Lengyel I. – Vas Zs. (eds) 2013: *Regional Growth, Development and Competitiveness*.
University of Szeged, Doctoral School in Economics, Szeged, p. 215-231. *(*ISBN 978-963-306-222-7)

15. Evidence on Knowledge-intensive Industries in the Regional Innovation System of the Southern Great Plain

Zsófia Vas

Aalborg school of innovation systems highlights the complementary nature of different approaches. Literature reveals the impact of the components of regional innovation systems on clusters, promote clusters in which industrial firms can reach higher innovation performance and reveal the interaction between sectors and the national innovation system.

Innovation performance in sectoral innovation systems depends on the nature of the industry and determined by its geographical location. However, it is not the most obvious to investigate the geography of sectoral innovation systems primary in national borders, since they are often localized, concentrated on subnational level, and influenced by regional innovation systems. The problem is the lack of empirical evidence on the mutual impact of sectors and regions. The relationship is even less examined in less developed regions.

This study[1] *is designed to examine the interaction of sectoral and regional innovation systems, and reveals the characteristics of sectors and regions in case of knowledge-intensive industries in the Southern Great Plain Region of Hungary. The questionnaire based survey shows the relevant organizations in innovation activities, their heterogeneity, geographical location and the diversity of links in innovation and R&D activities.*

Keywords: knowledge-intensive industries, regional and sectoral innovation system, less developed region

1. Introduction

As a result of the expansion of knowledge-based economy and the global economic activities higher attention is drawn to identify all the determinants, which contribute to the increase of competitiveness and the specialization of economic actors and regions. There are several factors, which explain the difference between developed and less developed regions, and one of them is the difference in innovation capacity, which can lead to differences in the innovation performance as well. The literature of innovation systems provide a suitable framework to analyze innovation processes both at regional and sectoral level and to reveal all the elements and interactions, which are essential for the production, diffusion and use of

[1] Present paper is supported by the European Union and co-funded by the European Social Fund. Project title: "Broadening the knowledge base and supporting the long term professional sustainability of the Research University Centre of Excellence at the University of Szeged by ensuring the rising generation of excellent scientists." Project number: TÁMOP-4.2.2/B-10/1-2010-0012

knowledge. The concept of innovation systems puts a great emphasis on the social context of innovation activities and the interactive nature of learning. According to the conceptual framework of regional innovation systems (RIS), the interactive learning takes place in two subsystems, in the knowledge application and exploitation subsystem, and in the knowledge generation and diffusion subsystem. The knowledge application and exploitation subsystem consists of firms forming regional clusters and also their support industries.

All industries produce and use new knowledge and technology, but industries with analytical or with the combination of analytical and synthetic knowledge base are more knowledge or technology-intensive. Knowledge-intensive industries have attracted a great attention in knowledge application and exploration. They generate positive effect on the regional economy, and can have a leading role in the development even of less developed regions. Due to their nature as special kind of sectoral innovation systems (SIS), knowledge and innovation activities in knowledge-intensive industries are generally spatially bounded. For this reason if firms in an industry are geographically concentrated in a region, economic conditions of the particular region have an impact on the industry, even if it is a knowledge-intensive one.

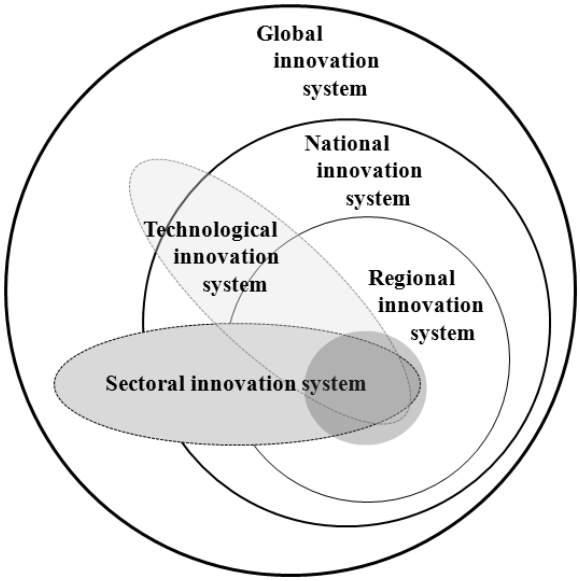
Recent study attempts to answer the following research question: how innovation activities of knowledge-intensive industries can be characterized in the less developed NUTS2 region of Southern Great Plain in Hungary? The questionnaire-based research highlights the specificity of knowledge-intensive innovation activities, the nature of cooperation the intensity of R&D activities, and the barriers of innovation. The questionnaire is based on the Community Innovation Survey, and completed with question from the innovation system literature and with general information on companies. The study shows the basic concept and some elements of the ongoing PhD work.

