

## UNIVERSITIES, KNOWLEDGE NETWORKS AND LOCAL ENVIRONMENT FOR INNOVATION-BASED REGIONAL DEVELOPMENT: CASE STUDY OF THE UNIVERSITY OF MARIBOR

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### **Universities, knowledge networks and local environment for innovation-based regional development: case study of the University of Maribor**

This paper deals with the importance of cooperation between knowledge institutions, the economy and the local environment to establish innovation-based regional development. Knowledge has become crucial for regional, innovation and development processes. The endogenous growth theory as well as the triple/quadruple helix concept emphasize the role of institutions of knowledge, not only in the creation of knowledge and ideas, but also in their transfer into practical use. Scientific and research institutions as well as educational institutions play a key role in contributing to the economic development and technological advancement of regions. In the case of the transfer of knowledge and scientific findings into practice, it is necessary to proceed from the whole complex of economic, social and ecological conditions for development. The goal of the University of Maribor is to develop an innovative ecosystem which will create a symbiosis between the University, the economy and the local communities through open innovations and technologies and through the creation of knowledge for new professions.

**Key words:** regional development, knowledge networks, education, research and development, innovative open technologies, University of Maribor, Slovenia

### INTRODUCTION

After the World War II, intensified globalisation of the economy occurred. The developed economies faced lower-priced competitors from developing countries. The traditional industrial sectors that did not detect danger and did not adapt to the new market conditions on time, influenced the crisis in the economically developed countries. This process started in the middle of the 20th century, initially in the United States of America, and spread to European economies in the 1970s and 1980s. Searching for a way out of the crisis led to the change in the industrial production paradigm, and the transition from Fordism to post-Fordism, while the mass production of material goods was replaced by an innovative, flexible production of goods, intended for target consumer groups. The service sector began to strengthen and the transition to information society occurred. Scientific development and technological advances caused structural changes in the economy (Lorber 1999).

Knowledge is now recognised as a key ingredient underlying the competitiveness of regions, nations, sectors and firms. At its most fundamental level, the knowledge-base of an economy can be defined as the capacity and capability to create and innovate new ideas, thoughts, processes and products, and to translate these into economic value and wealth (Huggins and Izushi 2007 and Huggins et al. 2008).

This paper studies various development policies and connections among the stakeholders of regional economic development. In the search for new innovative solutions for raising the competitiveness of regions, both in the social and economic sphere, the integration of knowledge institutions is essential.

At the most basic level, universities can be anchor institutions in local economies as major employers across a wide range of occupations, purchasers of local goods and services and contributors to the cultural life and the built environment of towns and cities. Regional investment in the infrastructure of a university to support its core business of research and teaching can therefore have a significant passive regional multiplier effect, even if the university is not actively supporting regional development. The main focus on promoting the active engagement of universities in regions has been in terms of their contribution to Regional Innovation Systems (EU 2011).

Smart specialisation as a strategic approach for an innovation-driven regional development policy is extremely important in the European policy context and a precondition for accessing significant amounts of funding. It will be the basis for European Structural and Investment Fund interventions in research and innovation (R&I) as part of the future Regional and Cohesion Policy's ambition to the European 2020 jobs and growth agenda (Asheim and Grillitsch 2015). The innovation system approach was born in an OECD (the Organization for Economic Co-operation and Development) project on "Science, Technology and Competitiveness" at the beginning of the 1980s. It builds on the premise that innovation is the key for competitiveness in a knowledge economy. Moving away from price-competition and a focus on comparative advantages, the future for advanced economies was seen in introducing new and improved products and processes, organisational routines and marketing strategies by promoting increased learning and innovation capacity. Innovation, interpreted in a Schumpeterian sense, was given the highest priority in order to promote the recombination of knowledge and resources in novel ways that create a higher value (Asheim et al. 2015).

Simultaneous to the emergence of the innovation systems approach in the 1980s, the concept of industrial districts was rediscovered and used to explain the success of post-Fordist regions characterised by flexible production systems and tight inter-firm networks giving rise to external economies of scale (Brusco 1982, Pyke et al. 1990, Asheim 2000 and Asheim et al. 2015). The notion of an industrial district began with the classical contribution of Alfred Marshall in his work "Principles of Economics" (Marshall 1920 and Gust-Bardon 2012). It was a revival of Marshall's ideas on the importance of local and regional context for the exchange of knowledge, the development of a local labour market and supplier industries (Asheim et al. 2015).

Following the idea that in economy competitiveness is increasingly based on the capacity to develop and apply knowledge, the concept of "Learning Regions" was coined by academic authors working in the field of innovation studies and economic geography (Florida 1995 and Morgan 1997). In the academic arena, the "Learning Region" presented a synthesis between new ideas from evolutionary economics – with emphasis on the institutional underpinning of systemic process of innovation and learning – and new theories on the role of spatial agglomeration. More recently, the "Learning Region" also became associated with the role of higher education and educational organisations at the regional level (Goddard 1998 and Lagendijk and Cornford 2000).

According to Florida, the new age of global, knowledge-intensive capitalism demands a new type of region being defined by similar standards as companies: permanent improvement, original ideas, learning processes and the formation of knowledge. The scholar stresses the necessity of accepting the rules of knowledge formation and permanent learning by regions – they have to evolve into learning regions in the process. Florida regards learning regions as “collectors and repositories of knowledge and ideas that provide an underlying environment or infrastructure which facilitates the flow of knowledge, ideas and learning” (Florida 1995 and Gust-Bardon 2012).

In this paper, we present and analyse the activities and efforts of the University of Maribor – the leading research and educational institution in the Eastern Slovenia cohesion region – to consolidate its role as an initiator and actor of knowledge transfer, innovative ideas and collaboration of the economy, the local government and the community (quadruple helix) through the appropriate development policy, planning and by providing the suitable support infrastructure.

## METHODS

In this article, we used both secondary and primary sources. In the use of secondary sources we focused on explaining these sources, identifying and classifying facts. We analysed and interpreted the secondary sources (books, articles, scholarly reports), and presented what was discovered through the study of sources and composed with the synthesis to the essence of the studied subject. By analysing and interpreting the primary sources (documents, annual reports of the UM, the UM Development Strategy) we interpreted the acquired data and examined the basis for concrete actions for implementation in practice. In addition, we focused on the historical development analysis, which helped us to determine the past development of the (University of Maribor) knowledge institutions' involvement into the efforts for regional socio-economic development. We used the method of analysis to describe facts about the creation of a supportive environment of the University of Maribor. These facts are corroborated by theories that enable the interpretation of the phenomenon.

