JTSR (2016) 23: 79-96
DOI 10.14665/1614-4007-23-1-006

PAPER

Entrepreneurship challanges in a Less Developed Region of Hungary ELI-ALPS Laser Research Centre in Szeged

Imre Lengyel • Miklós Lukovics • Szabolcs Imreh

Abstract The Extreme Light Infrastructure (ELI) project was initiated by the European Strategy Forum on Research Infrastructures (ESFRI). The ELI research project is conducted in 3 countries; different facilities are constructed in the Czech Republic, Romania and Hungary. The ELI Attosecond Light Pulse Source (ELI-ALPS) laser research centre with its equipment unique in the world is established in Szeged, Hungary, in the less developed Southern Great Plain region at a value of approximately EUR 200 million and is expected to start operation in 2016. The buildings to be constructed will not only house the laser equipment, but also provide space for offices and laboratories for the 220-250 researchers and administrative staff and a science park shall also be established for enterprises. The investment shall provide an opportunity for Szeged to attract knowledge-intensive enterprises and promote start-ups.

In our study[1] we undertake to attempt to systemise the possible local economic and enterprise development effects of the ELI-ALPS based upon international scientific findings and experiences. We have developed a proposal on a development strategy based on the fundamental concepts of smart specialization that outlines realistic connection points and opportunities for cooperation between the local knowledge-intensive business sector and the ELI-ALPS, with a special role of the University of Szeged in economic end enterprise development.

Keywords Knowledge-intensive enterprises - Science park - Local economic development Geographical and technological proximity - Smart specialisation strategy

JEL Classification L53, M13, O10, O30, O32

1 The research was supported by the project "Extending the knowledge base of the Research University Centre of Excellence of the University of Szeged and establishing its long-term professional sustainability by means of providing an excellent next academic generation", identification number TÁMOP-4.2.2/B-10/1-2010-0012.

Imre Lengyel[1] • Miklós Lukovics[2] (✉)• Szabolcs Imreh[3]
[1] Faculty of Economics and Business Administration, University of Szeged
e-mail: ilengyel@eco.u-szueged.hu
[2] Faculty of Economics and Business Administration, University of Szeged
e-mail: miki@eco.u-szeged.hu
[3] Faculty of Economics and Business Administration, University of Szeged
e-mail: iszabi@eco.u-szeged.hu

1. Introduction

The role of universities and the research institutes related to them has become more important in motivating regional and local economic development (Harding et al 2007; Huggins and Johnston 2009; Lawton Smith 2006; Varga 2009). Some excellent studies have provided detailed analyses of successful regions concentrating technology-driven or knowledge-intensive activities, such as the Silicon Valley (Saxenian 1994) or Oxfordshire (Lawton Smith 2003; Lawton Smith et al 2005). According to the literature, these knowledge-based activities exploit the advantages of geographical proximity, which have a different effect in metropolitan or small city, the regions of research universities or community colleges, in central regions or (semi-) peripheries (Anselin et al. 1997; Benneworth and Hospers 2007; Lengyel I. 2009; van Oort and Lamboy 2014).

Geographical and technological proximity can become the source of significant advantages in the case of knowledge-intensive activities, which operate efficiently when concentrated in space or when forming clusters (Boschma 2005; Capello and Faggian 2005; Varga 2007). They are cheap and reliable when the number of innovative companies and the connected business service provider, institutions and their employees reach a critical mass in the given industrial or business sector and positive external impacts take effect and a regional cluster is established (Porter 1998, 2008).

The exploitation of economies of scale is critical in global competition, and has two visible basic spatial types (Capello 2007; McCann 2013; van Oort and Lamboy 2014): in small towns so-called localization agglomeration advantages, Marshall-Arrow-Romer (MAR) externalities develop (companies in the same industrial segment exploit them and research and development conform to their demands), while in large cities or metropolitan regions so-called urbanization agglomeration advantages, Jacob's externalities operate (multiple industrial sectors can strengthen and the synergies between them are the engines of development).

Knowledge-intensive activities and relationships mainly concentrate **in city regions that have a research university, in growth poles**, often in science parks (Goddard and Vallance 2011; Goldstein and Renault 2004). Regions accommodating universities increase in importance where the most talented representatives of the given generations concentrate, and this **young, talented and creative labour force** is capable of quickly and efficiently applying new procedures (Huggins, Johnston, and Stride 2012). This labour force is "reproduced" every year in university towns and, with the existence of adequate training, it flexibly adapts to labour market demands, thus promoting local knowledge spillovers and the establishment of start-up enterprises (Harding et al. 2007; McKelvey and Holmén 2009; Anselin et al. 1997). Certain characteristics of collective learning promoting the spread of knowledge and its processes can be provided (Capello and Faggian 2005: 79): high mobility of local labour force, stable and fruitful relationships with local customers and suppliers, and spin-offs.

The city regions that have a research university in **less developed regions** are in a special position in the currently forming new, knowledge-based specialisation (Benneworth 2004; Benneworth and Charles 2005; Radosevic and Myrzakhmet 2009). The corporations participating in global competition that have their headquarters in these city regions compete mainly with factor-driven, or occasionally investment-driven strategies, that is, with cost advantages (Porter 2008). In these regions, the local innovation system is controlled externally, and the companies have no sources or demands for science research and do not develop new innovations (Lengyel B. and Leydesdorff 2008; Malecki 2014). The majority of newly developed knowledge-intensive companies and creative youth move from these regions to the large cities of more developed areas where it is easier to find business partners and a supporting local environment (Lengyel B. and Ságvári 2009; Pike et al. 2006).

