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THE ECONOMIC CONDITIONS OF ENTERPRISE FUNCTIONING

The Streamline of Research and Experimental Development's Infrastructure in Lithuanian National Innovation System

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A key element of competitiveness in the knowledge-based economy is to create linkages among academic society, research institutions, private sector and government. R&D (research and development) infrastructure involves mentioned subjects and could be interpreted as the main instrument of National Innovation System (NIS). Scientific researches theoretically attempt to describe the conception of R&D and innovation system. However there is a gap in explanation of constitution of R&D infrastructure and how it reflects in NIS. The detailed theoretical conception of R&D infrastructure is missing as well. This complicates understanding of construction and importance of NIS. The research problem being solved in this article is: how to highlight the correlation of R&D infrastructure and NIS in order to present recommendations for Lithuanian National Innovation System. The aim of the article was to highlight the correlation and streamline of R&D infrastructure and NIS in order to present recommendations for construction of Lithuanian National Innovation System. Seeking to solve scientific problem and to reach the aim, the conception of R&D infrastructure is crystallized in the article. The article stresses that the main elements of R&D infrastructure are R&D funding system; human resources and patent system. There was systemized classification of approaches to R&D infrastructure in the article as well. As the conclusion of this analysis two approaches to the infrastructure of R&D - institutional and functional – were highlighted and explained. Analysis of hypothetical constitution of NIS enabled to highlight characteristics of state's economy which may guarantee effective functioning of NIS. Hypothetical correlation of R&D infrastructure and NIS was presented analyzing knowledge flows in the NIS. The model of knowledge flows in the NIS was developed as well. Emphasizing that government is the main player of construction and implementation of R&D infrastructure, central and shared functions of government are systemized in the article. Analyzing theoretical methods of NIS's construction there were pointed the main aspects which should be evaluated in order to prepare effective state's innovation policy. Methodologically there were enumerated four steps how nations can take deliberate action to shape the character and results of their national innovation system. The practical findings were based on SWOT (strengths, weaknesses; opportunities and threats) analysis of Lithuanian R&D infrastructure. The essential threats of Lithuanian National Innovation System were named: linear funding model which is strongly bureaucratically controlled; shortage of horizontal interplay between governmental sectors which directly use R&D; miss of precise R&D funding mechanism; too conservative approach to innovations creation and application. As the outcome of theoretical analysis, recommendations how to construct NIS are presented. Finally, the possible construction of Lithuanian NIS is suggested. It is based on linkages among governmental, academic and private institutions.

Keywords: *research and experimental development (R&D); R&D infrastructure; National Innovation System (NIS).*

Introduction

While the transformations of XXI'st century word's economy are taking speed (Melnikas, 2007) and new engines of economy growth appear (Kriščiūnas, Daugėlienė, 2006), scientists and practisioners analize the possibilities of creation friedly environment for the pursuance of research and experimental development (R&D). For a number of reasons, the amount of R&D performed is being an issue of greater importance for public policy. Policy makers increasingly believe that the level and efficiency of R&D activities are important determinants of the overall well-being of societies. That is why the main idea of this article is to explain the specificity of R&D infrastructure which could be interpreted as a component of national innovation system (NIS). Johnson, Edquist and Lundvall (2003) pointed that NIS approach is under theorized and needs to be made more precise in its terminology and in its definition.

There are a lot of scientific works (Freeman, 1995; Lundvall, 1985; Metcalfe, 1995; Nelson, 1993; Patel, Pavitt, 1998; Kriaučionienė, Jucevičius, 2000; Kalvet, 2001; Nauwelaers, Veugelers, Looy, 2003; Ringland, 2003; Johnson, Edquist, Lundavll, 2003; Paterson, Adam, Mullin, 2003; Balzat, Pyka, 2005; Roos, Ferstrom, Gupta, 2005; Herstatt, Tiwari, Buse, 2008; Kriščiūnas, Daugėlienė, 2006) where the attempts of explanation of national innovation system as well as R&D systems are presented. However there are missing studies about definition of R&D infrastructure and as well as widely presented elements of NIS. Supposedly presented analysis would enable to prove that R&D infrastructure is deeply correlated with NIS and could be interpreted as instrument of the state's innovation policy.