2. Theoretical introduction - Interdependence of regional and sectoral innovation systems

Innovation system approach has emerged since its initial appearance with the concept of national innovation system (Freeman 1995, Lundvall 1992, Nelson 1993) and has extended with the notion of regional (Cooke et al. 1997), sectoral (Malerba 2002) and technological (Carlsson – Stankiewitz 1991) innovation systems. The approach of innovation systems provides understanding on the interactive and collective process of innovation, and describes the role of the variety of actors, information, knowledge, interactions and complementarities among agents involved in the process of innovation.

The literature on sectoral innovation system (SIS) explores the characteristics of the change and transformation of sectors, also the actors, links and interdependencies within and even between sectors (Malerba − Orsenigo 1997, Malerba 2002, 2004). It makes a combination of several perspectives to analyze sectors, and dissolves the limitations of case studies and industrial economics. The approach puts an emphasis on the study of the role of non-firm organizations and the transformation of sectors in their boundaries too, and emphasizes the importance of knowledge and interactive learning. The theory highlights that knowledge is a key asset for competing firms, and learning is a key process to strengthen competitiveness.

Figure 1 Relation between different approaches of innovation systems



Source: author's own construction based on Asheim and his co-authors (2011, p. 884.)

Based on the sectoral knowledge base Asheim and Coenen (2005), Baba and his co-authors (2009), Tödtling, Lehner and Trippl (2006) distinguish two main types of knowledge base: the *analytical* and *synthetic knowledge base*. The latter one is more likely concerned to the traditional industries, but analytical knowledge base, or the combination of analytical and synthetic knowledge base is typical to those knowledge-intensive industries, like ICT.

Innovation performance of firms depends upon the characteristics of the sector and closely related to geography. Research on innovation systems related to sectors (Breschi – Malerba 2005) demonstrate that SISs may be highly localized, and go under the impact of regional economic conditions. Innovation processes of firms are rooted in specific contexts with particular inputs, knowledge base, competences, institutional background and demand relevant to sectors, and localized on different territorial levels. While mode of sectors to innovate defines

the innovation pattern and economic performance of a region, meantime national, regional and even sub-regional conditions have impact on the sectoral pattern of innovation too.

It has been pointed out (Lundvall et al. 2002) and detailed (Casper – Soskice 2004) how interdependent relationship of sectors and national system exist. It is often examined how sectors explore clustering from the viewpoint of regional innovation systems (Cooke 1997, Asheim – Coenen 2005) or how firms in regional clusters reveal better innovation performance (Porter 2000, Beaudry – Breschi 2003). But it is less discussed how the interaction forms between regional and sectoral innovation system. There is also a lack to define less developed regions in terms of innovation.

3. Regional economic conditions in less developed regions

Special focus is given to less developed regions in the research. Hence there is no universally accepted definition for less developed regions (LDRs), for the further conceptualization of regional and sectoral innovation systems and to analyze knowledge-intensive economic activities, there is a need to make our own definition of LDRs.

Firstly, a precise definition of *regions* in terms of innovation from Cooke and Schienstock (2000, p. 273.) can be followed, regions are "*geographically-defined administratively-supported arrangement of innovative networks and institutions that interact heavily with innovative outputs of regional forms on a regular basis*". This definition is in harmony with the concept of functional (nodal) regions, defined by Malecki in 1997. The own definition and characterization of LDRs for the given purpose of this paper follows the concept of Cooke and Schienstock (2000) with the combination of other studies listing special features of regions.

Regions have increasingly have become a focus of economic policy. European Union on the field of economic and social cohesion, defines a circle of so called less prosperous regions, in relation with Objective 1. The objective lists the most common economic signals of *less prosperous regions*[2]. This is the first concept, which contributes to identify less developed regions, even if this definition was made for special policy issues. The most important economic signals of these regions are the low level of investment, the higher than average unemployment rate, the lack of services for business and individuals and the poor basic infrastructure.

Following the description of the article of Tödtling and Trippl (2005) less developed regions may be related to *peripheral regions*. Tödtling and Trippl (2005) identify peripheral regions with missing clustering efforts, SME dominance, low level of R&D, low or medium

[2]Source: ec.europe.eu/regional_policy/objective1

level educated workforce, lack of specialized services and thin institutional structure. In addition, Lagendijk and Lorentzen (2007) label peripheral regions as *"non-core" areas*, located outside the principal metropolitan areas without a sector being a leader in technological development, and with greater distance to sources of knowledge generation and transfer. This concept of peripheral regions has a limitation, namely that they are often concerned as those, which have too few firms in the same industrial sector or local production system, which would lead to regional cluster formation.

Also the classification of Asheim and Isaksen (2002) of three types of RIS (territorially embedded regional innovation networks, regional networked innovation systems, regionalized national innovation system) may give a guideline to name the factors that make a region to be less developed. This concept was applied in the research of Andersson and Karlsson (2004) too, to explore the differential features of small and medium-sized regions. The concept of *territorially embedded regional innovation networks* would be in harmony with the concept of less developed region, but partly. In territorially embedded regional innovation networks both geographical and relational proximity plays a crucial role in firms' (mainly SMEs) innovative activities. The competitive advantages of firms based on a localized learning process. The probability for radical innovation is low due to the lack of knowledge providers in the region. There is also a danger of lock-in in these regions, if the networks are not able to sustain firms' competitiveness in the region. The suggestion for these regions is to build external linkages.