## REGIONAL INNOVATION SYSTEMS

The notion of a Regional Innovation System (RIS) appeared as a territorially-oriented approach to innovation processes from a broader concept of a National Innovation System (NIS) in the early 1990s. The concept of the NIS views innovations as dynamic and interactive learning processes between companies and other organizations whose activities lead to initiation, diffusion, modification of new technologies and determine the innovative performance of national firms (Freeman 1995 and Gust-Bardon 2012).

Asheim (2007) defines the RIS as “the institutional infrastructure supporting innovation within the productive structure of a region” and identifies two subsystems of actors constituting the RIS. The first subsystem is called the regional production structure – consisting of companies for the most part. The second subsystem is called the regional supportive infrastructure (institutional infrastructure) and it comprises: public and private laboratories, higher education organizations, technology transfer agencies, business associations, finance institutions and vocational training organisations (Gust-Bardon 2012).

How the RIS is more specifically conceptualised partly depends on whether a top-down or bottom-up perspective on the RIS is taken (Howells 1999). It is important to note that both perspectives are complementary to each other (Howells 2005 and Iammarino 2005). The top-down approach is more closely related to the national innovation systems approach, in particular to its “European version” (Lundvall and Maskell 2000). It focuses on the specific way(s) that the dynamic interaction between the knowledge exploitation and knowledge generation subsystem of a region is organised. The bottom-up approach, on the other hand, is more concerned with the actual knowledge and learning dynamics between actors in the regional knowledge network (Howells 1999 and Coenen 2007).

The RIS is basically not about specialisation as is known from previous regional development strategies, i.e. Porter based cluster strategies. Porter (1998 and 2000) defines a cluster as “a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities”, but about diversification or diversified specialisation/specialised diversification. Thus, “smart diversification” would have been a better description of the strategy (Asheim and Grillitsch 2015).

Most regional development studies literature has focused on the way in which businesses support infrastructure (technology transfer centres, regional development agencies, universities, etc.), innovate, learn, and manage and transfer knowledge (Lagendijk and Cornford 2000).

**Tab. 1. RIS deficiencies in old industrial regions and in fragmented metropolitan regions**

Problem dimension	Old industrial region	Fragmented metropolitan region
Industry characteristics / problems	Often specialised on mature industries, large firm dominance	Many industries/services but high profile and knowledge based clusters often missing
Firm innovation activities	Mature technological trajectories, domination of incremental and process innovation	R&D in headquarters of large firms and in high-tech companies, product innovation and new firm formation often below expectation
Universities/research	Often oriented on traditional	Many and high quality, but often weak industry links
Education/training	Emphasis often on technical skills; managerial skills and ‘modern’ qualifications often missing	Large variety of schools and other educational organisations
Knowledge transfer	Many and specialised transfer organisations but weakly coordinated	In general a high density of such services, mostly commercialised
Network characteristics / problems	Often characterised by technological and/or political lockins	Market links dominate, often few cluster and innovation related networking

Source: Tödting and Trippel (2005).

Regional development can be properly divided into exogenous and endogenous development. Elementary exogenous factors are based on an appropriate valuation of imports of advanced technologies and direct foreign investments, often in conjunction with the extraction of natural resources. Exogenous knowledge-based regional development strategies, founded on relocation/attraction of firms from elsewhere, often subsidiaries or R&D centres of large multinationals, rely on marketing local assets, such as skilled workforce, good infrastructure and living conditions (Feldman and Francis 2004). The OECD Skills Strategy sets out a roadmap for investing in skills throughout the lifecycle, from early childhood to working life. It is not just about developing skills, but developing relevant skills.

Smart specialization strategies can be translated into practice by implementing the following steps (European Commission 2012):

- Step 1 – Analysis of the regional context and potential for innovation,
- Step 2 – Governance: ensuring participation and ownership,
- Step 3 – Elaboration of an overall vision for the future of the region,
- Step 4 – Identification of priorities,
- Step 5 – Definition of coherent policy mix, roadmaps and action plan, and
- Step 6 – Integration of monitoring and evaluation mechanisms.

Exogenous strategies are usually promoted on a top-down basis by active external factors such as central governments, private banks or transnational firms, which inject resources from outside the region to create jobs, wealth and a larger local tax base (Rangaa and Etzkowitz 2013).

On the other hand, endogenous development is based on the strengthening of local intellectual capital and on supporting the institutions, such as higher education institutions, research centres, business incubators and science parks, established to consider all available resources of individual regions (Farinha and Ferreira 2013). Endogenous knowledge-based regional development strategies recognise that local factors, such as a strong knowledge base, skilled labour services and proximity to the sources of knowledge and expertise, are much more important than cost reductions, especially for high-tech firms. Therefore, creating the infrastructure for local knowledge creation and knowledge-based firm formation and growth is the essence of an endogenous high-tech regional development strategy (Feldman and Francis 2004). Endogenous strategies are usually promoted bottom-up, emphasising high-tech entrepreneurship and local capacity-building through better use of local capital resources, increased local control and greater equity (Blakely 1989 and Rangaa and Etzkowitz 2013).

Radošević (2002), who was critical as to whether the RIS could be observed in Central and Eastern Europe, suggested that the key focus should be on the factors determining the emergence of the RIS, which according to him depend on the interplay between national, regional, micro-specific and sector-specific determinants. Against the backdrop of post-socialist transformation at the regional level, the RIS should be analysed from a multi-level perspective. Evidently, even though Radošević concluded that Central and Eastern European countries still have a formidable task ahead to establish strong RIS, the approach has been useful to identify the systemic deficiencies that hamper innovation, which relates less to the

presence of the RIS organisations but more to their quality and the local collaborative networks (Asheim et al. 2015).

### THE IMPORTANCE OF KNOWLEDGE INSTITUTIONS AND THEIR NETWORKING FOR REGIONAL DEVELOPMENT

Knowledge has become crucial for regional, innovation and development processes. Each development is conditioned by the ability of the environment to deploy and search for new innovative solutions. The knowledge triangle represents a framework for spatial research, in which the actors involved in education, research and innovation interact (Scott 2015). The role of scientific research and educational institutions in the innovative and socio-economic regional development policies is increasing significantly. Knowledge institutions participate in solving global challenges and contribute to the economic and technological development and social progress of local communities and regions. Stimulation of the entrepreneurial mindset, which in its basic definition involves the identification of any need and its fulfilment, leads to openness to innovation, spreading of knowledge and experience, and cooperation. Entrepreneurially oriented knowledge institutions depend on the individuals and their innovative approaches. Stimulation of entrepreneurial mindset is not something new, it is recognition and an innovative way of dealing with what already exists (Gibb 2013). The local and regional dimension of the innovation processes and policies is increasingly important in the post-Fordist period of regions of knowledge (Cooke et al. 2004 and Asheim 2007). The knowledge region is clearly a triple helix phenomenon par excellence: universities, governments and industries combine their efforts to construct a common advantage which they would not be able to offer on their own. They develop ideas which are enhanced by each other's perspectives, difficult as it may be sometimes to bridge different perspectives and interests. Intermediary organisations play a decisive role as the key facilitators of such interrelations, as motors of the triple helix interaction (Reichert 2006).

