 3

Introduction

In the last selected case we study the product BeeSmart, developed by the firm Smart Com. This firm was of interest to us, since it is one of the more successful and innovative firms in the Slovenian ICT sector. It is a medium sized firm and a member of the ICT network, which gives the possibility to detect possible size-specific characteristics of the inclusion of the firm in a network and the KD inside the network. The main benefit of being the member of ICT network is that they are informed about the current trends in Slovenian ICT and that they share the knowledge base with other members of the network (universities, firms, research institutes).

The studied product BeeSmart, is a complete, interactive middleware solution for IPTV systems. It is of central importance for the company, since it is the product with most potential on the international markets and can also open opportunities there for other products and services. BeeSmart is the central connecting component of IPTV ecosystem. It features an end-user interface and a system-administrator interface, and offers core services, live TV services, video on demand, customisation services, billing subsystem integration, hotel services, caller ID on TV, nPVR and gaming. The product is consistent with the latest ICT sector trends and acceptance of IPTV technology in the developed countries. BeeSmart is based on open systems which give freedom and flexibility for further growth. Moreover, it also offers an upgrade into a smart home Iris, which addresses the problematic of the elderly, ill and the disabled.

By the end of 2005, the IPTV technology and its acceptance on the market has matured enough. Therefore, based on the firm's knowledge base and monitoring of the environment, the idea for the product BeeSmart was born and analysed. In the end of 2006, the development of the product started and was soon followed by the beginning of the development of the smart home Iris. BeeSmart was developed mostly by the firm's internal actors by combining, upgrading, and integrating their knowledge. External actors (customers, competitors, science…) were important mostly as a source of information for absorption. Some external actors were also directly involved in the process of development. Mostly, this was due to the extent of work not the lack of knowledge. However, some external actors were included also because of their specific knowledge and therefore the knowledge dynamics with them was more intense.

1. Idea phase

The idea for the product was a result of the firm's IP technology knowledge base and monitoring of the technology and market development. The rough idea for the

product existed since 2003, but only by the end of 2005 the technology and market matured enough for the firm to seize its opportunity. Therefore, in the beginning of 2006 a more concrete idea was formed and analysed. While the first idea was to buy the necessary technology, the later decision was to develop it.

2. Development of the product
In the first half of May 2006, the development of the product started. The firm developed their own software and then applied it on the hardware, which was purchased from the suppliers (March 2006). The development of the BeeSmart software was soon followed by the development of its upgrade - the smart home Iris (November 2006).

3. Marketing
As soon as the first demo version of the product (or some product modification) is developed, it is tested with the custumers in order to get their feedback. Due to the product's characteristics, the cooperation with the customers is a necessity because of the product integration as well as support. Constant contact with the clients enables the firm to gather much feedback information and to improve the product. Besides the home market, the firm has also been trying to penetrate different foreign markets (Hungary 2007) for what it had to acquire a lot of new knowledge, also with the help of hired external agents. Since 2006 effort has been put into protecting the BeeSmart trademark, but the process has not been finished yet up to this date due to the legal problems.

4. Modifications and upgrades
The fact that the firm decided to develop their own platform instead of buying it, allows many modifications and upgrades of the product. Since the product is designed to be able to integrate all different kinds of technologies, there are practically countless possibilities for upgrades and modifications. The only guide here is the added value for the clients. There is however one modification that should be pointed out, and this is the smart home Iris, which was developed in cooperation with the Faculty for Electrotechnics in Ljubljana and The Ljubljana Institute for rehabilitation.

Phase 1 – Idea phase

The most important functional knowledge type in this phase was R&D and also strategic knowledge. The idea derived from the firm's existing knowledge base in the field of IP telephony and the absorption of knowledge from the environment. The firm monitored the development of the internet technology and its acceptance on the market. While paying attention to the market and cultural knowledge context it became apparent, that consumers are not interested in the specific products/services

anymore, but demand complete, integrated solutions. The firm started gathering internal information about the topic as well as educating their employees (product managers gather knowledge about the market on specialised conferences; when the idea is more shaped the R&D group receives additional technical training, self-education from books or internet communities, etc.). The firm's internal knowledge competences and the market had to be analysed. While the first idea was to buy the necessary technology, later the strategic decision was to develop it.

The knowledge, necessary for the first phase, flew into the business process from different sources. Very important was the monitoring of the environment. Additional technical knowledge was acquired mostly by training – specialised training courses, training courses with the graduate students, books, internet communities, etc. Besides that, the knowledge about the market and competition was acquired on conferences. Important was also good internal formal and informal transfer of knowledge. The testing was conducted with Hungarian alternative mobile phone operator Invitel.
The greatest influence on the knowledge dynamics in the firm has the firm's culture which is prone to learning, innovation and change. These are also the characteristics of the firm's human resources, who are curious by nature and have a desire to learn whenever they come across new developments in their field. Everybody has a chance to participate with their suggestions and ideas, which keeps them motivated.

While everybody in the firm is encouraged to participate with ideas and suggestions, the first idea for BeeSmart was shaped by a group of 3-4 people from R&D and marketing. By monitoring the environment they noted the emergence of certain needs that the clients were not able to express yet by themselves. This triggered the thinking about what the firm could do to answer those needs. Every participant offered his own insight (market point of view, technical point of view) on the idea in order to shape a more concrete idea that can be evaluated in the standard process of idea evaluation in the firm. In this process different profiles (product managers, function managers, technical solution leaders, marketing, etc.) are included in order to examine the idea from different angles.