The approach and applied set of tools of **regional and local economic development strategies** has undergone gradual changes in the past decades (Huggins and Williams 2009; Pike et al. 2011). Instead of the top-down type regional policies a **bottom-up strategic planning with an integrated approach has emerged** (Stimson et al. 2006; 2011). The improvement of the competitiveness of less developed regions, that is, **modernization is required**; the development of lacking public goods, the establishment of infrastructure and public services, which the market cannot perform (Lengyel and Rechnitzer 2013; Porter 2008). But this is only a necessary and not a satisfactory condition, since the local labour force and local enterprises must also be prepared for successful operation in a competitive environment, thus active economic and enterprise development programmes, culture change must also be implemented (Huggins and Strakova 2012; Julien 2007).

Bottom-up integrated strategic programmes mean the practical implementation of the well-known Triple Helix, or more recently the Quadruple Helix model, that is the harmonised operation of the local government and its institutions, the business sector (chambers, entrepreneurial associations), scientific communities (universities) and the interests of the local population and the agreed responses to new challenges (Carayannis and Rakhmatullin 2014; Etzkowitz and Leydesdorff 2000; Lengyel B. and Leydesdorff 2008). The traditional task of universities, education and research, are extended to the role fulfilled in the **development of the regional and local knowledge economy and society.**

According to the proposal of Huggins and Strakova (2012), three key fields of a knowledge-based development strategy can be differentiated in the emerging regions: **regional leadership and efficient coordination**, a **system-oriented policy** (the integrated development of the business environment and infrastructure) and a **firm-oriented policy**. That is, a separate economic development programme and enterprise development strategy are needed whose efficient local coordination can provide the opportunity for the development of a knowledge-intensive cluster. The **role of local governments is especially important** in the small towns of less developed regions (e.g. Newcastle, Enschede), since only they are capable of initiating the processes that strengthen the knowledge-based local economy in cooperation with universities (Benneworth and Hospers 2007). Universities do not have the financial sources or the organisational capacities to constantly manage university-industry relations and establish the lacking local business infrastructure that business life would develop in, for instance, a metropolitan regions. **Active local governmental behaviour** and a well-devised strategy are required in order to consciously strengthen knowledge spillovers, regional multiplicator effects, the establishment of new spin-off companies, strengthening university-industry relationships, establishing forums of cooperation, etc., by making university workshops interested.

The European Union has established a triple objective for the 2014-2020 planning period: **smart, inclusive and sustainable growth**. Within regional policies, it supports place-based, integrated, bottom-up programmes promoting smart growth, primarily ideas based upon the principles of new development strategies (Thissen et. al 2013). The national/regional research and innovation strategies for smart specialisation (RIS3) are integrated, place-based economic transformation agendas (EC 2014: 2): "They focus policy support and investments on key regional priorities, challenges and needs for knowledge-based development. They build on each region's strengths, competitive advantages and potential for excellence. They support technological as well as practice-based innovation and aim to stimulate private sector investment. They get stakeholders fully involved and encourage innovation and experimentation."

In this study we shall review the possible local economic development role and opportunities of the ELI-ALPS laser research centre operating from 2016 financed by the European Union with

EUR 200 million in Szeged, centre of one of the less developed regions in Hungary. Following the presentation of a theoretical background and international experiences, we shall first present the ELI-ALPS investment and its environment, the economic and social conditions of the region and Szeged, highlighting the most important characteristics of the university and local research institutes. We shall also propose a development strategy based upon the basic concepts of smart specialization (RIS3) that outlines realistic connection points and opportunities for cooperation between the local economy and the ELI-ALPS and other local research institutes, with a special role provided for the University of Szeged. The advantages and disadvantages of the ELI-ALPS institute on the local economy evoke a serious dilemma which we shall attempt to resolve by means of local economic and enterprise development proposals.

2. The laser research institute and its geographical environment

During contemplating the economic development impacts of the ELI-ALPS laser research institute, the development of the integrated bottom-up strategy, we must not only consider the characteristics of the investment and the facility, but also the existing features of the region and the city region.

The Extreme Light Infrastructure (ELI) project is an integral part of the planned and already constructed generation of large European research facilities managed by the European Strategy Forum on Research Infrastructures (ESFRI). The EU laser project amounting to a total budget of EUR 850 million is implemented in three countries, in independent fields and with separate instruments: research centres are constructed in the Czech Republic (beamline), in Hungary (attosecond) and in Romania (photonuclear).

The **ELI Attosecond Light Pulse Source (ELI-ALPS)** is being built in Szeged with a total budget of EUR 200 million. The primary mission of the ELI-ALPS laser research centre „is to make a wide range of ultrafast light sources accessible to the user groups of the international scientific community, with special consideration to coherent extreme-ultraviolet (XUV) and X-ray radiations, and to attosecond pulses”[2].

The primary mission of the laser research centre *"is to make a wide range of ultrafast light sources accessible to the user groups of the domestic and international scientific community. The equipment operating in the research centre is expected to achieve significant research results not only in the case of ultrafast physical basic processes, but also in the field of biological, medical and materials sciences"*[3]. Main research and application areas of ELI-ALPS: valence electron science, core electron science, 4D imaging, relativistic interactions, biological, medical and industrial applications etc. Possible application fields are expected to come from biological sciences, chemistry, climate research, energy and materials sciences, medical imaging, etc. According to the international application, 5 laser tools will be constructed, which will be capable of a significantly higher performance than anywhere previously in the world in producing ultrashort pulses.