LDRs also may be partly identified as *regional networked innovation systems*. The basic features of the networks are same like in case of territorially embedded regional innovation networks, but it is more systemic and organized (Asheim – Isaksen 2002). These regions have stronger regional infrastructure, with more local organization (R&D institutions, training organizations etc.). Local and regional knowledge providers give firms access to information and competences, and increase the collective innovative capacity and counteract a lock in situation. To describe a less developed region the combination of the territorially embedded and regional networked innovation system may be suitable.

Finally, Rosenfeld (2002) discuss clustering efforts in *less favoured regions* with special features like, weak infrastructure, lack of access to capital, technology, innovation, regional isolation, low educational level and low skilled workforce, mature or hierarchical industry structure.

The own definition would be related to the observation of Asheim and Isaksen (2002) on territorially embedded regional innovation networks, regional networked innovation systems, Tödtling and Trippl (2005) or Lagendijk and Lorentzen (2007) on peripheral regions, Rosenfeld (2002) on less favoured regions and the definition of Cooke and Schienstock (2000) on regions

in term of innovation and based on other observed characteristics. LDRs are defined through the following characteristics in a wider sense related to economic activities. LDRs have:

- dominance of small and medium-sized (SME) enterprises,
- low level of investment
- presence of traditional industries and increasing role of knowledge-intensive sectors,
- low level of R&D activities and business services
- lack of networking and clustering efforts from a bottom-up perspective.

Additionally, from the viewpoint of the institutional background and the factors, which explicitly affect the fundamental innovation activities and the networking of the primary actors (the firms) in sectors, LDRs have:

- strong geographical, weak relational proximity among agents,
- lack of sources of qualified human capital,
- lack of knowledge and financial sources,
- like the low number of knowledge providers (university, research center, technology transfer institutions etc.).

The definition emphasizes the role of those secondary actors from the institutional background influencing the behaviour and innovativeness of firms, which are closely related to knowledge generation, utilization and transfer.

4. Evidence on the innovation activities of knowledge-intensive industries

The fundamental goal of the survey is to study knowledge-intensive industrial sector activities and the factors determining their innovation activities in such a less developed region as the South Great Plain Region is. Our purpose is to reveal all the factors affecting the introduction and spreading of innovation. Regardless of which aspect the factors influencing the innovation process are studied (regional or sectoral), basic constituents like organizations, institutions, relationships, and infrastructure are analyzed. The goal of the questionnaire is to estimate the heterogeneity, geographical location, and the diversity of relationships within organizations relevant to the innovation activities in the knowledge-intensive industrial sector, determining the learning opportunities of the corporations. The questionnaire includes certain other elements of innovation systems, like infrastructure or institutions (e.g. local governments,

development agencies), but for their complete analysis more than corporate questioning would be appropriate and necessary.

To analyze knowledge-intensive sectors, we follow the OECD classification. Recently based on the technological standard of sectors - there are *high-technology, medium-high-technology manufacturing sectors* and *knowledge-intensive services* (KISs) (OECD 2001, Eurostat 2009). The circle of KISs is divided to knowledge-intensive market services and knowledge-intensive financial services, and the classification also makes distinction between high-tech KISs and other KISs. The latter refers to less knowledge-intensive industries, only exploiting the knowledge of other economic activities and qualified labour force. That is why enterprises providing less knowledge-intensive services as their main activity were excluded from the survey.

Micro, small and medium-sized enterprises having more than 1 employee (including the owners participating in the management), established before 01 January 2009 and having at least two completed business years were included in the study. 400 enterprises were included in the sample. The enterprises' seats on the territory of the counties of Békés, Csongrád or Bács-kiskun. The surveyed knowledge-intensive firms take the 4.5% of all knowledge-intensive industries located in the Great Plain Region.

Most of the knowledge-intensive (83.8%) and of the innovative knowledge-intensive industries (72.4%) are microenterprises, and there is relatively higher proportion of small enterprises (11.8% and 22.0%). Only 4.5% and 5.5% is medium-sized enterprises from the knowledge-intensive and innovative enterprises.

However, the number of companies that could be considered active in innovation is somewhat smaller than 400. There are 44 enterprises (including 21 innovative one) which are considered to be knowledge-intensive based on their registered main economic activity, but have become excluded. This happened because their major sources of revenue were non-knowledge-intensive activities. Thus, we are able to come to a conclusion on innovative activities in the based on the answers of 127 enterprises. Out of 400 enterprises 31.8% implemented innovations in the last 3 years. In the course of the study we are going to consider these companies as *innovative knowledge-intensive enterprises*. In the specification of the type of innovation we followed the definition of Oslo Manual (OECD 2005).