The very first rough idea about the new product appeared already in 2003. However, the firm and the environment were not ready yet. Therefore, from 2003 on, the worldwide monitoring of the market and technology development in this field started. In the first quarter in 2006, the circumstances matured enough for the development of a more concrete idea, the decision was made to start with own development of the product. In this year they participated at IPTV World forum in London, at different fairs and exhibitons. The training of staff was organised with JAVA, HP, Oracle. In 2006 they received a certain knowledge from the supplier Tamberg (Sweden). The concrete concept was evaluated in the middle of 2006.

Phase 2 - Development of the product

For the development of the product, the most important was the internal R&D knowledge base, which was upgraded by additional technical training. Much information was also absorbed from the environment (about the market, competition, technology…), and applied to the product and processes. During different development stages the client's feedback was acquired and taken into account. Besides the explicit technical knowledge, the implicit capability for combining and integrating different knowledge into the product was crucial. Also important was the external technical knowledge, since some of the tasks were allocated to subcontractors due to the extent of work or their specialised knowledge. Besides the firm, also the market knowledge context was important.

The development of smart home Iris was based on Smart Com's idea, but R&D knowledge was contributed by different partners. Most important were Faculty for Electrotehnics in Ljubljana, which contributed specialised R&D knowledge and Institute for rehabilitation, which contributed mostly knowledge about the end-users and their needs.

The internal transfer of the knowledge was very good, which can be attributed to the combination of formal and informal transfer. Besides the project meetings, a special project office was designed with the intention of ensuring the best possible knowledge transfer.

The required additional technical knowledge was acquired by subcontracting or outsourcing - the knowledge dynamics depended on the type of cooperation and the level of involvement. The subcontractors were included in the group and participated in their meetings – the knowledge was transferred in both directions. A lot of necessary knowledge was incorporated into the hardware, which was bought from the suppliers. However, since the firm did not want to be too dependent on one supplier (which is their competitive advantage), they did not want to attach too much. Still, the R&D group received a lot of knowledge about the use, configuration of the hardware, etc. In order to acquire as much relevant information from the clients as possible, first a demo version of the product was developed and demonstrated to the clients. This made it much easier for the clients to imagine what the product is about and give their opinions, suggestions and critiques.

Among the internal actors the group of developers in R&D department was the most important in this phase, but also marketing people. The company signed long term contracts with the suppliers of IPTV systems.

The suppliers - subcontractorswere also an important source of knowledge (Motorola, HP, Oracle, Verimatrix,..). They were motivated mostly by the increase of business. Very important was the close relationship with the clients, i.e. alternative telecom operators in Slovenia and Hungary (Siol, Invitel) which enabled the firm good acquaintance with their needs.

For the development of Iris modification, the Faculty of Electrotechnics (professors, assistants and students) and Institute for rehabilitation were of great importance. The new potential clients are system integrators in Slovenia (SRC d. d.) and abroad.

The development of the product took place in Ljubljana since 2006 and is continuing by adding new functionalities to the product until now at the firm's headquarters in Ljubljana, which was the central location in the FKD. The training of the staff took place in Ljubljana (2006,2007)

The development of the first phase of IRIS project started in August 2007 and finished in February 2008. The second phase started in November 2007 and finished in April 2008.

Phase 3 – Marketing

The most important functional knowledge types in this phase were knowledge about the market, the product and also IPR knowledge. The firm absorbed many information about the possible customers already in the previous phases, and therefore knew their needs pretty good. Even bigger knowledge dynamics with the customers was necessary when the firm tried to sell their products, which often demanded revelation of many detailed technical data to the customers, besides the basic data about the use of the product. After the application, the customers also test the product from their point of view, and the firm receives the feedback information, which enables them to apply it to the product in order to improve it to better fit the specific client's needs. When Smart Com integrates the product to the customer's environment, also an important internal KD takes place – their technical support personnel monitors this process in order to acquire knowledge about the system and its maintenance. Besides that, depending on the client's desires, they educate them not only about the use, but also about the administration and maintenance of the system. Smart Com also offers its clients knowledge that they can use in order to be better prepared for the negotiations with the content providers (mostly security issues), and information relevant to the end users. The firm is also still trying to protect the trademark BeeSmart, for what it needs knowledge about the IPR. The knowledge, transferred from the customers is not always explicit, therefore the firm needs to be able to transfer the implicit knowledge into the explicit.

The transfer of knowledge with the clients was formal as well as informal. Some of the basic information for their clients and the end-consumers could be put in brochures and user's guides. For more detailed technical knowledge, theoretical and practical training of the clients was necessary. The knowledge about the product was transferred on support and sales personnel on regular workshops. Besides that, the firm's support personnel was educated by the development group and also on spot by observing the integration. The knowledge necessary for the penetration to foreign markets as acquired by studying the market analyses, sending the sales personnel to the foreign markets (or even establishing branch offices there) in order to gather information about them and to present the product and make contacts on fairs (learning by doing method). However, to ease and speed up the entrance to the foreign markets, the firm first decided to hire some agents, which already have many contacts with the potential customers and know the market (outsourcing). At the same time, the above mentioned channels are used also for the transfer of knowledge about the firm and the product in the opposite direction.

The transfer of knowledge to and from the foreign markets was stimulated by the firm's goal to substantially increase their exports in 2008 (from 4% to 33%).