The triple helix model emerged from the analysis of academic research on the restructuring of the Boston economy in the 1930s through the cooperation of universities, industries and the government (Etzkowitz 2002). In the beginning, the government had a leading role (exogenous approach), followed by the industries (endogenous approach), and in the third stage, knowledge-based society and knowledge institutions (holistic approach) in partnership with the economy and government in joint initiatives for balanced models (Etzkowitz and Leydesdorff 2000 and Etzkowitz 2008 and Leydesdorff 2012). Regional development, to meet broader social needs, depends not only on economic development but also on the development of non-economic activities. In many countries and regions citizens have also become increasingly aware of the importance of the knowledge economy in general, and the role of the universities in particular, to ensure current and future wealth creation (Reichert 2006). The idea of the importance of the public as a fourth party in the system was already proposed by Mehta (2002) at the International Workshop on Science, Technology and Society in Singapore. Mehta proposed that the science and innovation system should include the public as a "fourth helix", given its influential role e.g. regarding the acceptance and resistance of new technologies (Reichert 2006 and Arnkil et al. 2010). Thus, the public may constitute a fourth party whose concerns and ideas have to be taken as seriously as those of the others. Indeed, we could say that knowledge regions are not so much

built on triple helix interactions but constitute a quadruple helix system (Reichert 2006 and Lorber 2015).

Universities and researchers must also accept the fact that research is no longer an isolated activity and that the research interest is shifting from individual researchers to teams and global research networks (Jenniskens 2001). When transferring scientific findings into practice, it is necessary to proceed from the whole complex of economic, social and ecological conditions for development. In the new forms of production (of scientific knowledge), which were established in the 1990s in the scientifically and technologically developed countries, the applicative and developmental role of science is crucial (Mali 1995). Knowledge transfer is as a model network, transferring from academic and other non-industrial institutions to the industrial sector. In this way, it is no longer a one-way course from basic to applied knowledge, from research to development, but the constant interplay of various factors (Lorber 2003a and 2010).

Synthetic knowledge tends to differ from place to place, while analytic knowledge is more codified, abstract and universal. As a consequence, innovation networks that rely on synthetic knowledge tend to be more local, while innovation networks built on analytic knowledge tend to be more global (Liu et al. 2013). Symbolic knowledge is related to the creation of meaning and desire as well as the aesthetic attributes of products, such as designs, images and symbols and its economic use. The increasing significance of this type of knowledge is indicated by the dynamic development of cultural production such as media (film making, publishing and music), advertising, design, brands and fashion (Asheim and Isaksen 1997).

The exchange of academic research and knowledge with the economy and society is still inadequate and undervalued within the academic community. Knowledge is a far broader concept than R&D. Knowledge transfer has weak effects on economic and social development, researchers with PhDs remain in academic circles at the universities and do not continue their careers in particular economic sectors and entrepreneurship (Clark 1998 and Lorber 2010).

An analytical knowledge base refers to economic activities, where scientific knowledge based on formal models and codification is highly important. A synthetic knowledge base refers to economic activities, where innovation takes place mainly through the application or novel combinations of existing knowledge (Asheim and Grillitsch 2015). Such a broad-based innovation strategy is in line with the innovation system perspective of defining innovation as interactive learning combining an STI (science, technology and innovation) and a DUI (doing, using and interacting) mode of innovation (Asheim and Isaksen 1997, Lorenz and Lundvall 2006 and Svare 2016).

Tacit knowledge is more important than the analytical one, in particular due to the fact that knowledge often results from experience gained at the workplace and through learning by doing, using and interacting. Compared to the analytical knowledge base, there is more concrete know-how (craft and practical skills) required, which is provided by technical universities, polytechnics or by on-the-job training. Overall, this leads to a rather incremental way of innovation, dominated by the modification of existing products and processes (Asheim and Grillitsch 2015).

**Tab. 2. The main characteristics of synthetic and analytic knowledge base**

Analytic (Science-based)	Synthetic (Engineering-based)
Innovation by creation of new knowledge	Innovation by application or novel combination of existing knowledge
Importance of scientific knowledge often based on deductive processes and formal models	Importance of applied, problem-related knowledge (engineering)
Research collaboration between firms and research organisations and between research units	Interactive learning with clients and suppliers
Dominance of codified knowledge due to documentation in patents and publications	Dominance of tacit knowledge due to more concrete know-how, craft and practical skill
More radical innovation	Mainly incremental innovation
More globally spread	More national and regionally spread

Source: Asheim and Gertler (2005) and Martin and Moodysson (2011a and 2011b).

#### EASTERN SLOVENIA COHESION REGION CASE STUDY OF THE UNIVERSITY OF MARIBOR

Regional development is intended to reduce the development differences among regions. We limited our analysis to the regional division based on the NUTS (Nomenclature des unités territoriales statistiques), which is used for the collection, development and harmonization of regional statistics, socio-economic analysis and regional policy. According to this nomenclature, Slovenia is divided into two cohesion regions NUTS 2 (Western and Eastern Slovenia) and twelve NUTS 3 regions.

A cohesion policy is essential for the sustainable and balanced regional development of Slovenia. In the period 2014 – 2020 this policy has two priority objectives, namely “Investment for Growth and Jobs” and “European Territorial Cooperation”. In the future, it will be closely related to the achievements of the objectives of the “Europe 2020” strategy for smart, sustainable and inclusive growth and the European framework programme for research, development and innovation “Horizon 2020”.

When planning a balanced regional development, it is necessary to examine the actual situation in the regions. The data in Table 3 show the economic and social backwardness of the Eastern Slovenian cohesion region. Accelerating the process of deindustrialization has created new methodological approaches and the shift of economic activities from the secondary to the tertiary sector. Economic changes during the deindustrialization period firstly emerged in the regions dominated by old classic industrial production. New development trends have strengthened the service sector, while the importance of secondary and especially primary economic activity has decreased (Lorber 1999).

Changes in the post-industrial period have been accompanied by rapid urbanization, which has also affected the structural changes in space. Studying the regional development problems of Podravje (Lorber 2005), we noted that the exogenous development model has not developed cooperation between local and national partners when forming regional policy and has also neglected the importance of activating innovative potentials and development initiatives. It also neglected the large



potentials for interregional cooperation and for building a recognisable regional identity (Lorber and Žiberna 2014a and 2014b). Special focus was given to the target identification of local strengths and the use of untapped resources. In order to achieve the development goals, the investments in utility and IT infrastructure as well as in new forms of economic activity, including supplementary activities, are crucial. The success of investments depends on the optimal use of local resources, natural and cultural potentials of the region in interdependence with human capital (Lorber 2005 and 2015).