Considering above mentioned aspects the **research problem** being solved in this article should be constructed: how to highlight the correlation of R&D infrastructure and NIS in order to present recommendations for transformations of Lithuanian national innovation system?

The **object of research** is R&D infrastructure and national innovation system.

The **aim of the article** is to highlight the streamline and correlation of R&D infrastructure and National Innovation System in order to present recommendations for Lithuanian national innovation system. To achieve this aim four tasks are to be solved:

- To systemise the conception of R&D infrastructure.
- To highlight the main elements of constitution of NIS.
- Explaining the knowledge flows in the NIS to highlight hypothetical correlation of R&D infrastructure and NIS.
- To systemise recommendations for constitution of Lithuanian National Innovation System.

Theoretical analysis of the scientific works and practical papers in this field was taken as the research method. Analysis of statistical data concerning SWOT analysis of situation of Lithuanian R&D infrastructure was applied as well.

Scientific originality and **practical significance** of the article is:

- Proposed basic definition of R&D infrastructure as well as crystallized two approaches to R&D infrastructure.
- Explaining the knowledge flows in the NIS, correlation of R&D infrastructure and NIS was highlighted.
- There are highlighted the main elements of NIS, analyzed central and shared functions of state's government which is the main player implementing effective innovation policy.
- Four steps how nations can take deliberate action to shape the character and results of their NIS's are systemized.
- Strengths, weaknesses, opportunities and threats of Lithuanian R&D instrastructure as well as proposed recommendations for the transformations of Lithuanian National Innovation System are arranged according to a system.

Crystallisation of Research and Experimental Development Infrastructure conception

As it is presented in paper of Johnson, Edquist and Lundvall (2007), research and experimental development (R&D) has been defined by the OECD (1994) to comprise creative work undertaken on systematic base in order to increase the stock of knowledge, including the knowledge of man, culture and society, and use of this stock of knowledge to devise new applications. R&D is the set of activities through which new products and production processes are discovered and refined (EC, 2003). Romer (1990) emphasize that the returns from R&D come in the form of economic rents gained from an imperfectly competitive market that innovations and new products create. The temporary monopoly profit, which may arise from a product's superiority, provides incentives for further investments in R&D.

The term R&D covers tree activities (Frascati manual, 2002): basic research, applied research and experimental development. Here *basic research* is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view. *Applied research* is also original investigation undertaken in order to acquire new knowledge. It is, however, directed primarily towards a specific practical aim. *Experimental development* is systematic work, drawing on existing knowledge gained from research and/or practical experience, which is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

In order to ensure functioning of R&D system it is important to see all R&D activities as well as supporting elements in one system. That system could be interpreted as R&D infrastructure.

Infrastructure is generally structural elements that provide the framework supporting an entire structure. There exist two approaches to the R&D infrastructure in scientific literature (Fig. 1).