Marketing and engineering personnel are in constant contacts with the clients (domestic Siol, national telecom operators in BiH andd Hungary, hotel chains in Slovenia and Austria) and collects their suggestions, critiques, etc. Besides them, practically all the employees monitor the market and trends and transfer relevant information to others. Very important for the transfer of knowledge from and to the foreign markets were the hired professional agents (authorised salesmen, system integrators).

The R&D team integrates the product with the client's environment and the support team administrates and maintains it. Smart Com's R&D team also trained the client's technical personnel about the system's maintainance in Slovenia, Bulgaria and in Hungary. The training (lasting few days) started in 2007 and continued in 2008. The training was conducted also in Russia and lasted few days.

Each client is entitled to a couple days of training according to the contract. Based on the request, a client can receive also more training. The training is conducted at company's headquarters and occasionally by the client.

Phase 4 - Modifications and upgrades

For the modifications and upgrades, knowledge about the product, the market and also strategic knowledge is important. Due to the firm's decision to develop its own platform, the explicit knowledge base about the product is extensive, which allows

many options for modifications and upgrades. A lot of the relevant knowledge, absorbed from the environment (clients, competition…) is however implicit, so in order to apply this absorbed information to a business decision, the firm has to be able to convert it into explicit information first. Among the knowledge contexts, the firm and the market knowledge contexts are the most important.

For the Smart home Iris project, the firm needed specialised technical knowledge in order to include different functions into their platform and also knowledge about the potential clients' needs.

The knowledge flew into the business process by systematic observation of the environment by all employees and good knowledge transfer among them. Very important here are also close relationships with the clients. The cooperation with Faculty for electrotechnics was based on a long term relationship and trust. Their supplied knowledge was included into the product as a separate part, and so was the knowledge acquired from other partners, who's technical knowledge was needed for the smart home Iris.

As already described in the idea phase, the most important motivation factor is again the firm's culture and the personal characteristics of its employees (e.g. curiosity, creativity, innovativeness...). The firm's business model corresponds its culture and therefore enables easy communication and transfer of knowledge and ideas between all employees and the management.

All employees are on constant watch for new knowledge and ideas. Besides that, it is also the official duty of the product managers and technical solutions' leaders to monitor the developments and provide ideas for improvements.

Overall summary of knowledge biography

The third selected case is also a product developed by one of the most successful and innovative firms in the Slovenian ICT sector and also a member of the ICT network. The knowledge biography dates back in 2003 and is still not finished to this date, since the learning and product improvements and modifications are an ongoing process.

While paying attention to the market and cultural knowledge context, a team of employees realised, that consumers are not interested in the specific products/services anymore, but demand complete, integrated solutions. Most of the basic product BeeSmart was developed based on the internal knowledge base, which is being constantly upgraded. The culture of the firm promotes learning and innovation and its employees are very motivated by their own interest and curiosity to

acquire new knowledge and participate with their own ideas for new product or improvements. Also the transfer of knowledge within the firm is very good. The monitoring of the environment for new developments enables the awareness and anchoring of relevant knowledge from worldwide locations. To anchor that knowledge, it is also necessary for the employees to be very mobile and participate in conferences and trainings wherever a specific (technical or business) knowledge is available, regardless the distance. Many of the technical knowledge is provided also by the international suppliers.

The partners, included in the development process are however located mostly within the same region. Their cooperation is usually based on acquaintance and trust. In the development of the Iris modification, the Institute for rehabilitation and the Faculty of eletrotechnics, Ljubljana were included. The firm has been cooperating with the Faculty on many different levels for long years and the knowledge is transferred in both ways.

The BeeSmart platform has the capability to integrate all different kinds of technologies, which means that there are practically countless possibilities for upgrades and modifications. The only guide here is the added value for the clients, therefore besides the R&D knowledge, the knowledge dynamics with the clients is most important. Since the product soon outgrew the regional market, so did the transfer of knowledge with the clients.

Gender

Women account for 20% of the firm's employees and can mostly be found in the support functions such as sales, marketing, accounting. However, there are also some women employed in the positions which require technical knowledge. The work is organised so that it does not present a problem for women. Also the informal activities, which are very important for the internal knowledge transfer, are appropriate for example also for women with small children, since they include lunch, coffee at work, recreation or family picnics. Women can be found also among the high level management. The management is very satisfied with the women employees. The problem is that there are not many skilled women in the labour market.

2.1.4 FINDINGS AND CONCLUSIONS FROM TKD 1 FKDs

In all FKDs all three knowledge phases are present, even though their importance and lasting differs, depending on the specific case. A lot of time and effort was put into exploration phase in all cases. All three studied companies systematically monitor the environment – technological and market trends, in order to come up with

ideas for innovations as early as possible. Analytical (e.g. development of technology) and synthetic knowledge (e.g. market research) was important in this phase, while symbolic knowledge was not paid much attention to in any of the cases.

Examination phase stands out in the SI3000 case, where this phase was indeed very exhaustive. Special tests, which took a whole year, were carried out by scientists in a Russian technopark (analytical knowledge), and the results were compared with the results of competitors. At the same time, the product was also being tested at the first client (synthetic knowledge). While the other two cases did not include scientific testing, the testing at the clients was equally important. For that, the synthetic knowledge of the firms' development teams as well as the clients synthetic knowledge were needed. Again, symbolic knowledge was not that important, although it did play a minor role in the communication with the clients (the presentation material, the personnel in contact with the client, etc.).