2 Source: http://www.eli-hu.hu/
3 Source: http://www.eli-hu.hu/

Figure 1 Location of ELI-ALPS and a planned Science Park

Source: http://www.eli-alps.hu/

The laser research centre is partly funded by the EU Structural Funds allocated to Hungary. Approximately 220-250 employees will work there, half of them as researchers who get their positions through international applications and whose salaries will reach a Western European level. The centre will be controlled and supervised by an international Scientific Advisory Committee without the active participation of any institutions of the university or the city. Researches conducted here will partly be funded from EU sources, but the equipment will also be rentable for corporate research.

The floor area of the research centre will be almost 24,462 square metres4 (5 buildings) and besides the rooms for the laser equipment, it will also accommodate laboratories (biological, chemical, medical, etc.), workshops, computer rooms, a conference room for 200, 8 seminar rooms, offices, a library, etc. The research centre can therefore accommodate not only researches, but also conferences, workshops and training courses.

In Hungary there are 7 regions of NUTS2 level, including 3-3 counties of NUTS3 level (Figure 2).

Figure 2 Regions and counties of Hungary

4 Source: http://www.eli-hu.hu/

The Southern Great Plain region is situated in the south-eastern border area of the country, and includes three counties: Bács-Kiskun, Békés, and Csongrád. Szeged, Hungary's fourth most densely populated city, which is situated approximately 180 kilometers south from Budapest, is the centre of both the Southern Great Plain region and Csongrád county. Trans-European transport corridors pass the city, the motorway towards Romania and Serbia reached the city in December 2005.

The GDP per capita on purchasing power parity of both the region and the county is far behind the EU average and varied between 45-50% thereof, and the economic growth following Hungary's accession to the EU in 2004 has also been minimal (Table 1). The employment rate is also significantly lower than the EU average, but also falls behind the Hungarian average.

In the majority of figures related to research and development, however, the Southern Great Plain has a strong position and comes directly after Central Hungary in the rank of regions. Csongrád county, in turn, is in an even better position, since in the majority of R&D input and output figures it ranks first among the counties. Indeed, the specific number of those with an academic degree (35 persons per 10,000 inhabitants) is higher than in Central Hungary (29 persons per 10,000 inhabitants) that belongs to the developed regions, and the proportion of those with tertiary education is close to the EU average.

Table 1 Main data of Hungarian regions and Csongrád county

Territorial unit	GDP per capita (PPS, EU27 =100%), 2012	Employment rate (ages 20-64) (%), 2013	R&D expenditures per GDP (%), 2011	R&D employees per 10,000 residents (%), 2013	Higher educational attainment (%) (ages 25-64), 2011	Academic degree (PhD) per 10,000 residents, 2013
Central Hungary	107.7	67.4	1.7	191	30.9	29
Central Transdanubia	58.5	66.0	0.8	35	17.2	6
Western Transdanubia	68.3	66.8	0.8	34	17.9	9
Southern Transdanubia	45.4	60.4	0.6	36	16.6	11
Northern Hungary	39.6	56.5	0.6	24	15.6	6
Northern Great Plain	42.8	58.4	1.1	34	16.3	11
Southern Great Plain	45.5	61.6	1.1	52	17.1	13
Hungary	65.7	63.2	1.2	59	21.0	15
EU-27	100.0	68.4	2.0	-	22.4	-
Csongrád county	50.5	61.6	1.3	116	21.1	35

Source: HCSO 2014, 2015

The close environment of the laser centre is comprised of Szeged and its agglomeration. The ELI-ALPS is being constructed at the edge of the city, near the motorway in a former Soviet barracks managed by the university. In general, the city region of Szeged, based upon the size of the population, the increase in the proportion of residential population (there was an increase from 201 thousand to 208 thousand between 2001 and 2011), the high proportion of those with tertiary

education, but even according to the high number of corporate enterprises operating there is a dynamically growing region by Hungarian standards. 29% of people between 25 and 64 in the city hold tertiary a degree, which is one and a half times more than the national average, while the specific number of those with an academic degree is multiple the times thereof. According to the employee LQ-indexes of the 13 sub-sections of the manufacturing industry, only the food industry (CA: the manufacturing of food products, beverages and tobacco products) displays characteristics of specialization and concentration in Szeged city region, which means that not only the county, but not even Szeged has any knowledge-intensive manufacturing industry (Lengyel and Szakálné Kanó 2012; Szakálné Kanó and Vas 2013).

The tertiary education sector and knowledge-intensive service providing activities are mainly connected to the University of Szeged, which is one of the top quality universities of Eastern Europe according to international rankings[5] (Lengyel I. 2009). The University of Szeged is the largest employer in the region with its approximately 7 thousand employees; it has 27 thousand university students studying at 12 faculties and 6-7 thousand students graduate there each year. Some 130 departments operate in a wide field of disciplines and the university has 770 professor-researchers with an academic degree. 8-9,00 PhD students study at the 19 doctoral schools, and the university has a significant international relationship network and an extended university-industry relationship system (Vilmányi 2011).

Many units of the research institute network of Hungary outside of Budapest are located in Szeged. Besides the University of Szeged, the Biological Research Centre of the Hungarian Academy of Sciences (with 260 researchers) also represents a significant scientific capacity and in 2000 it was awarded the prestigious title Centre of Excellence of the European Union. The Szeged Biotechnology Institute of Bay Zoltán Nonprofit Ltd for Applied Research (BAY-BIO) and the Szeged Cereal Research Nonprofit Ltd also operate here.

Based upon available data, the economy of the Southern Great Pain and Csongrád county qualifies as less developed, and industrial sectors and clusters that would classify as knowledge-intensive in the competitive sector are hardly present. However, the knowledge base concentrated in the county and the city region of Szeged is significant not only in Hungary, but also at an international level. There is a constant supply of graduates coming from the University of Szeged, some of whom continue their studies at the local doctoral schools. This knowledge base and the masses of talented youth emerging each year provide an opportunity for a knowledge-intensive economic restructuring to take place in the region. The ELI-ALPS investment does not only create the opportunity for local scientific capacities to strengthen in Szeged, but also for a real, knowledge-based local economic and enterprise development.