Among the 400 knowledge-intensive industries 15.5% is manufacturing companies, of which 13 companies are high-tech manufacturing company (Table 1) Almost half of the manufacturing enterprises are also innovative ones. Among knowledge-intensive and even among innovative knowledge-intensive enterprises the knowledge-intensive services are in the

majority. 74.2% of all enterprises are business service company, including 97 innovative one. This means that out of the 127 innovative companies, 66.0% provides services, and these are mainly knowledge-intensive market and high-tech services.

Table 1 Knowledge-intensive (and) innovative enterprises (according to main activity and activity providing the major revenue source)

		NACE Rev. 2.	Knowledge-intensive SMEs (n=400)		Innovative knowledge-intensive SMEs (n=127)	
			Number	%	Number	%
High-tech manufacturing industries		21	1	0.3	-	-
		26	12	3.0	4	2.7
Medium-high-tech manufacturing industries		20	7	1.8	3	2.00
		27	5	1.3	3	2.00
		28	21	5.3	12	8.1
		29	13	3.3	7	4.7
		30	2	0.5	1	0.7
All			61	15.5	30	20.2
Knowledge-intensive services	**High-tech knowledge-intensive services**	59	3	0.8	1	0.7
		60	1	0.3	1	0.7
		61	5	1.3	2	1.4
		62	18	4.5	8	5.5
		63	2	0.5	1	0.7
		72	27	6.8	15	10.1
	Knowledge-intensive market services	50	4	1.0	1	0.7
		51	2	0.5	1	0.7
		69	64	16.0	11	7.4
		70	19	4.8	4	2.7
		71	66	16.5	18	12.2
		73	10	2.5	7	4.7
		74	25	6.3	8	5.5
		78	3	0.8	2	1.4
		80	15	3.8	8	5.5
	Knowledge-intensive financial services	64	2	0.5	2	1.4
		65	3	0.8	-	-
		66	26	6.5	7	4.7
All			295	74.2	97	66.0
		All	**356**	**89.7**	**127**	**86.2**

Source: author's own construction

The survey shows that businesses implemented *product and / or process innovation* over the past three years, and it was new in the business or for the market (Table 2). Knowledge-intensive businesses mostly introduced new or significantly improved goods (38.6%) or new services (29%) for the market. Typically, companies tended to carry out service innovation, which was new not only to the business but also to the market, and this refers to product innovation as well as to process innovation.

Table 2 Product and process innovation of innovative knowledge-intensive businesses

Type of innovation activity	Yes. which is new to the market		Yes. which is new to the business		No	
	Number	%	Number	%	Number	%
Introduced new or significantly improved product (good) (n=126)	49	38.6	26	20.5	51	40.2
Introduction of new or significantly improved service (n=126)	38	29.9	36	28.3	52	40.9
Introduction of new or significantly improved process for producing or supplying goods or services (n=124)	32	25.2	27	21.3	65	51.2

Source: author's own construction

The questionnaire also focused on activities related *to organizational or marketing innovation*. Among the answers to did your business conduct any marketing or organizational innovation activities during in the past 3 years, the proportion of "no" answer is higher than it was in case of product and process innovation (Table 3).

Table 3 Organizational and marketing innovation of innovative knowledge-intensive businesses

Types of innovation activities	Yes		No	
	Number	%	Number	%
Implementation of new or significantly changed corporate strategy (n=127)	36	28.3	91	71.7
Implementation of new management techniques within this business (e.g. new supplier technique - Just in Time system) (n=127)	31	24.4	96	75.6
Implementation of major changes to your organization structure(e.g. cross-site. teamwork) (n=127)	44	34.6	83	65.4
Implementation of changes to marketing concepts or strategies (n=127)	54	42.5	83	65.4