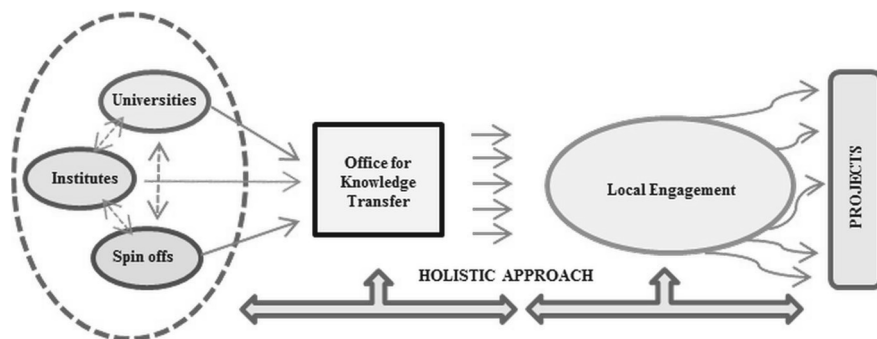
For the development breakthrough human capital is increasingly important. According to the World Bank, in the structure of total capital, defined as the manufacturing capital, human capital has with around 64 % the largest share, natural wealth has 20% and financial capital 16% share. Human capital, i.e. the knowledge and skills of the management of production processes, has reached such a high proportion thanks to the constant investment in this form of capital (Lorber 2002 and 2003a).

**Tab. 3. Selected socio-economic indicators on cohesion regions in Slovenia**

Indicator	SLO	W SLO	E SLO
Number of population in thousands (1.1.2016)	2 064	972	1 092
Mean age (1.1.2016)	42.7	42.2	43.2
Surface area of territorial unit in sq. km (1.1.2016)	20 273	7 840	12 432
Population density (1.1.2016)	101.7	124	87.8
GDP per capita, index SI = 100 (2014)	100.0	118.3	83.3
Activity rate in % (1.1. 2016)	55.8	56.9	54.9
Registered unemployment rate (1.1.2016)	8.9	7.5	10.2
Persons in employment whose workplace is not in cohesion region of their residence in % (31.12.2015)	9.4	3.6	14.0

SLO – Slovenia, W SLO – Western Slovenia, E SLO – Eastern Slovenia.

Source: Adopted from Lorber (2015), SORS.



**Fig. 1. A model for universities, institutes and spin-offs to stimulate local competitiveness**

Source: Lorber and Žiberna (2014b).

In order to achieve development goals, we need to strengthen the integration of knowledge at the local level. The link between research and regions does not exist today because most regions do not yet have clear strategies and because national research is focused on sectors, not regions (Drabenstott and Henderson 2006 and Lorber 2003b). In Slovenia, it can be noted that cooperation of development institutions and individual researchers is limited to projects and individual bilateral contracts. Only recently, Slovenian universities have started a trend to create a strategy to include research into the local environment.

It is particularly interesting that the fast growth of GDP resulted in widening regional disparities everywhere. Many authors have come to the conclusion that an increasing GDP means a smoothing of regional disparities in high-developed countries, while it means exactly the opposite for medium-developed countries. This is very true for Slovenia, where regional disparities increased during the period of the strongest economic growth. This is logical regarding the fact that the growth of less developed regions should be much faster than the growth of the most developed ones (Lorber 2011 and 2012).

In 2009 Slovenia fell into a deep economic crisis. Rapid growth after EU access was based on the rapid growth of export and cheap money, which promoted excessive growth in the building of homes, businesses and sports facilities on a mortgage basis. In 2009, the breakdown of the building industry began, which affected also building materials and the equipment industry. Access to money became extremely difficult practically overnight. Difficulties of large building companies affected their subcontractors and this resulted in a large number of bankruptcy processes of small enterprises (Lorber 2011 and 2012).

This time of recession should be used to implement distinct structural economic changes, which will enable the creation and growth of high-quality jobs. This means that the labour market will have to become more flexible and that educational reforms will have to be implemented. Restructuring of the public sector is supposed to be a priority to ensure social cohesion, which is the EU's global advantage in the context of the quality of life and the development of democracy (Lorber 2011).

**Tab. 4. Research and development activity indicators by indicators, year and cohesion region**

	SLO		W SLO		E SLO	
	2008	2014	2008	2014	2008	2014
Gross domestic expenditure on R&D (% of region. GDP)	1.7	2.4	2.1	2.7	1.1	2.0
Gross domestic expenditure on R&D (of total Slovenia)	100.0	100.0	71.3	64.0	28.7	36.0
Share of business enterprise funds in GERD	62.8	68.0	55.1	59.4	81.9	84.0
Share of government funds in GERD	31.3	22.0	38.1	28.2	14.4	10.0
Share of higher education funds in GERD	0.3	1.0	0.2	0.5	0.6	1.0
Share of private non-profit organisations funds in GERD	0.0	0.0	0.0	0.1	0.0	0.0
Share of funds from abroad in GERD	5.6	9.0	6.6	11.9	3.1	5.0
Researchers by region (% of total Slovenia)	100.0	100.0	80.5	75.0	19.5	25.0

Source: SORS

In the past number of years, the main focus was laid on improving infrastructure, which – due to a lack of investments into small and medium-sized enterprises – actually deepened regional disparities. In order to improve the sectoral structure, GVA and investments into Research and Development (R&D) will have to increase significantly. In the year 2008 the ratio of investment into R&D between Western and Eastern Slovenia was 71.3:28.7 (in 2014 – 64:34) as a percentage of Slovenia in total (Lorber 2012).