3. ELI-ALPS, as an opportunity for local economic development

Results published in prestigious international literature point out that three programmes are required in small city regions: the improvement of the business environment (in narrow terms, economic development), enterprise development and the motivation of clusters. In the smaller towns of less developed regions, as for instance in Szeged, these programmes must be coordinated efficiently, which requires local collaboration between the government, business, university and non-governmental sectors. In these regions the role of the university is especially important, as a constant output source for a highly qualified labour force and a motivator for new, innovative (start-up) enterprises.

5 Quacquarelli Symonds (QS) (The QS University Rankings: EECA is a dedicated ranking of the top universities in Eastern Europe and Central Asia) ranks the University of Szeged at number 22: http://www.iu.qs.com/eeca2014-rankings-results/.

During the 2014-2020 period, EU Structural Funds sources for the development of knowledge-based local economy can be applied for based upon the RIS3 strategies, thus for strengthening the regional multiplier effects of the ELI-ALPS (Thissen et. al 2013). Based upon the available data, according to the standardization of the RIS3 manual (EC 2012): **Szeged and its city region is a catching-up city region** (knowledge region) of population growth and inflows and a knowledge and potential technology hub where economic activities **exploiting new market niches** can start. In the case of such a city region type, the recommended strategy is the support of knowledge-intensive enterprises strengthening the potential competitive advantages of the region and the research institutes creating new knowledge that cooperate with them (EC 2012): reinforcing the R&D infrastructure related to new industrial sectors, attracting knowledge-intensive companies and their units, establishing science parks and incubators, attracting and supporting talented youth and a constant monitoring of high-tech market niches.

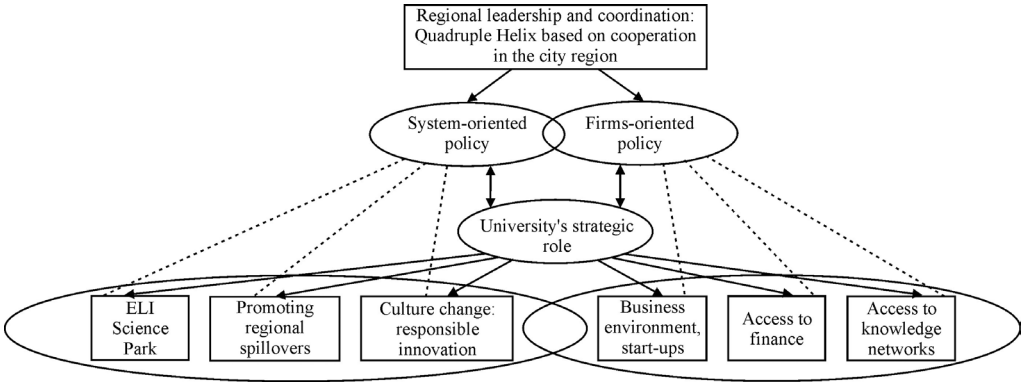
During the development of local economic development recommendations related to the activities of the ELI-ALPS, we highlight three special local aspects. One is the critical mass determined by the city size (the population of 208 thousand), which only enables the strengthening of one or two industrial sectors (localization agglomeration advantages), that is, a strong specialization and a concentration of scarce sources are required. The other aspect involves the low development of the region and the shortcomings of the service providing background, due to which a modernisation process must be started where the university will be assigned a special role. The third aspect is the too broad potential application scope of the results achieved during the experiments performed at the ELI-ALPS. Because of that, it is currently unknown which scientific disciplines will experience fundamental breakthroughs, that is, which industrial sector will utilise any innovation, which means that the development of knowledge-intensive clusters, if they are even established, can only take place later.

Based upon the aforementioned, we believe that boosting the economic development effects expected on behalf of the ELI-ALPS research institute should be divided into two steps according to the logic of the RIS3 strategies. In the first step, two elements of the microeconomic business environment, the quality of the business environment (as economic development) and the refinement of company operations and strategy (as enterprise development) must be strengthened, while in the second step, clusters should be motivated. According to Huggins and Strakova (2012) two priorities can be distinguished in knowledge-based local economic development in small cities of emerging regions: a system-oriented policy (in essence, economic development) and an firm-oriented policy (enterprise development). This model, at the same time, emphasizes the importance of the coordination role of local governmental actors, in concurrence with the recommendations of Benneworth and Hospers (2007).

Based upon these concepts, we reshaped Huggins and Strakova's model according to the special local conditions of the ELI-ALPS research centre (Figure 3). Since the development of clusters will take place later, we highlight two of the aforementioned subsystems of the system-oriented policy promoting economic development (Huggins and Strakova 2012): on the one hand, it is necessary to establish the infrastructural background of regional spillovers, and on the other hand, a culture (attitude) change is required that would promote the foregrounding of **responsible innovation** in the field of R&D. In the first step, a science park, including an incubator, would be established parallel to the ELI-ALPS investment, directly neighbouring the laser research centre in the area managed by the university. At the same time, company-oriented developments must also be implemented: various divisions of companies must be attracted, start-ups supported, funding ensured and knowledge relationships reinforced (locally and globally). It is also important to consider that the role of the university in local knowledge-based economic

development is of special interest due to the special environment of Szeged and we believe it is related to all issues to be developed.