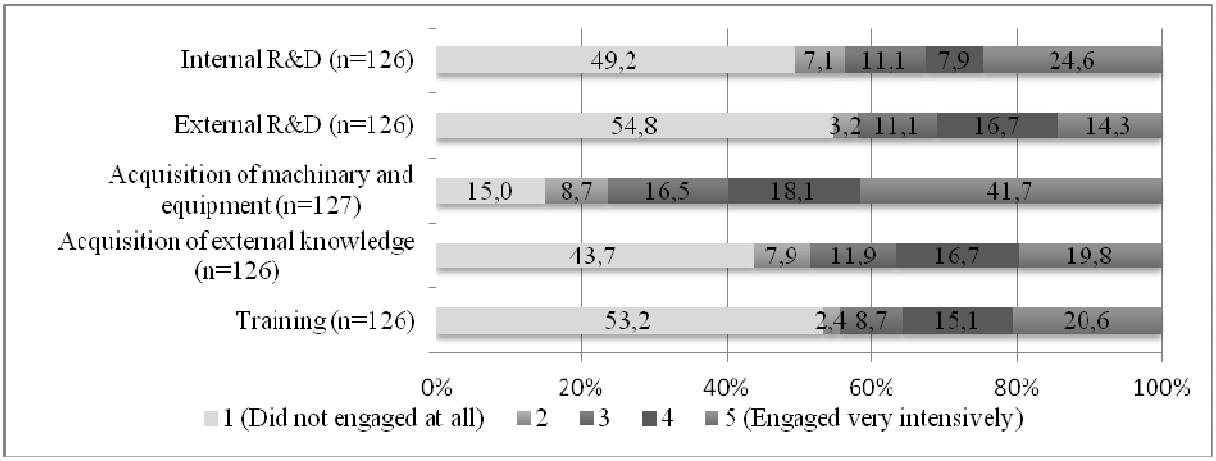
Source: author's own construction

If we look at organizational innovation, we can see that only 28.3% of the innovative knowledge-intensive companies implemented new or significantly modified organizational strategies. New business practices were used by almost 24.4% of the companies. More than one third of the innovative companies (34.6%) introduced changes related to their organization structure and 42.5% of them used new marketing concepts and strategies.

The questionnaire also included a question asking whether (and if yes, how intensively) the business engaged in the following innovation related activities in the past 3 years: research and development, acquisition of equipment, acquisition of external knowledge or training. Knowledge-intensive companies marked the intensity of the listed activities on a five-grade scale.

49.2% of innovative companies did not engage in any *internal R&D*, and the same goes for 54.8% them in relation to external R&D (Figure 2). In contrast, in the past three years a number of companies were intensively engaged with internal R&D (24.6%) and *external R&D* (14.3%). The average is 2.52 for internal R&D and 2.33 for external R&D. The most heterogeneous group of firms relates to internal R&D and training (standard deviation is 1.70). In other words, even if companies can be defined as innovative, in almost 50% of the cases they introduce new solutions without R&D activities.

Figure 2 The extent of activities needed for innovation



Source: author's own construction

In order to carry out innovative activities, the acquisition of machinery, equipment and software, i.e. of developed technology, machines, computer hardware and software. The average of answers given to this question is 3.63. 41.7% claimed that these are strongly related to their innovative activities. We cannot state the same about the acquisition of external knowledge (the mean is 2.61) or about the necessity of training (the mean is 2.48). *Acquisition of external knowledge* basically refers to acquisition or licensing of patented and non-patented inventions, know-how and other knowledge from other companies. 43.7% of companies did not need external knowledge at all, while more than 40% of them acquire external knowledge more intensively than the average, so that they could carry out innovative activities. The tendency is the same for innovation-related *training*, in case of internal or external training of experts (the training serving specifically the development or introduction of innovation). Employees did not participate in any training at half of the companies (53.2%).

Through innovation knowledge-intensive companies might be present at the knowledge market with products protected by *intellectual property*. Table 4 summarizes the answers given

to the question "During its operation, did your business apply for a patient, register an industrial design or trademark or produce materials eligible for copyright?".

Table 4 Intellectual property of innovative knowledge-intensive companies

Form of intellectual property	Yes		No	
	Number	%	Number	%
Did you apply for a patent? (n=127)	12	9.4	115	90.6
Did you register an industrial design? (n=127)	4	3.1	123	96.9
Did you register a trademark? (n=127)	7	5.5	120	94.5
Did you produce intellectual products eligible for copyright? (n=126)	38	30.2	88	69.8

Source: author's own construction

Because gaining copyright is a typically complex and costly process, small and medium enterprises did not apply for a patent (90.6%), register an industrial design (96.9%) or register a trademark (94.5%). On the other hand, 30.2% of innovative knowledge-intensive companies produced such intellectual products which are under copyright. 9.4% of the companies applied for a patent in the past three years.

Table 5 shows the answers to the question "How important were the following factors in the decision making to innovate during the last 3 years?". The factors listed in the table were evaluated by the companies on a five-grade scale, from "not important at all" (1) to "very important" (5).

Table 5 Objectives and importance of innovative activities

Factors	Importance ranking	Mean	Standard deviation
Improving quality of goods or services	7.11	4.32	1.05
Increase range or goods or services	5.97	3.85	1.27
Increasing capacity. efficiency for producing goods or services	5.97	3.81	1.29
Meeting regulatory requirements	5.94	3.75	1.53
Entering new markets	5.75	3.71	1.44
Increasing market share	5.70	3.71	1.42
Replacing outdated products and processes	5.58	3.57	1.48
Reducing costs per unit produced or provided	4.64	3.13	1.57
Have environment friendly products. processes	4.28	2.95	1.59
Improving health and safety	4.05	3.00	1.49

Source: author's own construction

The importance of each factor can be compared with the help of a Friedman-test. This test assigns an importance value to each objective and this value shows the average rank each of the given ten objectives gains from the respondents. A higher value shows greater importance of the

objective. Based on this you can put together a list in order of importance. The test showed that the individual factors or objectives are not equally important for innovation. “Improving the quality of goods or services” and increasing the range of the same tops the list of importance, while in the bottom of the scale we find “Improving health and safety”.