#### INCLUSION OF THE UNIVERSITY OF MARIBOR IN THE MODERN APPROACHES OF NETWORKED INNOVATIVE REGIONAL DEVELOPMENT “INNOVATIVE OPEN TECHNOLOGIES” PROJECT (IOT)

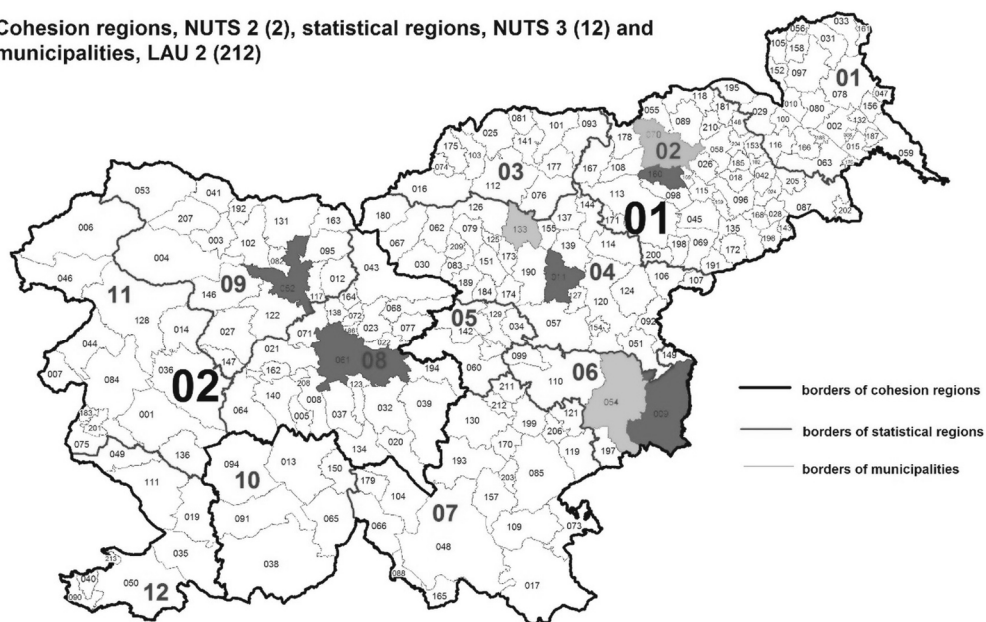
The role of universities as knowledge institutions in regional development can be identified in four areas:

- entrepreneurial innovativeness, which is closely, though not exclusively, linked to the research function of universities;
- human capital development is linked to the educational function of universities;
- the development of local/regional communities is linked to the function of universities as public institutions;
- contribution of universities to the institutional capacities for sustainable development of the region through active involvement in management at the local/regional level and involvement in civil society (EU Regional Policy 2011).

Knowledge institutions, mainly active in the first two areas, rank among the passive stakeholders of regional development. Both, the endogenous growth theory and the triple helix concept – university-industry-government interactions, emphasize the role of knowledge institutions, not only in the creation of knowledge and ideas, but also in their transfer into practical use (Veugelers and Del Rey 2014). Slovenian knowledge institutions with political support have been actively involved in global and regional development models only in recent years, in preparation for the disbursement from the cohesion funds in the context of the EU programme “Horizon 2020”. Progress can only be achieved through the continuing education and following of scientific and practical experience, comparable to more developed environments. An upgrade of teaching and research curriculums at all levels of education, including lifelong learning programmes, is necessary. Knowledge institutions play an important role in the development of human capital, basic and applied researches. New development approaches of open innovation as well as social conditions require stronger cooperation with the economy and local and regional environment in solving development dilemmas.

In Maribor, the higher education institutions were formed in the 1960s in order to meet the needs of the economy and the labour market. By strengthening the economy, the need for an increased role of knowledge and technological development emerged, and therefore in 1975 the higher education institutions were united under the University of Maribor. The University has currently 17 faculties, 15,000 students and 2,000 employees.

### Cohesion regions, NUTS 2 (2), statistical regions, NUTS 3 (12) and municipalities, LAU 2 (212)



Sources: Statistical Office of the Republic of Slovenia and Surveying and Mapping Authority of the Republic of Slovenia

Cohesion region NUTS 2	Region NUTS3	Municipalities LAU2	Faculties University of Maribor
Eastern Slovenia SI03 (01)	Podravska SI032 (02)	Maribor 070	Faculty of Economics and Business, Faculty of Electrical Engineering and Computer Science, Faculty of Law, Faculty of Civil Engineering, Transportation Engineering and Architecture, Faculty of Chemistry and Chemical Engineering, Faculty of Health Sciences, Faculty of Medicine, Faculty of Mechanical Engineering, Faculty of Arts, Faculty of Natural Sciences and Mathematics, Faculty of Education
		Hoče-Slivnica 160	Faculty of Agriculture and Life Sciences
	Savinjska SI034 (04)	Celje 011	Faculty of Logistics
		Velenje 133	Faculty of Energy Technology
	Posavska SI036 (06)	Brežice 009	Faculty of Tourism
		Krško 054	Faculty of Energy Technology
Western Slovenia SI04 (02)	Osrednjeslov. SI041 (08)	Ljubljana 061	Faculty of Criminal Justice and Security
	Gorenjska SI042 (09)	Kranj 052	Faculty of Organizational Sciences

Fig. 2. Spatial distribution of faculties of University of Maribor

With the spatial distribution of its faculties in five Slovenian NUTS 3 regions UM today represents a regional university, which is actively involved in regional development through research projects, patents and innovation in collaboration with the economy, development agencies and stakeholders in decision-making at a local and regional level.

For this purpose, at the end of the 1990s the Technology Transfer Office was established with the aim of setting-up two-way communication between entrepreneurs and researchers at the university. The key objective of connecting offices with partners is the transfer of knowledge and technologies from research environments to the economy and the region. Industrial zones combined with centres of scientific research and development and implementing technological and scientific transfer (centres of technology and technological parks) are a primary condition for the development of the national economy (Lorber 1997). The aim is to establish the conditions which will give the Slovenian economy a competitive position in the global market and enable regions their own development. An interdisciplinary approach to scientific research work will empower cooperation and bring together researchers from various scientific fields and the economy. Increasing cooperation among research institutions at a national and international level will provide greater effects to achieve balanced and sustainable development.

Business incubators at the UM were established with the intention of shaping the partnerships networks at a regional and national level as well as in the international arena. The university has founded a Scientific Institute for Regional Development (ZIRRUM) as an instrument of regional development and regional policy, especially in support of the development of structurally weak regions. Taking into account the proportion of students, the number of employees at the university, a significant proportion of income in urban services, share in the total income of the local economy, investments, knowledge and information transfer, we can say that the UM is playing an active role as a regional development partner.

To a large extent, the success of regional development depends on regional consciousness or regional affiliations of the population and the creation of a positive image of the region. The collaboration of business enterprises, municipal institutions, politicians and other regional actors decisively influences regional development. Cooperation of the public sector, private capital, research and development institutions will accelerate the building of a creative environment that will enable the balanced and sustainable development of Slovenian regions within an integrated European space (Lorber 2003a and 2003b).