Figure 3 Knowledge-based economic development organised around the ELI-ALPS



Source: own edition based on Huggins and Strakova (2012: 971)

4. Regional leadership and coordination

As we have already highlighted, the efficient operation of local cooperation networks is indispensable in bottom-up integrated economic development. In the RIS3 strategy, in a given region, the actors (according to the Quadruple Helix model) accept a joint vision based on a consensus, which they use as a basis for an economic development strategy. In Szeged, the local government and its institutions must actively participate in the coordination of the development and implementation of local economic development programmes aligned to the RIS3 strategy utilising the ELI-ALPS as an opportunity. However, due to the special conditions of the city region, the university and its concerned departments and research institutes must also participate with various levels of intensity in the implementation of practically all elements of the development programmes[6].

4.1 System-oriented policy: the improvement of the business environment

The system-oriented policy encompassing economic development is comprised of three programmes that concentrate on creating an efficient business environment.

ELI Science Park: access to physical infrastructure

The role of science parks as generators of dynamic economic restructuring is significant in RIS3 strategies of city regions (Nauwelaers et al. 2014). The ELI Science Park will provide an infrastructure background for a wide range of knowledge-intensive activities. Since the business utilisation of research results is expected to cover a rather broad scope, the park will not concentrate on a single R&D&I area, but will provide room for the geographical concentration of heterogeneous, multifocal high added value companies. The special characteristic of the ELI Science Park is that, the ELI-ALPS itself fulfils an "integrator role", however, that will

6 The expression "fourth generation" university has already appeared in the literature and refers to the fact that modern universities of our day must become capable of proactively influencing the economic and social processes of their region (Lukovics and Zuti 2013; Pawlowski 2009).

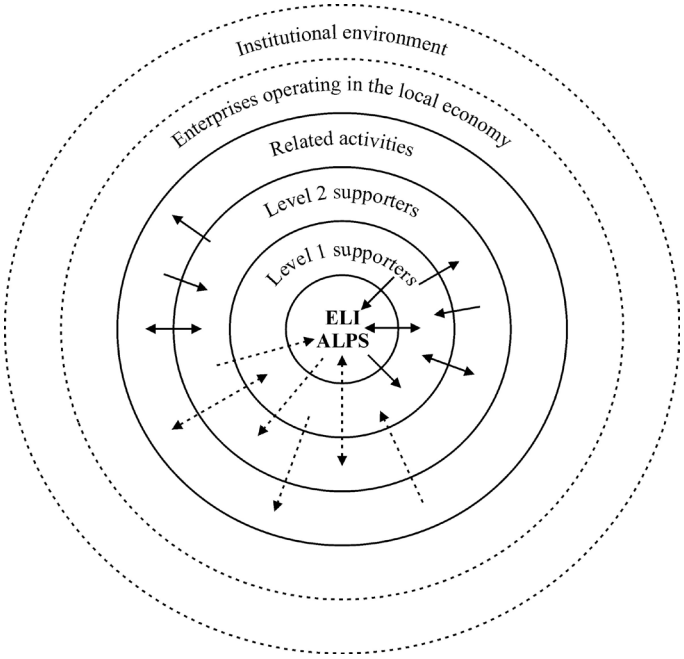
not generate a supplier dependence as strong as what is visible in the case of a manufacturing industry supplier network, and instead only carries the function of initiating the development of geographical concentration.

An **incubator** is to be established within the science park, which would not only provide rooms for starting enterprises with advantageous conditions, but also provide high-quality and cheap business services (counselling, accounting, information technology, etc.).

Promoting regional spillovers

The types of relationships of the companies to the ELI-ALPS and the science park are easiest to describe in the form of concentric circles based upon their technology-orientedness and their demand for geographical proximity (Figure 4).

Figure 4 The types of activities organised around the ELI-ALPS



Source: prepared by the authors

- **Level 1 supporters** are the divisions of primarily multinational companies settling in the science park and maintaining direct (even daily) contact with the ELI-ALPS. Geographical proximity is vital for level one supporters, since these companies are closely related or are suppliers (maintenance staff, etc.) to the technological operation of the ELI-ALPS and/or settled there because of the expected basic research findings.
- The **second concentric circle** depicts so-called **level 2 supporters** that are in indirect contact with the ELI-ALPS and have a direct (supplier or R&D&I) relationship with the companies in the first concentric circle. In their case, geographical proximity to level 1 supporters is vital, since they utilise the latter supporters' applied research or experimental development results, or are their suppliers, whereas they only have an indirect R&D or supplier's relationship with the ELI-ALPS. This group includes, among others technology-oriented start-up companies connected in some way to research conducted in the ELI-

ALPS, which have a high risk and therefore the services provided by the science park are vital to them.

- The **third concentric circle** is where we find the so-called **related activities** that have a direct (supplier or R&D&I) relationship with the enterprises in the first and second concentric circles, and which presumably have no direct relation towards the ELI-ALPS. They logically include, among others, primarily local companies that have no technological relationship with any research conducted in the ELI-ALPS (their activities including patenting, interpretation, information technology, etc.) and also other, technologically prepared local companies striving to apply the new technologies based upon the findings of the research conducted in the ELI-ALPS. Although in the case of the latter companies a relationship (technological) proximity is vital, a further advantage is constituted by geographical proximity, since, in possession of local, "noiseless" information they can start development earlier and at a lower risk than distant competitors, thus most of them will probably settle in the science park.
- The **fourth and fifth concentric circle** is where we primarily find those mostly **local enterprises** that may have any (supplier or R&D&I) relation with the enterprises in the science park and **local institutions** that fundamentally influence the broader city and county business environment of the science park. The enterprises of the fourth circle and the institutions of the fifth circle are not expected to settle in the science park, but will, however, maintain an intense relationship with those in the park.