Based on the Friedman-test we conclude that the importance of reaching individual objectives does not appear to the same extent in our sample. The same is supported by the means of answers given to each option. Here the most important objective is the improvement of the quality of goods and services with a mean of 4.32. Standard deviation from the mean is the smallest in case of quality (1.05), which means that quality is important for all companies. A total of 58.3% of the companies find it exceptionally important to improve quality during its innovative activities. After quality “Increase range or goods or services” and “Increasing capacity” are of the same importance (with means 3.85 and 3.81 respectively). The least important factors are environment consciousness (mean=2.95) and health, safety was not an important reason for companies with respect to innovation.

Table 6 Geographic scope of the partnerships innovative companies have

Actors	**Relation**						**No relation**	
	Region		**Country**		**Abroad**			
	Number	%	Number	%	Number	%	Number	%
Suppliers of equipment. materials. services. or software (n=126)	28	22.2	58	46.0	16	12.7	24	19.0
Clients and customers (n=125)	24	19.2	64	51.2	9	7.2	28	22.4
Competitors or other businesses in your industry. which are								
SMEs (small and medium sized) (n=125)	22	17.6	43	34.4	5	4.0	55	43.3
Large companies (n=124)	9	7.3	29	23.4	4	3.2	82	66.1
Consultants. commercial labs or private R&D institutes (n=126)	7	5.5	27	21.3	-	-	92	72.4
Universities or other higher education institutions (n=126)	9	7.1	28	22.2	1	0.8	88	69.8
Government or public research institutes (n=126)	4	3.2	14	11.1	1	0.8	107	84.9
Innovation and technology centers. development agencies (n=126)	7	5.6	14	11.1	1	0.8	104	82.5

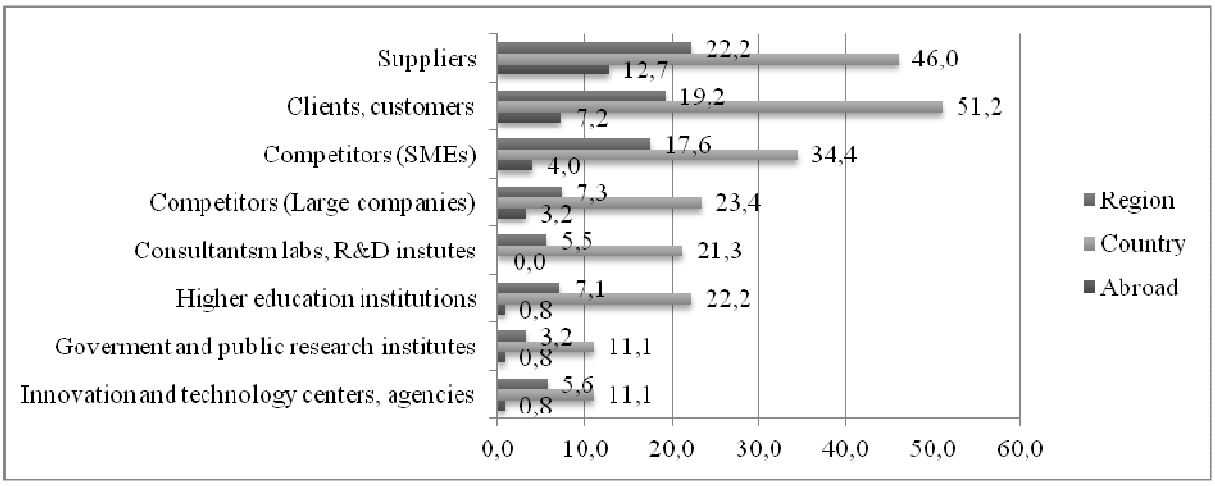
Source: author’s own construction

When investigating the group of knowledge-intensive companies, the analysis of statistical data on the most important *business actors they cooperate* with during their innovative activities and the geographic scope of their partnerships form an important part of the analysis (Table 6.).

The question arises: do these actors, which appear to form a homogenous group, they cooperate with come from the region, the country or from abroad? Partnerships can be formed with direct suppliers, clients, customers, competitors, consultants, research institutes, universities or other higher education institutions, public institutes or even with regional development agencies, which can be in the same region in which the business is located, in other part of the country and abroad.

The results clearly show that partnerships are usually not formed within the South Great Plain Region, rather outside it, countrywide (Figure 3). Knowledge-intensive businesses which are most active in innovation typically work together with clients, customers, suppliers and with competitors, mostly SMEs. The same actors dominate international partnerships as well.

Figure 3 Partnerships of innovative companies



Source: author's own construction

The majority of knowledge-intensive companies do not cooperate with higher education institutions. Partnerships with government or public research institutes are the least important, with innovation and technology centers and regional development agencies are also irrelevant, 72,4% of companies does not have any co-operation with consultants, commercial labs or private R&D institutes.