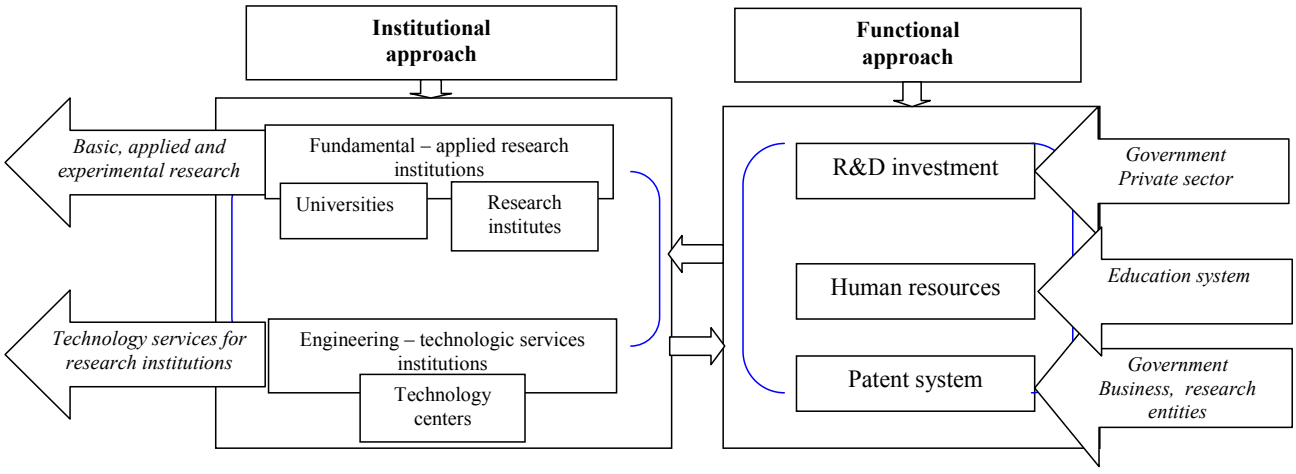

Figure 1. Classification of approaches to R&D infrastructure

Figure 1 presents *institutional* and *functional approach* to the R&D infrastructure. It is a key to stress that presented classification is significant for understanding of R&D infrustructure conception. According to *institutional approach*, R&D infrustructure is a *system of scientific and research institutions* which pursue scientific research (basic, applied and experimental). Level of fundamental – applied research institutions are comprised of universities and research institutes; and level of engineering – technologic services institutions mostly are compressed of technology centres, which supply universities and research institutes technology services. R&D activities should be combined with preparation of knowledge workers (highly qualified workers) (Daugėlienė, 2007) at this level.

According to functional approach R&D infrastructure is interpreted as a system of elements which are essential for effective functioning of infrastructure. They are:

- R&D investment (sources and instruments of funding).
- Human resources (level of education, number of scientists, scientific career, mobility of researches, ect.).
- Patent system (creation of patent system, intellectual property security).

Although it is possible theoretically to divide mentioned approaches, in practice elements of these approaches closely correlates. In the formation of R&D infrastructure it is essential to ensure dialogue between government, academic society and private sector. As a consequence of productive cooperation between mentioned subjects investment in human capital, creation of new products and services as well as total growth of state's economy is guaranteed (Kriščiūnas, Daugėlienė, 2006).

As a consequence of scientific literature analysis there were crystallized three *elements of R&D infrastructure*: R&D funding system, structure of human resources and patent system.

R&D funding system. Institutional funding is the main form of R&D funding in many countries. Several aims of such funding could be highlighted:

- to develop the level of cognition, infrastructure of longitude research as well as to understand the specificity of novelties created in foreign countries;
- to solve essential problems of society;
- to promote economic activity encouraging creation of high quality products and services;
- to ensure productive work of academic institutions which prepare highly educated members of society;
- to retain achieved scientific level and attract highly qualified and education researches;
- to conserve existing level of business investments and attract foreign investments.

Other form of R&D funding system is *risk capital* (or venture capital) *funding.* Funds made available for start-up firms and small businesses with exceptional growth potential. Managerial and technical expertise is often also provided. Usually risk capital is used for funding of projects in seed, primary or early stage. These resources are allocated for the development of created product, marketing of it as well as for the primary selling procedure. The role of intermediators is essential when matter goes about risk capital. These intermediators' could be banks as guarantee providers for companies.

Next element of R&D infrastructure is *patents*. In order to encourage development of R&D government should create transparent and clear policy of intellectual property rights[1]. The patent is one of the most significant elements. Creators have to be sure that there will not be any obstacles for the registration of new product or idea. As practice shows, European Union is still lagging in this field.

Human resources are one of the most important elements of R&D infrastructure. They could be interpreted as the engine, stimulator of creation of R&D. Overall element of human resources is comprised of total level of people's education; employment level of knowledge workers; investment in human resources, structure of human resources as well as implementation of life-long learning conception (Kriščiūnas, Daugėlienė, 2006).

Summarizing statements mentioned above, hypothetical model of R&D infrastructure is presented in Figure 2.