Since the purpose of innovating is profit, the exploitation phase is of course crucial for every commercial product, and the same goes for the studied cases. In the exploitation phase, only for the BeeSmart product the effort has been put into the protection of the brand name (symbolic knowledge). While in all of the cases symbolic knowledge type comes to use in presentations to dealers or clients, PR, etc., this is not perceived as the knowledge type of central importance. Since the studied products are of very technical nature, also in this phase synthetic knowledge and the commercialisation of the products plays the key role.

It is important to emphasise, that the described phases however do not always follow one another, but often overlap and evolve in loops. In all of the studied cases, the exploitation phase does not present the last phase. Since all of the studied products have can be adjusted to best fit specific (or newly emerged) needs of the clients, and to integrate with new technologies, the exploration phase is practically an ongoing phase. Every new idea, which derives from the exploration phase, is followed by the examination phase, and then again the exploitation. All the studied firms constantly try to improve their knowledge and subsequently also their products, therefore these knowledge phases form a loop in which they evolve until the firm decides to withdraw the product from the market.

Central to all of the studied cases is the technical knowledge, which is reflected in the so called "hard innovations". This kind of knowledge is usually codified. The programming knowledge for example, which is important in all of the cases, is (or can be) codified already by definition: Therefore the R&D teams in the studied cases could transmit this kind of knowledge pretty easily to their dislocated units or partners which possessed enough relevant knowledge to absorb it.

Even though quantitatively speaking only a minority of the knowledge in all three studied FKDs was tacit[3], this knowledge still crucial for the success. The relevant tacit knowledge in the studied FKDs could be divided in two groups. On one hand, there is the tacit knowledge that is embodied in the firms' employees. This is for example the knowledge about how to how to think outside the box, and how to combine different information into innovative and profitable solutions. Since this kind of knowledge is difficult to transfer, the firms try to attract people, who already possess these qualities and keep them motivated by the firms' innovative culture. On the other hand, there is also tacit knowledge that the customers possess. While the customers of course know their business very well, they can often not express their problems and needs in a certain business area or go and actively search for a solution, since they are not always aware that a certain product can help them solve some of their problems or make certain things easier. This is specially important for the ICT sector, since the potential customers are usually not aware of the existence of certain technology or do not know it enough to realise how it could serve their needs. This is why it is very important that the studied firms establish close relations with the customers, so that they achieve the proximity that is needed, in order for that tacit knowledge to be transferred to them. They can observe the customers and ask questions in order to be able to convert the customers' tacit knowledge into codified knowledge and transfer it inside the firm in order to provide the customers with a solution that would best fit their needs.

[3] Polanyi, M., 1966. The Tacit Dimension. Gloucester, MA, Peter Smith.

SECTION 3 - CONCLUSIONS AND COMPARISONS

3.1. Conclusions about micro-level knowledge dynamics – who, what, where, why

In all of the studied FKDs, internal as well as external actors are very important, Since the studied changes are all of very technical nature ("hard" innovations), the internal R&D teams and also external partners, who provided R&D knowledge were crucial. Among those partners, the cooperation with the University needs to be exposed. While in general this cooperation is pretty bad or practically non existent, these cases prove that if both sides are interested and motivated, it can turn into a great synergy and excellent results. Since all of the studied firms are innovative, they constantly search for new opportunities, which means that they systematically monitor the external environment and try to acquire as many information as possible from the competition, potential customers and suppliers. Of course, in all of the firms the management is also of crucial importance. The management not only makes all the strategic decisions, but establishes the innovative culture in the firm, enables good transfer of knowledge and keeps the employees motivated.

Besides the internal and external technical knowledge, knowledge about the customers was crucial in all of the cases. All studied products can be adapted to a client's specific needs, therefore it is very important for the firm to get to know those needs, since they can sometimes not be expressed by the clients themselves (they are tacit). Good business knowledge and combinatorial knowledge are also necessary. The firm has to know how and when to make the right decisions, where to find the necessary knowledge (absorption), how to combine it into a potentially profitable idea, and how to commercialise the product in order to get maximum return (application).

None of the selected FKDs are limited within the regional borders. Of course, within those borders the firm has better connections and awareness of the existing knowledge. Therefore, much of the external knowledge comes from within the region. However, all of the firms search for knowledge sources also outside the region and absorb it from very distant locations, when necessary (in our cases from the EU, Russia and USA).

The good KD in the studied firms is triggered by the firm's vision, which is reflected also in the firm's culture. All studied firms are committed to constant improvements and innovation. All the processes and the internal organisation are shaped so that they support that as much as possible. Much effort is put into upgrades and good internal transfer of knowledge. All employees are expected to participate in the FKD

with improving and sharing their own knowledge, and also with their ideas. The firms try to find the employees who are compatible with the firm's culture, and at the same time, experts which are eager to learn and innovative, are drawn by these kind of firms. This means, that most of these firms' employees do not need to be specially motivated to explore and learn, since this is already part of their personality.

3.2 Conclusions in relation to the WP5 main parameters – generation/use, mobility/anchoring, distance/proximity

The conclusions that can be drawn based on the studied FKDs, do in many views not overlap with the conclusions drawn in the territorial knowledge dynamics study. Since the selected cases present good practice, they are of course in many aspects different (better).

The selected firm cases can all be categorized as knowledge producers as well as good knowledge users. They know how to combine both in order to come up with the best result. While they all developed the studied products practically by themselves (produced the knowledge) they also generated and used as much external information as they could. The generated knowledge about the market was for example crucial for the decision what product and when to develop. Also the knowledge, acquired from different partners was included in the product development process. While the linkages between the academic institutions and firms are generally not good, the selected firms present good exceptions, since they are all included in the networks and cooperate with research institutions as well as University professors and students.