We were also curious whether there was anything to *constrain* the companies during their *innovative activities*, and if yes, to what extent (Table 6). Certain factors did not constrain innovative activities at all, while others formed major obstacles. Companies provided evaluation on a five-grade scale. We analyzed the means and standard deviations along several factors. The most important constraints to introducing innovation were the ones due to economic development(mean=3.34), to lack of finances (mean=3.08) and to high costs of innovation

(mean=3.07). Innovative companies also ranked these as significant constraints: they were mentioned by 32.0%, 24.6% and 20.6% of the companies.

Markets dominated by established businesses and uncertain demand form a less significant constraint. The least constraining factors are the ones related to technology and technical infrastructure. Based on the Friedman-test we conclude that the importance of individual constraints differs throughout the sample, but these differences are not always significant.

Table 6 Constraints and their extent in innovative activities

Factors	Importance rank	Mean	Standard deviation
Constraints due to recent economic developments (e.g. recession)	8.53	3.34	1.53
Availability or lack of finance	8.04	3.08	1.51
Direct innovation costs too high	8.00	3.07	1.45
Market dominated by established businesses	6.89	2.60	1.38
Uncertain demand for innovative goods and services	6.88	2.55	1.38
Lack of qualified personnel	6.29	2.40	1.46
EU. public or other government regulations	6.28	2.45	1.45
Organizational rigidities (internal resistance. long administrative and approval process)	5.80	2.11	1.39
Lack of financial. technical support of the local government	5.52	2.10	1.57
Lack of information on markets	5.40	2.01	1.28
Lack of (technical) infrastructure	5.37	2.00	1.10
Lack of information on technology	5.00	1.82	1.09

Source: author's own construction

Finally, it is important to look at innovative activities from the aspect of the form and source of *information necessary for introducing innovation* companies receive. This aspect is also interesting because the knowledge-intensive companies in our survey are located in a less developed region. In the questionnaire we listed various sources of information, and companies decided how important each source was for them on five-grade scale (Table 7).

The most important sources of information for activities related to innovation are clients and customers. On the one hand, 50.0% of the companies evaluated these factors as very important, and, on the other hand, companies form the most homogenous opinion along this factor (knowing that standard deviation from the mean is 1.11). Suppliers, informal relationships as well as colleagues and factors within the company are equally important. Based on the Friedman-test we conclude that the evaluation of individual sources differs.

Table 7 Importance and source of information needed for innovation

Factors	Importance rank	Mean	Standard deviation
Clients or customers	10.16	4.13	1.11
Suppliers of equipment. materials. services or software	9.13	3.82	1.30
Informal relations (family. friends. former colleagues etc.)	9.01	3.80	1.24
Colleagues. documents etc. within your business or enterprise group	8.73	3.77	1.29
Competitors or other business in the industry	7.66	3.30	1.29
Conferences. trade fairs. exhibitions	7.02	3.14	1.38
Scientific journals and trade/technical publications	6.93	3.06	1.32
Technical. industry or service standards	6.42	2.90	1.34
Professional and industry associations	6.00	2.69	1.39
Consultants. commercial banks	5.54	2.54	1.32
Universities or other higher education institutions	5.54	2.60	1.46
Regional development agencies	4.63	2.17	1.92
Government or public research institutes	4.22	2.06	1.30

Source: author's own construction

Innovative knowledge-intensive companies find that the least immportant sources of information are research institutes, but regional development agencies also qualified as unimportant sources. Data obviously show that these are not very good sources of information as 48.8% and 46.0% of the respondents marked them as "not important at all". Universities and higher education institutions are "not important at all" for 36.6% of the companies, however they are "important" and "very important" sources of information for 16.3% and 13.8% respectively.

In addition we were investigating in the clustering effort of the knowledge-intensive enterprises. As a result, we see that only 9.3% of knowledge-intensive enterprises have become part of a cluster, and out of these 37 enterprises, 19 were innovative.

5. Conclusion

Recent study attempted to reveal that the literature on innovation systems highlights that there are relation and interdependency between the different approaches of innovation systems. However there were less mentioned about the relation between knowledge-intensive sectors as certain types of sectoral innovation systems and regional innovation systems in less developed regions. This study could not go into details in connection with the characteristics of knowledge-intensive industries, but it is provided by the secondary literature. What we tried to demonstrate is the characteristics of less developed regions by pooling several concept of underdeveloped regions. Evidence on innovative knowledge-intensive industries in the Great

Plain Region revealed some aspects, which appeared in the definition of less developed regions too. We definitely can see the dominancy of micro and small enterprises in the region, which take low clustering efforts. Enterprises - probably because they are located in a less developed regions - have their relevant relations rather outside the region. The most important partners and information sources are the customers, suppliers and competitors, which results were also reflected by previous research based on CIS. Surprisingly innovative firms have less connection with universities, research institutions or agencies even they are knowledge-intensive. However it can be described by the dominancy of knowledge-intensive service providers in the sample. Clearly can be seen that innovative firms have to face constraining factors. These are not the lack of information, technology or infrastructure, but the lack of finance, the high costs and the economic recession. The study showed preliminary result of the survey, further analyses is required to reveal the connection between the factors.