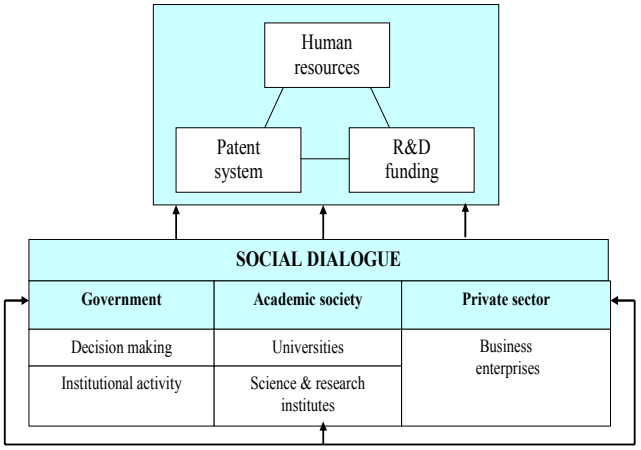

Figure 2. Hypothetical Model of R&D infrastructure

Referring to the "national production system", List pointed to the need to build national infrastructure and institutions in order to promote the accumulation of "mental capital" and use it to spur economic development rather than just to sit back and trust "the invisible hand" to solve all problems. It was a perspective and strategy for the "catching-up" economy of early 19th century in Germany.

After its introduction in the late 1980s (Freeman, 1982; Lundvall, 1988; Nelson, 1988), the concept of national innovation systems (NIS) has been further elaborated and theoretically underpinned in the early 1990s by Lundvall (1992), Nelson (1993) and Edquist (1997, 2005). As Balzat and Pyka (2005) stress, the new approach focuses on the analysis of nation-wide structures of innovative activities, their institutional determinants and economic effects. The importance of NIC creation rose after the transformations of models of national science policies which were presented by Gibbons (2004). There the interdisciplinary of science made the essential influence.

Systems of innovation may be delimited in different ways: spatially/ geographically, sectorally, and according to the breadth of activities they consider (Johnson, Edquist, Lundvall, 2003).

[1] Intellectual property rights (IPR's) such as patents, design registration and copyright have attracted growing policy interest in the past decade, due to the belief that we are now living in a „pro-rights" era where IPRs are considerably more important than they were in the past (Cowan, Paal, 2000).

The concept of national innovation systems rests on the premise that understanding the linkages among the actors involved in innovation is a key to improving technology performance. Innovation and technical progress are the result of a complex set of relationships among actors producing, distributing and applying various kinds of knowledge. The innovative performance of a country depends to a large extent on how these actors prelate to each other as elements of a collective system of knowledge creation and use as well as the technologies they use. These actors are primarily private enterprises, universities and public research institutes and the people within them. The linkages can take the form of joint research, personnel exchanges, cross patenting, purchase of equipment and variety of other channels. There is no single accepted definition of a national system of innovation. It could be defined as follows:

- the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies (Freeman, 1987);
- the elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge and are either located within or rooted inside the borders of a nation state (Lundvall, 1992);
- a set of institutions whose interactions determine the innovative performance of national firms (Nelson, 1993);
- the national institutions, their incentive structures and their competencies, that determine the rate and direction of technological learning in a country (Patel, Pavitt, 1994);
- that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provide the framework within which governments form and complement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies (Metcalfe, 1995);
- a metaphor – a powerful metaphor for describing many interactions among a lot of participating institutions, organisations and firms, most of which "formally" operate independently of each other (Paterson, Adam, Mullin, 2003)

Roos, Fernstrom and Gupta (2005) highlight that NIS can be broadly defined as all economic, political and other social institutions affecting learning, searching and exploring activities (i.e. nation's universities and research bodies, financial system, its' monetary policies, and internal organization of private firms). Authors present the conceptual constitution of NIS where the main elements are enumerated: people and culture; education; public & non-profit R&D; public good; linkages; clusters; domestic and international customers; intellectual property; risk finance; rewards / incentives; government policy, funding and procurement institutions; international links & infrastructure. All these elements directly participate in the functioning of NIS (Johansson, Karlsson, Backman, 2007). In the research paper the authors present the main and specific instruments of innovation policy. Where:

- the main instruments are institutions[2], infrastructure, incentives, education and training (higher education, primary and secondary education, other sources), international trade (exports, imports), labour market, financial markets; companies;
- Specific instruments are systems of innovations, R&D, commercialisation, general procurement.

Figure 3 defines hypothetical constitution of NIS.