The description above clearly illustrates that the establishment of a science park in the immediate environment of the ELI-ALPS is of vital importance from the aspect the enterprises of the local economy. The reason being that the existing enterprises in the area will not, or only to a limited extent and in small numbers be capable of establishing any business relations with the ELI-ALPS initially, due to its special nature. It is rather the divisions of the high-tech international companies settling in the science park that would be expected to primarily constitute significant business relationships with enterprises of the local economy, more precisely, mainly the level 2 supporters and those performing related activities and, to a lesser extent level 1 supporters.

Culture change: responsible innovation

The ELI-ALPS and the science park may also become initiators of a change in approach and culture (entrepreneurial spirit, risk taking, tolerance, etc.) observed by Huggins and Strakova (2012) necessary for knowledge-intensive activities in an emerging region. Disseminating the concept of **regional responsible innovation** (RRI) is an important part of that process. The ELI-ALPS and the science park to be established around it could create a geographical concentration, an innovative environment where the introduction and dissemination of the concept of responsible innovation may result in real positive effects. The adaption of the RRI approach on behalf of the ELI-ALPS is the first step of the introductory phase. It may well be expected of the introduction of RRI that the approach would reach the organisations settled in the park through various channels and, through them, the local enterprises related to them too (Gyurkovics and Lukovics 2014).

4.3 Firm-oriented policy: integrated enterprise development programme

The development of the infrastructure – in this case, the science park – is necessary, but not satisfactory for successful local economic development, thus efforts must be made to strengthen existing and newly established enterprises. The enterprise development strategy is based upon

a defined target system and the related three enterprise development interventions, which carry special characteristics in a less developed country (Kállay and Lengyel 2009).

Business environment, start-ups
Services that help to become an entrepreneur and aid the operation of inspiring, new companies are required:

- **Education, a conscious development of "entrepreneurship" and business management competences**: high-level enterprise education is required for the ELI-ALPS, the researchers and experts of the science park and the professors and students of the University of Szeged to ensure the establishment of spin-off enterprises with a large growth potential. For that purpose, a practical education of entrepreneurial and business skills must be organised for actors with no economic qualifications (researchers).
- **Developing special business development services for spin-off and start-up enterprises**: special business development services (consulting, mentor programmes, early growth management) that contribute to long-term success both during establishing an enterprise and throughout its operation are of utmost importance. Developing a consulting background specialising in knowledge-intensive enterprises is worthwhile in the long run in the case of such concentration.
- **Managing knowledge transfer and technology transfer**: installing technologies that are key sectors within the European Union (e.g. photonics, medical device manufacturing) would significantly enhance the success of the economic region developing around the science park. The conscious management of the knowledge and technology transfer based upon these sectors, with, for instance, technology transfer offices, could expedite the development of knowledge-intensive enterprises.

Access to finance
Newly started and rapidly growing knowledge-intensive companies have special financing demands, which can only be efficiently supported with special financing structures.

- **Supporting seed funding, or business angel financing**: the greatest obstacle for larger-scale and successful investments is usually not the insufficient amount of risk capital, but the actors even finding each other. Connecting to various business angel networks and organising investors' forums or brokerage events is therefore of special importance. These include the preparation of knowledge-intensive enterprises (the receiving side) for receiving risk capital.
- **Supporting donor financing**: monitoring domestic and EU grants and preparing and managing application materials are a great help both for the enterprises in the science park and the related knowledge-intensive companies in the city region. The professional background satisfactory to the current regulators must be established, with a clear distinction between tasks to be performed by the community funded (non-profit) and the for-profit sectors.

Access to knowledge networks
Knowledge-intensive companies possess both local relationships (based on geographical proximity) and global relationships (based on technological proximity), which are equally necessary for success in international competition.

- **Supporting foreign market expansion, encouraging export**: the international relationships of the companies strengthening in the park are of fundamental importance

for appearing on the export market, thus consciously managing efficient external market relationships and networks is an important task. Personal meetings are also required to establish relationships, which have to be facilitated by organising business meetings, conferences and workshops, appearing at exhibitions, inviting guest researchers and professors, etc.

- **Encouraging business and scientific networks**: connecting to interpersonal and business networks makes it easier for researchers and corporations to get access to existing knowledge and experience and also to create new knowledge and at the same time decrease the risk of their decisions (clubs, associations, etc.). The professional relationships can also be reinforced by organising ad-hoc meetings.

4.4 Strategic role of the university

Due to its size and position, the University of Szeged participates in the development and implementation of the activities of both system-oriented and firm-oriented policies: it is an organiser of training courses adapting to the labour force demand of knowledge-intensive companies, one of the entities preparing regional economic development decisions, an active participant in forming university-industry relationships, and an actor in local enterprise development programmes. Therefore, it has an especially important role in promoting spillover, developing the science park, the practical introduction of the concept of responsible innovation, facilitating access to financial sources and knowledge networks and developing the business environment (Table 2).