References

Andersson, M. – Karlsson, C. (2004): Regional Innovation Systems in Small and Medium-Sized Regions. A Crtitical Review and Assesment. *CESIS Electronic Working Paper Series*. Source: http://www.kth.se/dokument/itm/cesis/CESISWP10.pdf

Asheim, B. T. – Coenen, L. (2005): Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy*, 34, pp. 1173-1190.

Asheim, B. – Smith, H. L. – Oughton, C. (2011): Regional Innovation Systems: Theory, Empirics and Policy. *Regional Studies*, 45, 7, pp. 875-891.

Asheim, B. T. – Isaksen, A. (2002): Regional Innovation Systems: The Integration of Local 'Sticky' and Global 'Ubiquitous' Knowledge. *Journal of Technology Transfer*, 27, pp. 77-86.

Baba, Y. – Shichijo, N. – Sedita, S. R. (2009): How do collaborations with universities affect firms' innovative performance? The role of „Pasteur scientists" in the advanced materials field. *Research Policy*, 38, pp. 756-764.

Beaudry, C. – Breschi, S. (2003): Are firms in clusters really more innovative? *Economics of Innovation and New Technology*, 12, 4, pp. 325-342.

Breschi, S. – Malerba, F. (2005): Sectoral innovation systems: technological regimes, Schumpeterian dynamics, and spatial boundaries. In Edquist, C. (ed.): *Systems of innovation. Technologies, institutions and organizations*. Routledge, London and New York, pp. 131-156.

Carlsson, B. – Stankiewitz, R. (1991): On the nature, function and composition of technological systems. *Journal of Evolutionary Economics*, 1, pp. 93-118.

Casper, S. – Soskice, D. (2004): Sectoral systems of innovation and varieties of capitalism: explaining the development of high-technology entrepreneurship in Europe. In Malerba, F. (ed.): *Sectoral systems of innovation: concepts, issues and analyses of six major sectors in Europe*. Cambridge University Press, pp. 348-387.

Cooke, P. – Schienstock, G. (2000): Structural Competitiveness and Learning Regions. *Enterprise and Innovation Management Studies*, 1, 3, pp. 265-280.

Cooke, P. – Uranga M. J. – Etxebarria, G. (1997): Regional Innovation System: Institutional and Organizational Dimensions. *Research Policy*, 26, pp. 475-491.

Eurostat (2009): High-tech industry and knowledge-intensive services. Metadata. Source: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/htec_esms.htm

Freeman, C. (1995): The „national systems of innovation" in a historical perpective. *Cambridge Journal of Economics*, 19, pp. 5-24.

Lagendijk, A. – Lorentzen, A. (2007): Proximity, Knowledge and Innovation in Peripheral Regions. On the Intersection between Geographical and Organizational Proximity. *European Planning Studies*, 15, 4, pp. 457-467.

Lundvall, B-A. (1992) (ed): *National System of Innovation. Towards a Theory of Innovation and Interactive Learning.* Pinter Publisher, London.

Lundvall, B-A. – Johnson, B. – Andersen E. S. – Dalum, B. (2002): National systems of production, innovation and competence building. *Research Policy*, 31, pp. 213-231.

Malerba, F. (2002): Sectoral systems of innovation and production. *Research Policy*, 31, pp. 247-264.

Malerba, F. (2004): Sectoral systems of innovation: basic concepts. In Malerba, F. (ed.): *Sectoral System of Innovation. Concept, issues and analysis of six major sectors in Europe*. Cambridge University Press, Cambridge, pp. 9-41.

Malerba, F. – Orsenigo, L. (1997): Technological Regimes and Sectoral Patterns of Innovative Activities. *Industrial and Corporate Change*, 6, 1, pp. 83-117.

Nelson, R. R. (1993) (ed.): *National Innovation System*. Oxford University Press.

OECD (2001): *Science, Technology and Industry Scoreboard: Towards a Knowledge-based Economy*. Organisation for Economic Co-operation and Development, Paris.

OECD (2005): *Oslo Manual: Guidelines for collecting and interpreting innovation data*. Third edition. OECD Publishing, Paris.

Porter, M. E. (2000) Location, Clusters, and Company Strategy. In Clark, G.L. – Feldman, M.P. - Gertler, M.S. (eds): *The Oxford Handbook of Economic Geography*. Oxford University Press, Oxford, pp. 253-274.

Rosenfeld, S. A. (2002): *Creating Smart Systems. A guide to cluster strategies in less favoured regions.* European Union and Regional Innovation Strategies. Regional Technology Strategies, Carrboro, North Carolina, USA.

Tödtling, F. – Trippl, M. (2005): One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy*, 34, 8, pp. 1203-1209.

Tödtling, F. – Lehner, P. – Trippl, M. (2006): Innovation in Knowledge Intensive Industries: The Nature and Geograpy of Knowledge Links. *European Planning Studies*, 8, pp. 1035-1058.