European Innovation system could be characterized by a multitude of actors at different territorial levels, who have significant competencies and resources at their disposal to promote innovations; considerable differences in the measures member states apply for internal coordination in innovation policies; large institutional differences regarding member states' publicity funded R&D – systems, and; significant variations in innovative performance, industrial structure, and patterns of technological specialization among regions, and member states (Kaiser, Prange, 2005).

Successful NIS's are leaders in managing the transition to a fundamentally new approach to innovation policy and share the following characteristics (Roos, Fersntrom, Gupta, 2005):

- Recognitions of the need for and cohesive, deliberate action by governments to invest productively in each of the elements of the innovation system, and in the way the structure works together as a whole. Too often, innovation policies focus on single components only like R&D investment, or access to venture capital.
- An economy which is flexible and adaptable, with a commitment to reform a global focus.
- The existence of demanding sophisticated leading-edge customers.
- A high level of networking among innovators, and the existence of robust industry clusters.
- Improved linkages between science and industry.
- An increasingly diversified base of research and development performers.
- High business and government expenditure of R&D; a supportive financial system.
- Above average rates of investment in education, research and innovation.

Hypothetical Correlation of Research and Experimental Development Infrastructure and National Innovation System

The measurement and assessment of national innovation systems has centred on four types of knowledge or information flows (OECD, 2007). Core knowledge flows could be organised via industry alliances; industry / university interactions; industry / research institute interactions; technology diffusion and personnel mobility (Fig. 4).

[2] „*Institutions*" could be seen as organisations responsible for policy making or as informal and formal norms and rules regulating how people interact. According to World Bank, institutions have three main objectives. They channel information about market conditions, goods, and participants, they define and enforce property rights and contracts and they regulate competition.

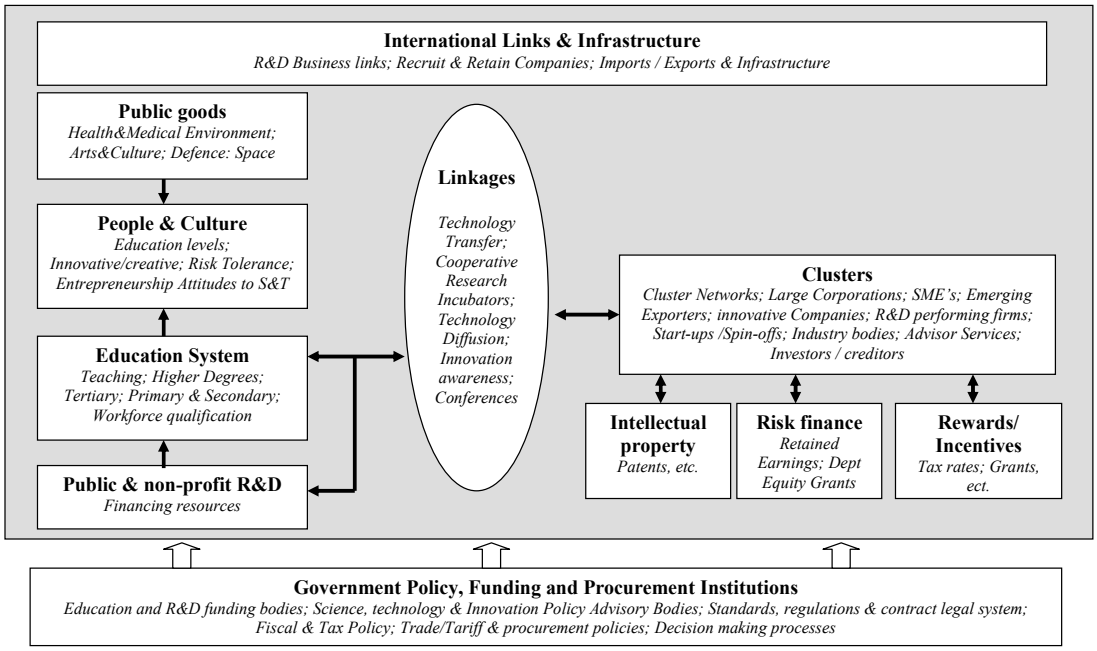

Figure 3. Hypothetical Constitution of National Innovation System (adapted according to Roos, Fernstrom and Gupta, 2005)