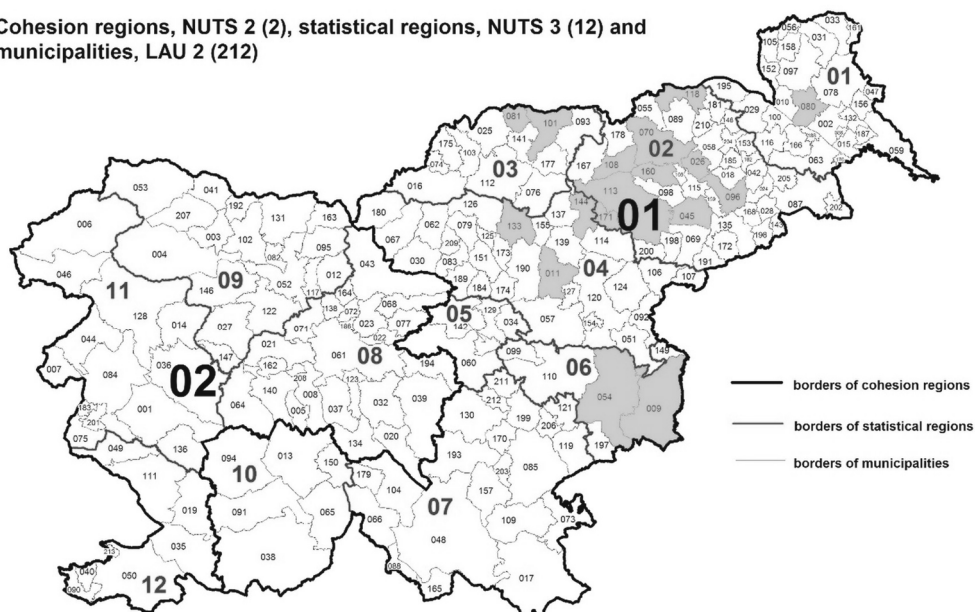
The University of Maribor can as a knowledge institution contribute to regional development by assuming an active role in the process of regional development, together with relevant regional stakeholders. Necessary activities are identified and included in the "Development strategy of the University of Maribor 2013 – 2020" (UM 2013): focus on the needs and requirements at a local and regional level, dialogue with regional stakeholders, transfer of research results into regional development processes.

UM along with its primary mission, the implementation of educational and research activities, is increasingly developing its third mission, cooperation with the environment for the purpose of sustainable and socially responsible development.

The development programme "Innovative Open Technologies" (hereinafter IOT) is an example of the symbiotic integration among universities and research

organizations, the economy and local communities for the development of the Eastern Slovenian cohesion region. The “Operational programme for the Implementation of the European Cohesion Policy for the period 2014 – 2020” places the IOT primarily under thematic priority 1 – strengthening of the research, technological development and innovations, and secondarily under thematic priority 3 – increasing the competitiveness of small and medium-sized enterprises (UM 2016).

**Cohesion regions, NUTS 2 (2), statistical regions, NUTS 3 (12) and municipalities, LAU 2 (212)**



Sources: Statistical Office of the Republic of Slovenia and Surveying and Mapping Authority of the Republic of Slovenia

Cohesion region NUTS 2	Region NUTS3	Municipalities LAU2
Eastern Slovenia SI03 (01)	Pomurska SI031 (01)	Murska Sobota 080
	Podravska SI032 (02)	Maribor 070, Ruše 108, Slovenska Bistrica 113, Šentilj 118, Hoče-Slivnica 160, Duplek 026, Ptuj 096, Kidričevo 045,
	Koroška SI033 (03)	Muta 081, Radlje ob Dravi 101, Podlehnik 171
	Savinjska SI034 (04)	Celje 011, Velenje 133, Zreče 144
	Posavska SI036 (06)	Brežice 009, Krško 054

**Fig. 3. Cooperation between UM and municipalities**

The project brings together the key stakeholders in the regional development and follows the programme objectives:

- increasing the number of high-tech enterprises and the competitiveness of small and medium-sized enterprises in the region through the development and marketing of new innovative products, processes, business models, etc.;

– creating new high value-added jobs and in this way stem the brain drain and enable the long-term development of the region (UM 2016).

The University of Maribor, has for the implementation of the European cohesion policy, formulated three pillars of the project: innovation support, infrastructural and research development (R&D).

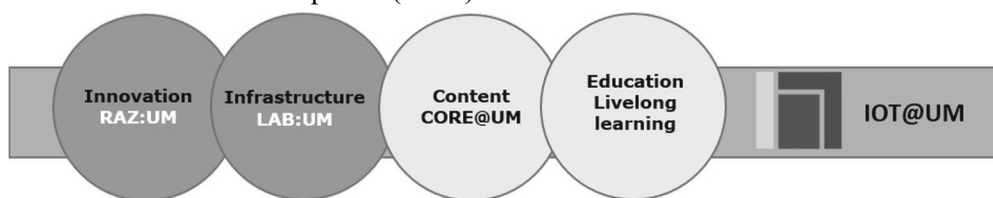


Fig. 4. Key support institutions of UM's innovation ecosystem

Source: UM (2016).

Key support institutions of UM's innovation ecosystem operate both inside and outside the academic environment (Fig. 4).

The innovation support pillar establishes an effective supportive environment according to the principle “all in one place”. It brings together the professional services needed by enterprises and research institutions: the search for suitable partners in the region and beyond, acquiring European assets, intellectual property protection, assistance in entering foreign markets, assistance in introducing new product lines or the creation of spin-offs, attracting investors, etc. To provide these services, the following institutions have joined forces and knowledge: Innovation Ecosystem of the University (RAZ:UM – the research and arts zone). Its primary objective is to establish and coordinate an entrepreneurial environment for students and researchers and to strengthen UM's leading position in terms of knowledge transfer in the region. Among its key tasks are the provision of assistance and the implementation of ideas produced by researchers from UM (students, professors, etc.) and the transfer of know-how to the industry and the broader social environment.

The development of a modern infrastructure centre entitled LAB:UM in Maribor will provide researchers from UM and the region with access to research equipment and R&D capacities in the field of new, advanced and key technologies. The Living lab model is an environment for end-users involvement in research and development innovation projects for the development and testing of new products and innovation technologies (Stihlbröst and Holst 2012).

The key advantages of the CORE@UM consortium, composed of partners from the economy, representatives of end users and renowned international and domestic research institutions are: the shared use of knowledge and technologies, the transformation of scientific findings into innovations and sustainable regional development (triple and quadruple Helix).

In the light of lifelong learning, we wish to provide all citizens with the same rights regardless of the period of life in which they decide to study.

As a technology transfer office, TechnoCenter UM aims to transfer new technologies and innovations to the industry. In addition, it provides professional advice during the research phase and in employee invention acquisition procedures at UM and assistance in industrial property rights protection. In order for the inven-

tions to become highly marketable innovations, TechnoCenter UM conducts various activities, such as an assessment of market potential, identification of relevant partners from the industry, negotiations for the sale and licensing of patents, conclusion of licensing agreements as well as assistance in the establishment of spin-offs.