A similar conclusion can also be made for the mobility vs. anchoring of knowledge debate. The selected cases are successful examples, and therefore show a better picture of the situation as the Slovenian ICT sector in general. While for the sector as a whole, neither knowledge mobility nor anchoring are very good, the studied cases show a tendency to better knowledge anchoring capabilities. While in all three cases they managed to anchor the regional knowledge (besides knowledge from different partners also most promising human resources) in two of them they also managed to anchor some developmental knowledge from abroad.

The best firms are capable of surpassing their close environment and track and make use also of more distant sources of knowledge. As already mentioned in the previous paragraph, the same goes also for our selected cases, which are not limited to regional borders when looking for knowledge. Specific technical knowledge that was needed to upgrade the existing internal knowledge base of the companies was often acquired from distant sources, since it was not even available in proximity. Since all the studied firms operate on international markets, distance was not relevant also

when monitoring the environment and searching for knowledge about the technological developments, customers, suppliers, competition, etc.

3.3 Conclusions in relation to WP6 hypotheses

The studied FKDs confirm the hypothesis that the firms combine knowledge from intra and extra-regional sources. The comparison of the FKD studies in different regions will show whether the relevant importance of these is region specific. Since a lot of programming and other specialised technical knowledge, that is needed in the ICT sector, is not available within the region, we could however assume that the relevant importance of intra and extra-regional sources. Besides that, looking at the whole ICT sector in the region it can also be concluded, that the relevant importance of these is firm specific – successful and innovative firms tend to limit themselves less with the regional borders.

Further more, our studied FKDs also speak in behalf of the second postulated hypothesis, which is that the most important knowledge of any business is knowledge of its different external and internal knowledge domains. Relevant knowledge can always be found in the external environment, regardless the amount of internal knowledge that the firm already possesses. Thinking that somebody is self-sufficient as far as knowledge is concerned, can be a serious handicap. The studied firms also all try to identify the shortages in internal knowledge and find external sources that can fill them.

As it is postulated in the third hypothesis, knowledge in the studied cases is indeed selected by firms for its relevance to their strategic objectives and goals, and is harnessed to these objectives.

The sixth hypothesis postulates that the communications revolution is promoting the development of knowledge networking and outsourcing. The studied cases confirm that new means of communication indeed enable easier and cheaper communication with the dislocated sources of knowledge. Besides that, the possibilities of intranet, sharing files on servers, e-mailing, etc. enable also much better access to information and internal transfer of knowledge.

Based on the studied FKDs we could also confirm that the type of knowledge (technical ICT knowledge) determines the level of female and male participation, as part of the hypothesis number 10 suggests. The share of women in this field is very low already among student population, therefore it is understandable, that even though women in ICT are not discriminated, there are very few of them in the studied firms (not taking the women employed in the support functions into account).

Universities' main contribution to commercial knowledge generation is at one or two stages removed from immediate commercial activities (hypothesis 11).

The studied FKDs do however not confirm the hypothesis that gender imbalances in the exploration of knowledge contribute to gender imbalances in the products or services produced. The gender dimension does not seem to matter in the studied products. This is probably due to the nature of products, which is very technical, and besides that, the products are not being sold to the end consumers.

We can partly confirm both hypothesis from society and culture, which refer to the growing knowledge of consumers and their better access to information. All our studied cases indeed confirm that the consumers are a very important part of the development process. However, the studied products are too complex and high technological in order for most of the customers to completely understand them, despite their growing knowledge. Therefore, the firms usually need to come up with at least a prototype, in order to be able to better demonstrate the practical benefits of their products to the customers, who otherwise have difficulties imagining what a certain product could do for them. Only then are the customers able to give relevant feedback and be included in the development process, even though they sometimes still have difficulties expressing their needs.

3.4 Conclusions about abstract categories of knowledge

In all FKDs all three knowledge phases - exploration, examination, exploitation, (Antonelli, 2001) are present, even though their importance and lasting differs, depending on the specific case. A lot of time and effort was put into exploration phase in all cases. All three studied companies systematically monitor the environment – technological and market trends, in order to come up with ideas for innovations as early as possible. Analytical (e.g. development of technology) and synthetic knowledge (e.g. market research) was important in this phase, while symbolic knowledge was not paid much attention to in any of the cases.

In the examination phase, synthetic knowledge was important in all three studied FKDs, since all of the products were tested at the clients. For that, the synthetic knowledge of the firms' development teams as well as the clients synthetic knowledge were needed. However, in the SI3000 case also scientific testing (exhaustive testing by researchers in a Russian technopark) was included, therefore also analytical knowledge played a very important role. Again, symbolic knowledge was not that important, although it did play a minor role in the communication with the clients (the presentation material, the personnel in contact with the client, etc.).

Since the purpose of innovating is profit, the exploitation phase is of course crucial for every commercial product, and the same goes for the studied cases. In the exploitation phase, only for the BeeSmart product the effort has been put into the protection of the brand name (symbolic knowledge). While in all of the cases symbolic knowledge type comes to use in presentations to dealers or clients, PR, etc., it is not perceived as the knowledge type of central importance. Since the studied products are of very technical nature, also in this phase synthetic knowledge and the commercialisation of the products play the key role.