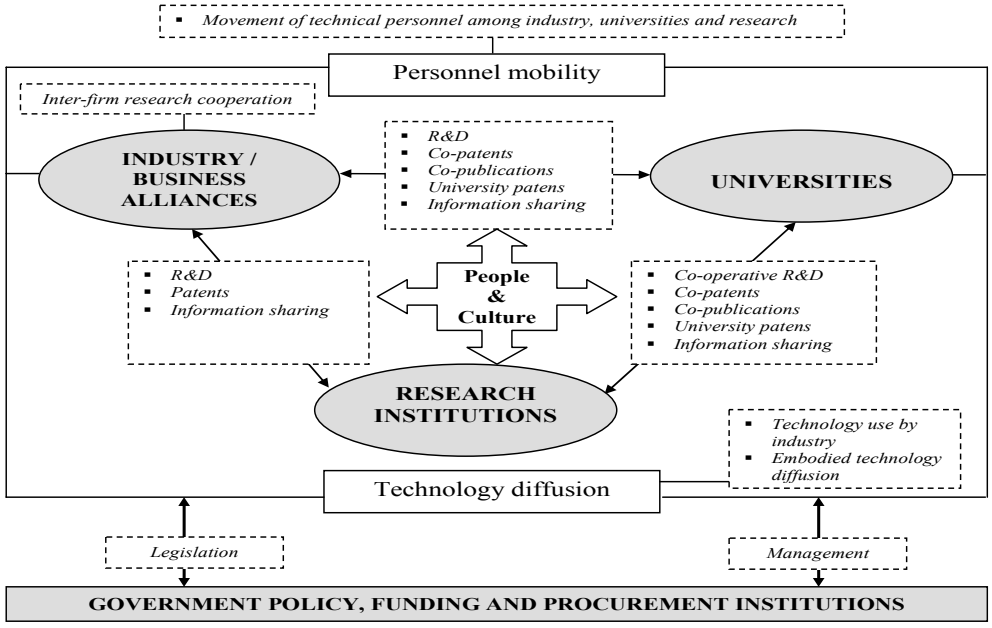

Figure 4. Model of Knowledge flows in the National Innovation System

Presented model (Fig. 4) *substantiates the hypothetical correlation of R&D and NIS.* The conclusion should be made that knowledge flows ensure effective functioning of NIS where the core element is R&D. Government plays a vital role in any NIS, in that it formulates policies that may or may not be conductive to business environment and may or may not reward entrepreneurial quest for innovative products (Singh, 2006; Furman et. al., 2002; Porter, 1990). Impartial managerial and legal actions could create an institutional framework which may in varying degree support basic and advanced research in universities, industrial R&D, and grass-root innovations including in SMEs. Herstatt, Tiwari and Stephan (2007) stress that the government also determines in which industry sectors, and to which degree it welcomes foreign participation, e. g. in form of foreign direct investments (FDI) and whether or not it would like foreign firms to engage in R&D activities on domestic soil.

Paterson, Adam and Mullin (2003) highlighted the central and shared functions of government:

- Central – policy formulation and resource allocation at the national level; specialised advisory functions; regulatory policy-making; and national S&T and innovation international relations at the bi-lateral and multi-lateral levels.
- Shared – financing of innovation-related activities; performance of research, development and innovation; the creation of linkages and knowledge flows; human resource development and capacity building; and the provision of technical services and infrastructure.

However in all mentioned functions of government there is one essential responsibility for all governments despite the level of states' economy. Essential liability of government is to create favourable environment for creation and application of innovation. This could be done via formation of fiscal (tax system), R&D financing, education, and public welfare policy.