IOT follows the principle of a polycentric and complementary development. The infrastructural pillar offers a fundamental support for effective research and development breakthrough and for increasing the competitiveness to the developed regions (UM 2016). The research development pillar is in accordance with smart specialization focused on priority area of “Horizon 2020” – “Health, demographic change and well-being” societal challenge, which is especially important for Podravje and Slovenia as a whole.

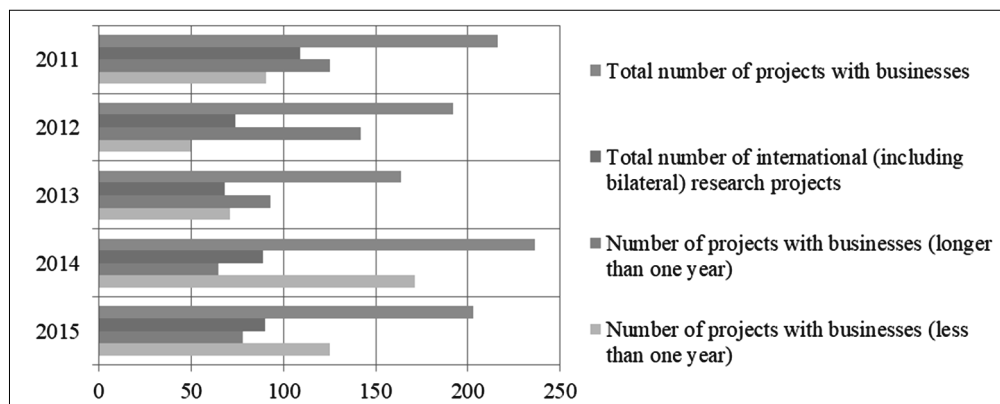


Fig. 5. Number of projects with economy, year 2011 – 2015

Source: Annual Reports of UM 2011 – 2016

Research and development work is focused on the needs of enterprises and tackles with societal challenges in the region. The efforts of the UM for cooperation with the economy are reflected in numerous projects.

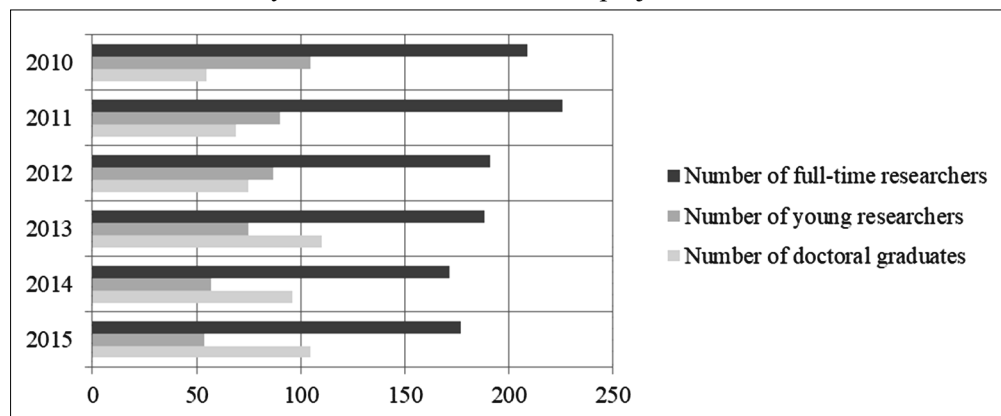


Fig. 6. Number of doctoral graduates, young researchers and researchers

Source: Annual Reports of UM 2011 – 2016



The increase in the number of doctoral graduates is the result of the successful doctoral studies of young researchers. Unfortunately, the lack of funding has caused the decline in the number of young researchers.

The decrease in the number of patents is partly the result of a decrease in the long-term projects with the economy, while the major projects are being completed. Depending on the structure of the currently implemented projects, we expect an increase in innovation and the long-term growth in the number of patents.

Recently, the University of Maribor gave an initiative to the City of Maribor to prepare a regeneration strategy for the old (traditional) industrial zones of Maribor. The regeneration of the industrial zones of Maribor, which were active just a quarter-century ago, is – according to the tradition, the identity of the city and the existing knowledge – the key and, in fact, the only option for establishing a sustainable development strategy for the city's restructuring. Once a recognizable industrial area, Maribor inevitably needs the measures of economic, social and spatial renewal in areas that once generated its development. Once active industrial zones of Maribor are now areas with high and diverse proportions of degraded or unused lands. Maribor has among the Slovenian cities in the former industrial zones the highest share of degraded areas, which have a great influence on the economic and urban development of the city. After almost a quarter of a century of the less successful economic development of the city, the University of Maribor has linked the city institutions (stakeholders) in the preparation and formation of a strategic interdisciplinary project for sustainable regeneration of former industrial zones of the city. In the process of city regeneration, which is planned for the period from 2017 to 2028, the University of Maribor will take on the role of a knowledge provider. The goal of strategic planning for the regeneration of former industrial areas is the creation of new, innovative urban areas that will enable the establishment of the sustainable urban development processes. The plan for the regeneration of industrial zones is to reveal the priority development areas in the city, where all key city regeneration strategies (reindustrialization) can be implemented.

Therefore, the initiative of the University of Maribor for the preparation of the regeneration strategy of the old (traditional) industrial zones of the city of Maribor was positively accepted. The success of the university as a knowledge provider is highly dependent on its operation, which must enable the best possible connections with other stakeholders in order to achieve the desired goals. The success of the UM, as the leading knowledge institution in the Eastern Slovenian cohesion region, in the regional development depends on the creation of an entrepreneurial mindset, the introduction of new open innovation educational contents and research achievements in cooperation with the local and regional environment, with a modern approach of triple and/or quadruple helix. Moreover, it supports the participation of students and young graduates in the companies innovation processes.

## CONCLUSIONS

The evolution of the entrepreneurial universities is linked to the interrelations of universities and research centres with firms and the government, as part of the triple helix model (Etzkowitz and Leydesdorff 2000). The evolution begins with a model of expectation of continuing use and transformation of knowledge in a linear model process (Godin 2006). The second phase “entails a *laissez-faire* policy, nowadays also advocated as shock therapy to reduce the role of the state in Triple Helix

I”; and in the third phase, the institutional spheres overlap, “with each taking the role of the other and with hybrid organizations emerging at the interfaces” (Etzkowitz and Leydesdorff 2000 and Corona-Treviño 2016).

Specifically, technology and knowledge have become the key factors of production; knowledge is now the basic form of capital. Economic growth is driven by the accumulation of knowledge, and new technological developments create technical platforms for further innovations. These technical platforms are, in turn, drivers of economic growth. Technology raises the return on investment (Laperche and Liu 2013).