As far as the temporal dimension of the knowledge phases within the FKDs is concerned, it is important to emphasise, that the described phases do not always follow one another, but often overlap and evolve in loops. In all of the studied cases, the exploitation phase does not present the last phase. Since all of the studied products have can be adjusted to best fit specific (or newly emerged) needs of the clients, and to integrate with new technologies, the exploration phase is practically an ongoing phase. Every new idea, which derives from the exploration phase, is followed by the examination phase, and then again the exploitation. All the studied firms constantly try to improve their knowledge and subsequently also their products, therefore these knowledge phases form a loop in which they evolve until the firm decides to withdraw the product from the market.

The observation of the spatial dimension of the knowledge phases and types shows, that the studied firms do not restrict themselves, when they are in search of certain knowledge. As one of the interviewed in the studied firms nicely put it: “The acquisition of certain knowledge is never as expensive, as a lack of that knowledge can be”. While of course firms usually search for a certain knowledge in their proximity, the regional borders will not stop them, if all the desired knowledge is not available within.

3.5 Policy conclusions related to ICT territorial knowledge dynamics

In Slovenia there is no explicit policy oriented towards ICT TKD. The attempt was made in 2005 through the preparation of ICT strategy at the Chamber of Industry. This strategy was not implemented.

Slovenian development strategy follows the belief that Slovenia has potential to increase the rate of economic growth by creating more favourable environment for ICT entrepreneurship. The elements of this environment include more investment in R&D and innovation and improved flow of knowledge and cooperation between public research and private business sector. The main objectives of SDS (IMAD

2005) are the following: exceed the average level of EU's economic development and increase employment in line with the Lisbon strategy goals in the next ten years:

- improve the quality of living and the welfare of each individual, measured by the indicators of human development, health, social risks and social cohesion,
- enforce the sustainability principle as quality criterion in all areas of development,
- develop into a globally recognizable and renowned country through a characteristic development pattern, cultural identity and active engagement in the international community.

NRDP (National R&D programme) includes for ICT important tasks:

More selectivity in R&D financing, restructuring of public research funding from programme to project funding; proposal for stricter promotion criteria at academic and research institutions both the scientific excellence as well as socio-economic relevance; development of R&D evaluation system; policy of increasing budget allocation for R&D.

The key issue for enhancing ICT TKD is intensification of science –industry co-operation on domestic and international level. This policy implies improving overall environment for co-operation, building alliances through formal and informal contacts. The specific measure is design of proper mechanisms at public R&D institutions to stimulate the researchers and scholars for the work with industry (salary incentives, promotion criteria, incentives for IPR and spin-offs).

SECTION 4 - GENERAL CONCLUSIONS

4.1. Conclusions of knowledge case studies (FKDs) based on the empirical findings

All of the studied FKD present good practices and therefore stand out from a typical FKD in the ICT sector in the region. All of the selected firms are innovative and are aware of the importance of knowledge and knowledge dynamics. Therefore, much effort and resources are put into identifying the shortages of knowledge and into filling those shortages. The internal knowledge base is being constantly upgraded. All these characteristics are reflected in the firms' culture, which also supports innovative behaviour and knowledge dynamics. The firms' search for employees who are compatible with this kind of culture, who are good team players, and motivated to learn. All these firm characteristics support and enhance one another, so that the circle of knowledge in this firms keeps spinning.

The selected firms are not only aware of the importance of internal knowledge, but also the external knowledge. They are capable of finding the sources of the necessary knowledge regardless the distance, to absorb the knowledge from them and of course, to apply it to their business or products. Therefore, in all of the studied FKDs the transfer of knowledge with external players is very important, whether they are clients, partners, competitors or suppliers. The relationships are sometimes two sided, which means that they are based on trust and mostly oriented towards long term mutual benefits. All of the studied firms are also members of networks, where they acquire access to many information and can establish close contacts. However, since all the firms systematically monitor the environment for information and ideas, the transfer of knowledge from outside the firm can also be one-sided and without the direct contact with the source (e.g. reading scientific articles, observing the actions of the competition or the customers' behaviour, etc.).

While the studied firms cooperate with different external partners, the cooperation with the Universities needs to be exposed here. While there is a general problem of cooperation between public and private research sector, the studied FKDs demonstrate, that the cooperation can work out very well, if the interest and motivation exists on both sides. Still, the problem, that the academic measures of success do not appreciate the commercial applications of scientific knowledge enough, and therefore do not motivate the scientists for this kind of work, remains. While the scientists can on one hand be very successful and contribute to many worldwide thriving business projects, they might for example still encounter difficulties when trying to acquire some public funding due to the lack of theoretical articles.

The FKD studies show, that the successful firms all realise the importance of knowledge, and have the capability of combining all different kinds of knowledge. Besides the internal, they value also external knowledge and find different proximate or distant sources of it. They demonstrate mobility, and at the same time are capable of anchoring the knowledge, they produce their own knowledge as well as make good use of the existing knowledge. All levels of personnel in different business functions are included in the KD, and the transfer of knowledge between them is very good. It is however evident, that somehow less importance is put on symbolic knowledge, compared to other knowledge types. While on one hand it is possible, that symbolic knowledge is in fact not that important in the ICT, it can on the other hand present many opportunities for those who possess it.

The studied FKDs are not finished after the product is launched. All of the selected firms are oriented towards constant improvement, therefore the phases of the KD do not follow one another in a linear manner from the first phase to the last. Usually, many of the phases run parallel with each other or follow one another in a circle, which of course includes also feedback loops. For example, when the product is developed and even before it is commercialised, the environment is still monitored, and the ideas for the improvements are already being gathered.