Recommendations for Constitution of Lithuanian National Innovation System

Seeking to systemize common recommendations for constitution of Lithuanian National Innovation System construction attention should be paid to some statements presented by Johnson, Edquist and Lundvall (2003):

- The construction of NIS depends on its application volume or purpose, i.e. it is spatial, geographical or sectorial orientated.
- The national systems differ in terms of specialization in production, trade and knowledge.
- Elements of knowledge important for economic performance are localized and not easily moved from one place to another.
- The relationships between elements of NIS may be seen as carriers of knowledge and interaction as processes where new knowledge is produced and learnt. Neither firms and knowledge institutions nor people innovate alone. Perhaps the most basic characteristic of innovation system approach is that it is "inter-actionist".
- The concept of NIS is broad and flexible enough to serve as a framework for organizing knowledge.

It is very important to stress that existing NIS of Lithuania is mostly orientated to the positions of institutions which could be responsible for the implementation of innovation policy. There are missing concrete procedures and rules how to make innovations "live" creating new products or services.

Recommendations for Lithuania's National Institutional Innovation's System were made after the analysis of good practise examples presented by Finland, Sweden, Australia (Roos, Fernstrom, Gupta (2005), The South Africa, China, the Latin America (Pateson, Adam, Mullin, 2003), India (Herstatt, Tiwari, Buse, 2008) as well as Estonia (Kalvet, 2001).

Methodologically there are enumerated four steps how nations can take deliberate action to shape the character and results of their national innovation systems (Roos, Fernstrom, Gupta (2005):

- First of all, there is a need to identify region-specific advantages, paying close attention to existing networks, firms, clusters and supply chains. Use networks to talk to local and foreign firms about their strategies.
- Secondly, to identify complementarities, scrutinising the region's assets in capabilities, infrastructure, upstream and downstream resources and skills.
- On the third stage it is important to identify what is missing: barriers to networking, capabilities, infrastructure, supply issues, marketing know-how, efficient administration, appropriability of investments.
- Finally, to use incentives, networking support and regulation to develop complementarities and address missing elements so that the NIS complements the business strategies of companies that are moving towards knowledge-based activities providing targeted, well-timed support.

It is important to stress that all countries differ markedly in different fields and that should be calculated creating NIS. For example, differences in the capacities and traditions of their science and technology policy institutions; the division of responsibilities between central and sub-central levels of government; the role of different ministries; the nature of government / industry relationships and the scope for public / private partnerships.In order to make recommendations for Lithuania's NIS the SWOT analysis of Lithuania's R&D infrastructure is presented below (Table 1).

Analyzing existing Lithuanian National Innovation System essentials threats could be highlighted:

- Linear funding model which is strongly bureaucratically controlled. Finances are shared not according to the principal strategies which would stimulate the R&D creation in academic or research entities as well as its application in private sector.
- Shortage of horizontal interplay between governmental sectors which directly use R&D.
- Precise R&D funding mechanism is missing.
- Reticence of institutions of governmental sector. Conservative standpoint to the innovative ideas and realisation of them work as obstacle for the development of productive relations between private and academic sectors.

Taking into account the weaknesses of Lithuanian national innovation system as well as looking at good practise examples, recommendations for development of national institutional innovation system is presented in the model of Figure 5.

In order to develop innovation policy in Lithuania and create favourable conditions for R&D creation first of all it is important to construct transparent infrastructure of institutions which would be responsible for the implementation of innovation policy. That would be perhaps the most efficient steps towards R&D infrastructure development in Lithuania. As it was highlighted above in the process of R&D infrastructure development support as well as in the implementation of innovation policy, the state's government is most significant. And, as it was stressed in the works of Herstatt, Tiwari and Buse (2008) as well as in working paper of Johnson, Edquist and Lundvall (2003), first of all it is important to affect and change attitudes of total society to the innovation creation and application processes.

Conclusions

- It was newly stated that the main elements of R&D infrastructure are R&D funding system, structure of human resources and patent system. The conceptual understanding of R&D infrastructure depends on approaches to this phenomenon. There exist two approaches: institutional approach where R&D infrastructure is a system of scientific and research