We can define knowledge-capital as the set of scientific and technical knowledge and information produced, acquired, combined and systematized by one or several firms for productive purposes. Knowledge-capital refers to the accumulated knowledge of one or several linked firms (embedded in the individuals – know-how – machines, technologies and routines of the enterprise), which is continuously enriched by information flows and which is used in the production process or more widely in the value creation process. Thus, it is a dynamic concept – a process – that defines the knowledge accumulated by one or several firms, continuously enriched and combined in different ways and eventually used or commercialized. This productive aim – the creation of value – is the main characteristic which turns knowledge into “capital” (Laperche 2007 and Laperche and Liu 2013).

In the planning and execution of new development projects, the integration of knowledge and economy with the participation of local and national institutions, and open innovation and smart specialization decision-making approaches are crucial. The competitiveness of individual regions provides an open cross-sectoral cooperation, based on the endogenous approach of stakeholders. Smart specialization is a strategy, included in the European Commission cohesion policy programmes. Development of strategies for research and innovation, based on the concept of smart specialization, is one of the conditions to access the structural funds from 2014. Less developed cohesion regions are prioritized in the disbursement of funds within individual EU member.

In the Slovenian economy, people are aware that effective restructuring of industry requires synergy between industry and science. Inclusion in the world market will only be successful if companies grow based on the technologically more demanding products and processes in production and service activities. Investment in research and development is the primary requirement for the economic development of regions. Employing a highly skilled work force, capable of innovative creations, an aggressive appearance in competitive markets and the ability to cope with the demands of the world market through the permanent upgrading of skills will ensure successful regional development (Lorber 1999).

Knowledge institutions have the biggest opportunity and responsibility for the successful implementation of projects that provide regional development. They are responsible for monitoring the global development trends at theoretical (the new methods) and practical level (transfer of good practices). Their constant responsibility is to establish cooperation with local and regional environments at the corporate and institutional level. The University of Maribor is the leading knowledge and research institution in the Eastern Slovenian cohesion region. Their mission is to establish, according to the triple/quadruple helix model, the open innovation enables synergy of the various stakeholders in the field of exchange and upgrading of

knowledge, and the access to common scientific and research equipment. Research work is increasingly focused on regional space. The number of joint projects with the economy is increasing and this contributes to long-term sustainable regional development. Through the support of the institutions of the Innovation Ecosystem of the University that operate within the university environment, UM is actively involved in local, regional and international arena.

In the transition countries without proper entrepreneurial tradition, innovation is of key importance and not only at entrepreneurial and production levels but also at organisational, motivational and leadership levels.

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Lučka Lorber

## UNIVERZITY, ZNALOSTNÉ SIETE A MIESTNE PROSTREDIE V REGIONÁLNOHOM ROZVOJI ZALOŽENOM NA INOVÁCIÁCH: PRÍPADOVÁ ŠTÚDIA UNIVERSITY V MARIBORE

Úspešnosť hospodárskych odvetví v rámci národných ekonomík sa meria hrubou pridanou hodnotou (gross value added – GVA), ktorá má rozhodujúci vplyv na výšku hrubého domáceho produktu (HDP). Efektívnosť ekonomických odvetví spočíva v inovatívnych

technológiách založených na vedomostiach, ktorých kľúčovou výhodou je rýchly prenos výsledkov základného i aplikovaného výskumu do vývoja technológií a technologických zariadení. Hnacou silou týchto zmien je vývoj nových materiálov a produktov, ktoré sú zaujímavé pre trh. Základný výskum je doménou univerzít a špecializovaných vedeckých a výskumných ústavov. Pri aplikovanom výskume je potrebné brať do úvahy hospodárske prostredie. Koordinácia medzi vedeckými inštitúciami a hospodárstvom je na všetkých úrovniach riadená politikou. Môžeme teda hovoriť o triáde univerzity (veda) – hospodárstvo (výroba a služby) – vláda (legislatíva, územný režim, rozvojová politika). Priority a strategické smernice sú založené na programe Európa 2020. Na národnej úrovni sú to jednotlivé krajiny, ktoré zodpovedajú za zabezpečenie podmienok na realizáciu rozvojovej paradigmy a jednotný regionálny rozvoj.

Ekonomická štruktúra regiónov Slovinska, determinovaná hrubou pridanou hodnotou (GVA), sa pomaly približuje k štruktúre vyspelých ekonomík s výrazným poklesom poľnohospodárstva a výroby a značným nárastom služieb. Avšak finančné a obchodné služby, ako aj technologicky vyspelé odvetvia rastú v menej rozvinutých regiónoch príliš pomaly. Znalosti sa vytvárali vo vedeckých a výskumných inštitúciách, na univerzitách a špecializovaných pracoviskách, prenos znalostí do praxe a spolupráca s hospodárstvom a širším prostredím neboli dostatočné. Príliš málo iniciatív rozvoja prichádzalo z miestneho prostredia, ako aj z hospodárstva. Napriek veľkým ťažkostiam možno konštatovať, že spolupráca medzi výskumnými inštitúciami a ekonomikou narastá, najmä pri zakladaní podnikateľských inkubátorov, technologických parkov a infraštruktúrnych centier. Spoločnosti (firmy) sa zoskupili do medzipodnikových klastrov. V prímestských a rozvinutejších vidieckych oblastiach boli vytvorené priemyselné a/alebo kombinované priemyselné/podnikateľské zóny.

Dôležitá je integrácia domácich vedeckých inštitúcií a spoločností (firiem) a taktiež distribúcia poznatkov v rámci jednotlivých odvetví a podnikov. Preto pri plánovaní miestneho, regionálneho a národného hospodárskeho rozvoja bude potrebné venovať osobitnú pozornosť umiestneniu a zoskupovaniu nových špičkových a inovatívnych podnikov, výrobných služieb a služieb súvisiacich s výrobou v blízkosti univerzít a centier vedeckej excelentnosti, ako aj v blízkosti väčších lídrov v danom priemyselnom odvetví.

Bez investícií do vývoja hospodárskych odvetví založených na vedomostiach nemôže byť slovinská ekonomika, ktorá je orientovaná na vývoz, konkurencieschopná na globálnych trhoch. Možno poznamenať, že v Slovinsku sa spolupráca rozvojových inštitúcií a jednotlivých výskumných pracovníkov obmedzuje na projekty a individuálne dvojstranné zmluvy. Iba nedávno slovinské univerzity začali s trendom vytvárania stratégie na zahrnutie výskumu do lokálneho prostredia. Cieľom Univerzity v Maribore je rozvinúť inovatívny ekosystém, ktorý vytvorí symbiózu medzi univerzitou, hospodárstvom a miestnymi komunitami prostredníctvom otvorených inovácií a technológií a získavaním poznatkov pre nové profesie.