The gender issues appear to be similar in all the studied FKDs. While women do not seem to be discriminated, and are appreciated for their different way of thinking, there is a great lack of them, specially in the technical functions. Mostly, this can be attributed to the lack of women in certain fields (including ICT) already among the students.

4.2 Conclusions from current perspective

FKDs in ICT sector were studied and elaborated during the period of prosperity, above average growth rates in Slovenia and EU regions and favourable international environment worldwide. These economic and social conditions enabled also relatively high knowledge investments: at macro level high expenditures for education, training and public R&D, at micro level relatively high spending in private R&D and software. These overall knowledge investments in Slovenia approached nearly 8% GDP (what represented the average of EU) and yielded good macroeconomic (high growth rates, growth of employment) and microeconomic results (profitability, exports).

The successful development of new knowledge (i.e. new product development in our FKD cases) was conducted under the conditions of trust and long term collaboration among the main players (firms, universities, research institutes, intermediary institutions like technology parks, technology networks, research and technology

agencies, incubators). The distant locations either as sources of knowledge (multinational companies from USA) and destinations of transfer of knowledge (customers and clients in Russia, Ukraine) did not represent any significant obstacle. ICT technologies certainly reduced geographical constraints of moving knowledge from one location to another. The question arises whether such open innovation systems (comprising low transaction costs, establishment of strategic alliances, enhancement of the role of IPR, liberalised trade and capital flows) could be applied under the conditions of the present economic and financial crisis. It should be admitted that ICT sector because of its pervasiveness and cross cutting nature was not so badly impacted by the crisis as automotive and other sectors producing investment and consumer goods.

Our FKD cases in Slovenia showed that the firms parallel to their product development did not pay enough attention to symbolic knowledge (patenting, branding, trade marks). ICT FKD cases confirmed the thesis that patents are not always considered a good mechanism to protect economic knowledge. For SMEs representing more than 99.5% of all firms the patenting means huge costs. The firms preferred - due to the fast technological changes, shortened product cycles, nature of software products and volatile markets - not to protect their intellectual property. Nevertheless, the patent system has certain advantages which are fully exploited by the leading multinational ICT firms:

- by increasing the expected private return of an innovation it acts as an incentive mechanism to private investment in knowledge production,
- patents facilitate the market test of new inventions because they allow disclosure of related information while protecting against the imitation,
- patents create transferable rights and can therefore help to structure a transaction that also concerns unpatented knowledge,
- patents are means to signal and asses the future value of the technological effort of the firms that own them (Foray, 2000).

Our FKD case studies confirmed the thesis that ICT technologies are heavily involved in the production and dissemination of knowledge and information. They allow more flexibility regarding the constraints of physical proximity in many activities, such as distance learning (Smart-com case) and distance experimentation (Iskratel case). Last but not least, ICT represents the base of new modes of knowledge production. ICT enhances creative interaction between researchers, scholars, scientists, product designers, public servants, suppliers and end customers.

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ANNEX

I. Identity card of the firm

- Smart – com, Ljubljana
- ŠPICA, Ljubljana
- Iskratel, Kranj

II. Timeline matrixes

- Smart – com, Ljubljana
- ŠPICA, Ljubljana
- Iskratel, Kranj

Name of Company	**Smart - com**		
Location (local and NUTS III region level)	Local: **Ljubljana**		
	NUTS I: **Slovenia**		
Legal status	Company ✓	Sole proprietor	Partnership ✓
	Public corporation	Governmental	Non-profit
Single or multi-established firm?	**single**		
Sector NACE code www.c2n.info/repository/class/nace.html	64.2		
EURODITE sector	ICT		
Important products	IPTV Systems, telephone TV systems, telecommunications		
Does the firm apply any formal knowledge management tools?	Yes		
No. of employees (establishment level)	130 (2007)		
No. of female employees (establishment level)	27		
% of employees with tertiary education	65%		
% of female employees with tertiary education	81%		
Last year's turnover in 1 Mio. € and exports (%)	23,5 mio € (2008)		
Last year's turnover in 1 Mio. € and exports (%) group level (only if firm is part of a group	1,2 mio €		
Product development activities use knowledge from other branches (only if part of a group)	Only answer **yes** ✓ or no		
Product development activities use knowledge from firms in other sectors?	Only answer **yes** ✓ or no		
Product development activities use knowledge from local/regional universities?	Only answer **yes** ✓ or no		
No. of interviews	**4**		

Name of Company	**ŠPICA**		
Location (local and NUTS III region level)	Local: **Ljubljana**		
	NUTS I: **Slovenia**		
Legal status	Company ✓	Sole proprietor	Partnership ✓
	Public corporation	Governmental	Non-profit
Single or multi-established firm?	**single**		
Sector NACE code www.c2n.info/repository/class/nace.html	K 72		
EURODITE sector	ICT		
Important products	SW, IT services		
Does the firm apply any formal knowledge management tools?	No		
No. of employees (establishment level)	80		
No. of female employees (establishment level)	5		
% of employees with tertiary education	35%		
% of female employees with tertiary education	8,6%		
Last year's turnover in 1 Mio. € and exports (%)	6,3 Mio €; 10% exports		
Last year's turnover in 1 Mio. € and exports (%) group level (only if firm is part of a group	-		
Product development activities use knowledge from other branches (only if part of a group)	Only answer **yes** ✓ or no		
Product development activities use knowledge from firms in other sectors?	Only answer **yes** ✓ or no		
Product development activities use knowledge from local/regional universities?	Only answer **yes** ✓ or no		
No. of interviews	**5**		