Table 2 The possible role of the university in each programme

Name	Possible university activities
ELI Science Park	• performing economic impact analysis of companies settled in park • promoting local embedding of settlers • contributing to the exploitation of the economic development potential of the ELI and the science park • organising relationships between settling companies and university departments and institutes • extension training and courses provided for the employees of settling companies
Regional spillovers	• developing local innovation system • establishing economic and enterprise development centre • preparing economic situation analyses • operating technology transfer office • organising informal meetings, professional forums and business clubs • organising training for related activities generated by the ELI-ALPS

Name	Possible university activities
Culture change: responsible innovation	• disseminating the approach of responsible innovation • facilitating the practical introduction of responsible innovation • providing training in laser application opportunities • strengthening engineering training • organising related PhD programmes, advertising research topics • inviting guest professors and researchers
Business environment, start-ups	• wide-scale education of entrepreneurial skills • developing legal, business, IT, etc. consulting network • organising patenting procedure • organising brainstorming sessions • screening project ideas • managing mentoring network • consulting in strategic planning • monitoring grants, preparing applications and consulting
Access to finance	• providing help in reaching investors, business angels • organising investors' meetings • helping the preparation of business plans
Access to knowledge networks	• organising international conferences • organising business meetings • strengthening international professional relations with fellow universities • supporting international research cooperation

A "Strategic Council" ought to be established from the representatives of the concerned departments and research institutes at the University of Szeged that would prepare and constantly monitor the accession of the various university divisions to the aforementioned programmes. One of its important tasks would be to sense and indicate in a timely manner, if any deviations or negative phenomena were seen in programmes the university participated in. It is also important that an 'Economic and Enterprise Development Centre' should operate at the University of Szeged, which would establish and maintain a relationship between the research institutes and the knowledge-intensive companies, and would coordinate the services of the related university divisions (training, events, consulting, etc.).

5 Summary

A high-tech laser research centre, the ELI-ALPS, is implemented in Szeged, a university town in one of the less developed regions in Hungary. This international research institute, operational as of 2016, will operate laser equipment unique worldwide, which can be utilised by both scientific

researchers and industrial appliers. The ELI-ALPS was placed in Szeged for fundamentally two reasons: in order to exploit the internationally renowned scientific capacity existing there and also to boost the development of the local knowledge-based economy and enterprises. The research institute is an opportunity in Szeged that both the city and the university wish to utilise in order to facilitate the economic development of the region.

According to international experiences, an efficient collaboration between the town leadership, the city's institutions and the university and its research institutes is necessary in a small university town of a less developed region in order to strengthen knowledge-intensive economy. The management and the logical framework of knowledge-based local economic development concepts ought to be financed within the framework of a bottom-up smart specialization strategy (RIS3) supported by the EU.

Based upon the literature and local characteristics, we believe that in the case of the expected economic development impacts generated by the ELI-ALPS we must distinguish two chronologically consecutive phases. In the first phase, two elements of microeconomic fundamentals must be strengthened: economic development that improves the quality of the business environment and the refinement of corporate operation and strategy. The research conducted in the framework of the ELI-ALPS provide an opportunity for a multitude of business applications, therefore, it is impossible to say today, which activities will form clusters. Thus, encouraging knowledge-intensive clusters shall take place in the second phase when the number of companies related to the activities of the ELI-ALPS has reached critical mass in a sector.
In the first step of the development strategy, we recommend establishing a science park, including an incubator, which would be established directly neighbouring the ELI-ALPS and would provide a home to knowledge-intensive enterprises, settling companies and start-ups. Supporting enterprise development is also very important, so that knowledge-intensive companies be established related to the university and so that local enterprises be able to become business partners of the companies operating in the science park.

References

Anselin L, Varga A, Acs Z (1997) Local geographic spillovers between university research and high technology innovations. Journal of Urban Economics 42: 422–448.

Benneworth P (2004) In what sense 'regional development?': Entrepreneurship, underdevelopment and strong tradition in the periphery. Entrepreneurship & Regional Development 16(6): 439–458.

Benneworth P, Charles D (2005) University spin-off policies and economic development in less successful regions: learning from two decades of policy practice. European Planning Studies 13: 537–557.

Benneworth P, Hospers GJ (2007) Urban competitiveness in the knowledge economy: Universities as new panning animateurs. Progress in Planning, 105-197.

Boschma R (2005) Proximity and Innovation: A Critical Assessment. Regional Studies 1: 61–74.

Capello R (2007) Regional economics. London – New York: Routledge.

Capello R, Faggian A (2005) Collective Learning and Relational Capital in Local Innovation Processes. Regional Studies 1: 75–88.

Carayannis,EG, Rakhmatullin R (2014). The Quadruple/Quintuple Innovation Helixes and Smart Specialisation Strategies for Sustainable and Inclusive Growth in Europe and Beyond. Journal of Knowledge Economy 5: 212–239.

EC (2012) Guide to Research and Innovation Strategies for Smart Specialisations (RIS 3). Luxembourg: European Commission.

EC (2014). National/Regional Research and Innovation Strategies for Smart Specialisation (RIS3 strategies). Luxembourg: European Commission.

Etzkowitz H, Leydesdorff L (2000) The dynamics of innovation: from National Systems and ‘‘Mode 2’’ to a Triple Helix of university–industry–government relation. Research Policy 29: 109-123.

Goddard J, Vallance P (2011) Universities and regional development. In Handbook of Local and Regional Development, edited by Pike, A, A. Rodríguez-Pose, J. Tomaney, 435-437. London – New York: Routledge.

Goldstein HA, Renault CS (2004) Contributions of universities to regional economic development: a quasi-experimental approach. Regional Studies 38 (7): 733–746.

Gyurkovics J, Lukovics M (2014) Generations of Science Parks in the Light of Responsible Innovation. In Responsible Innovation, edited by Buzás, N, M. Lukovics, 193-208. University of Szeged, Faculty of Economics and Business Administration, Szeged.

Harding A, Scott A, Laske S, Burtscher C eds. (2007) Bright Satanic Mills - Universities, Regional Development and the Knowledge Economy. Aldershot: Ashgate.

HCSO (2014) Research and Development 2013. Budapest: Hungarian Central Stastistical Office.

HCSO (2015) STADAT system. Budapest: Hungarian Central Stastistical Office.

Huggins R, Johnston A (2009) The economic and innovation contribution of universities: a regional perspective. Environment and Planning C: Government and Policy 27(6): 1088-1106.