Name of Company	**Iskratel**		
Location (local and NUTS III region level)	Local: **Kranj**		
	NUTS I: **Slovenia**		
Legal status	Company ✓	Sole proprietor	Partnership ✓
	Public corporation	Governmental	Non-profit
Single or multi-established firm?	**multi**		
Sector NACE code www.c2n.info/repository/class/nace.html	DL 32		
EURODITE sector	ICT		
Important products	Call and application servers, telecommunication equipment, home gateways		
Does the firm apply any formal knowledge management tools?	Yes, they appointed “knowledge manager” in 2006		
No. of employees (establishment level)	731		
No. of female employees (establishment level)	178		
% of employees with tertiary education	79%		
% of female employees with tertiary education	75,3%		
Last year’s turnover in 1 Mio. € and exports (%)	114,1 mio €	export: 82,9 mio €	
Last year’s turnover in 1 Mio. € and exports (%) group level (only if firm is part of a group	114,1 mio €		
Product development activities use knowledge from other branches (only if part of a group)	Only answer **yes** ✓ or no		
Product development activities use knowledge from firms in other sectors?	Only answer **yes** ✓ or no		
Product development activities use knowledge from local/regional universities?	Only answer **yes** ✓ or no		
No. of interviews	**6**		

Timeline matrixes

Partner name: IER
Name of the case: Smart- com

Id	Start date	Duration (months)	Country	Region	City	Knowledge dimension	Knowledge range	Knowledge type	Knowledge domain	Power-relation	Knowledge phase	Knowledge relevance	Intensity	Stability	Explanation
99	0603		Slovenia	Ljubljana	Ljubljana	NO DATA HERE									Smart Com d.o.o. Ljubljana
1	0704	9	Slovenia	Ljubljana	Ljubljana	3	2	1	1	2	2	4	3	3	Faculty for Elektrotechnics
2	0704	9	Slovenia	Ljubljana	Ljubljana	2	2	2	4	3	2	5	3	2	Institute for rehabilitation
3	0707	10	Slovenia		Dutovlje	2	2	1	3	2	2	3	5	2	Guru d.o.o.
4	0707	6	Slovenia	Ljubljana	Ljubljana	2	2	1	3	2	2	3	5	2	Prešernova družba
5	0611	15	United States of America	California	Sunnyvale	2	2	2	1	2	1	5	4	1	Kassena
6	0611	15	United States of America	Alabama	Huntsvile	2	2	2	1	2	1	4	4	1	Motorola
7	0611	15	Slovenia	Ljubljana	Ljubljana	2	2	2	1	2	1	4	4	1	HP
8	0611	15	Slovenia	Ljubljana	Ljubljana	2	2	2	1	2	1	4	4	1	Oracle
9	0611	15	United States of America	California	San Diego	2	2	2	1	2	2	5	4	1	Verimatrix
10	0702	15	Hungary	Budapest	Budapest	2	2	2	4	3	3	5	5	1	Invitel
12	0611	20	Slovenia	Ljubljana	Ljubljana	2	2	2	4	3	2	5	3	2	Ministry of high education, science and technology
13	0805	5	Slovenia	Ljubljana	Ljubljana	2	2	2	1	2	2	5	4	1	Ockham d.o.o.

Partner name: IER
Name of the case: ŠPICA

Id	Start date	Duration (months)	Country	Region	City	Knowledge	Knowledge range	Knowledge type	Knowledge domain	Power-relation	Knowledge phase	Knowledge relevance	Intensity	Stability	Explanation
99						NO DATA HERE									
1	0103	0	Germany	Germany	Hanover	5	2	2	3	3	1	2	1	1	Ce BIT
2	0404	0	Slovenia	Slovenia	Ljubljana	3	2	2	4	2	3	2	1	1	LJ event
3	0404	0	Croatia	Croatia	Zagreb	3	2	2	4	2	3	2	1	1	ZG event
4	0405	0	Srbia	Srbia	Beograd	3	2	2	4	2	3	2	1	1	BG event
5	0310	4	Slovenia	Slovenia	Ljubljana	2	2	1	7	2	2	3	3	3	Mercuri
6	0208	0	Czechosl	Czechoslovakia	Praga	2	2	2	4	2	2	2	3	3	Motorola presentation Praga
7	0108	0	Hungary	Hungary	Budapes	2	2	2	4	2	1	2	3	3	Motorola presentation Budapest

Partner name: IER
Name of the case: Iskratel

Id	Start date	Duration (months)	Country	Region	City	Knowledge	Knowledge range	Knowledge type	Knowledge domain	Power-relation	Knowledge phase	Knowledge relevance	Intensity	Stability	Explanation
99	01 03	52	Slovenia	Gorenjska	Kranj	NO DATA HERE									Iskratel
1	06 03	46	Slovenia	Ljubljanjska	Ljubljana	3	2	2	2	1	4	4	4	3	University of Ljubljana, LTFE
2	06 03	46	Slovenia	Štajerska	Maribor	3	2	2	2	1	4	4	5	3	University of Maribor, FERI
3	01 04	12	Russia		Moscow	4	2	1	1	2	3	3	4	2	CNIIS
4	01 05	28	Russia		Moscow	1	1	2	3	1	3	3	5	3	IskraUralTel
5	05 04	37	Slovenia	Štajerska	Maribor	2	2	2	3	1	3	3	4	2	MgSoft

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