Huggins R, Johnston A, Stride C (2012) Knowledge networks and universities: locational and organisational aspects of knowledge transfer interactions. Entrepreneurship and Regional Development 7-8: 475-502.

Huggins R, Strakova L (2012) Knowledge-based economic development in emerging regions: policy issues and implications in the Balkan Peninsula. Regional Studies 7: 961-975.

Huggins R, Williams N (2011) Entrepreneurship and regional competitiveness: The role and progression of policy. Entrepreneurship and Regional Development 23 (9–10): 907–932.

Julien PA (2007) A Theory of Local Entrepreneurship in the Knowledge Economy. Cheltenham-Northampton: Edward Elgar.

Kállay L, Lengyel I (2008) The Internationalization of Hungarian SMEs. In Handbook of Research on European Business and Entrepreneurship. Towards a Theory of Internationalization, edited by Dana LP, Welpe IM, Han M, Ratten V 277-295. Cheltenham- Northampton: Edward Elgar.

Lawton Smith H (2003) Local innovation assemblages and institutional capacity in local high-tech economic development: the case of Oxfordshire. Urban Studies 40 (7): 1353–1369.

Lawton Smith H (2006) Universities, Innovation and the Economy. London and New York: Routledge.

Lawton Smith H, Glasson J, Chadwick A (2005) The geography of talent: entrepreneurship and local economic development in Oxfordshire. Entrepreneurship and Regional Development 17: 449–476.

Lengyel B, Leydesdorff L (2011) Regional innovation systems in Hungary: The failing synergy at the national level. Regional Studies 5: 677-693.

Lengyel B, Ságvári B (2011) Creative occupations and regional development in Hungary: mobility of talent in a one-centred transition economy. European Planning Studies 19(12): 2073-2093.

Lengyel I (2009) Knowledge-based local economic development for enhancing competitiveness in lagging areas of Europe: The case of the University of Szeged. In Universities, Knowledge Transfer and Regional

Development: Geography, Entrepreneurship and Policy, edited by A. Varga, 322-349. Cheltenham-Northampton: Edward Elgar.

Lengyel I, Rechnitzer J (2013) Drivers of Regional Competitiveness in the Central European Countries. Transition Studies Review 20(3): 421-435.

Lengyel I, Szakálné Kanó I (2012) Competitiveness of Hungarian Urban Microregions: Localization Agglomeration Economies and Regional Competitiveness Function. Regional Statistics 52(2): 27-44.

Lukovics M, Zuti B (2013) Successful universities towards the improvement of regional competitiveness: 'Fourth Generation' universities. Paper presented at the „Regional Integration: Europe, the Mediterranean and the World economy, 53th Congress of the European Regional Science Association (ERSA), Palermo, Italy, August 27-31.

Malecki EJ (2014) The Geography of Innovation. In Handbook of Regional Science, edited by Fischer M, Nijkamp P 375-389. Heidelberg: Springer.

McCann P (2013) Modern Urban and Regional Economics (2nd ed.). Oxford: Oxford University Press.

McKelvey M, Holmén M eds. (2009) Learning to Compete in European Universities. From Social Institution to Knowledge Business. Cheltenham- Northampton: Edward Elgar.

Nauwelaers C, Kleibrink A, Stancova K (2014). The role of science parks in smart specialisation strategies. JRC Technical Reports, S3 Policy Brief Series, No. 08/2014, European Commission.

Pawlowski K (2009) The 'Fourth Generation University' as a Creator of the Local and Regional Development. Higher Education in Europe 34(1): 51-64.

Pike A, Rodríguez-Pose A, Tomaney J (2006) Local and Regional Development. London – New York: Routledge.

Pike A, Rodríguez-Pose A, Tomaney J eds. (2011) Universities and regional development. In Handbook of Local and Regional Development. London – New York: Routledge.

Porter ME (1998) Clusters and the New Economics of Competition. Harvard Business Review 11-12: 77-90.

Porter ME (2008) On Competiton. Updated and Expanded Edition. Boston: Harvard Business Review Book.

Radosevic S, Myrzakhmet M (2009) Between vision and reality: Promoting innovation through technoparks in an emerging economy. Technovation 29: 645-656.

Saxenian A (1994) Regional Advantage. Cambridge, MA: Harvard University Press.

Stimson R, Stough RR, Nijkamp P (2011) Endogenous Regional Development. Cheltenham: Edward Elgar.

Stimson RJ, Stough RR, Roberts BH (2006) Regional Economic Development. Analysis and Planning Strategy. Berlin: Springer.

Szakálné Kanó I, Vas Zs (2013) Spatial Distribution of Knowledge-intensive Industries in Hungary. Transition Studies Review 19(4): 431-444.

Thissen M, van Oort F, Diodato D, Ruijs A (2013) Regional Competitiveness and Smart Specialization in Europe: Place-based Development in International Economic Networks. Cheltenham: Edward Elgar.

Van Oort F, Lamboy JG (2014). Cities, knowledge, innovation. In Handbook of Regional Science, edited by Fischer, M, P. Nijkamp, 475-488. Heidelberg: Springer.

Varga A (2007) Localized knowledge inputs and innovation: The role of spatially mediated knowledge spillovers in Hungary. Acta Oeconomica 1: 1-20.

Varga A ed. (2009) Universities, Knowledge Transfer and Regional Development: Geography, Entrepreneurship and Policy. Cheltenham- Northampton: Edward Elgar.

Vilmányi M (2011) The relationship performance in the field of university-industrial R&D cooperation. In Diversity of Research at the Szeged Institute of Business Studies, edited by Hetesi, E, Zs. Kürtösi. 75-95. JATEPress: Szeged.