Table 1

SWOT analysis of Lithuanian R&D infrastructure

Strengths	▪ Number of people with higher education
Weaknesses	▪ Insufficient investment in R&D ▪ Absence of social dialogue between business, government and academic institutions ▪ Absence of institutions which are responsible for the implementation of NIS and development of R&D instrastructure ▪ Absence of modern R&D financing mechanisms ▪ Too expensive system of patens registration and maintenance ▪ Shortage of high qualification scientists and researches at universities
Opportunities	▪ Gradually raising the share of financing R&D by public institutions, to attract more private finances; ▪ Create favourable conditions for researches encouraging them to seek progressive results of research; ▪ Create NIS with networked mechanism of financing and clear system of functions sharing among responsible institutions ▪ Stimulate cooperation of government, business and academic institutions in the R&D field
Threats	▪ To be among lagging word countries losers regarding criteria of innovativeness and R&D

institutions; and functional approach, where R&D infrastructure is a system of elements which are essential for effective functioning of the infrastructure. In order to ensure effective functioning of R&D instrastructure both approaches should be combined.

- There was concluded that there exist two standpoints to the NIS: institutional-based and state's market players - based . The first one could be interpreted as total infrastructure of state's institutions which are responsible for the implementation of innovation policy. As analysis of good practise examples showed almost all NIS of different countries are institutional-based. According to the state's market players – based standpoint, the main elements of NIS are institutions, infrastructure, incentives, education and training (higher education, primary and secondary education, other sources), international trade (exports, imports), labour market, financial markets and companies. As specific instruments there can be interpreted systems of innovations, R&D, commercialisation, general procurement. In order to create effective NIS, the economy of state should be flexible and adaptable, based on knowledge creation, dissemination and application. High level networking among innovations, science and industry should be ensured as well. High investment in R&D is a core precondition.

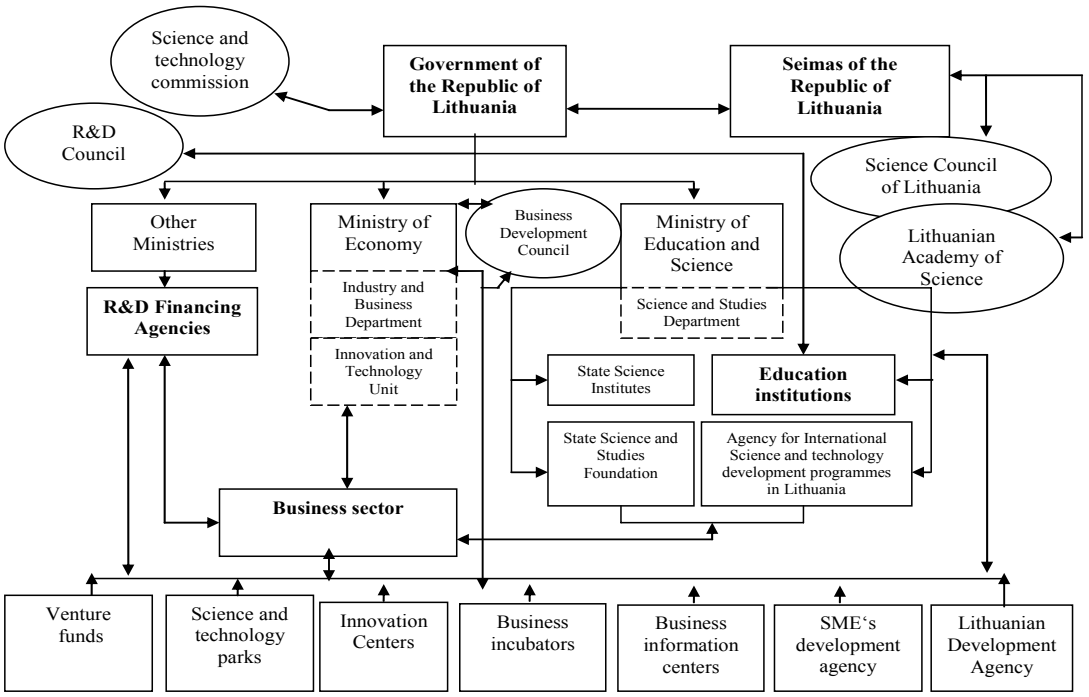

Figure 5. Possible constitution of Lithuanian National Innovation System

- Knowledge flows ensure effective functioning of NIS where the core element is R&D infrastructure. Just interlacement of all elements and subjects of NIS as well as actions of government could change the profile of economy. The government should formulate policy that would be conductive to R&D infrastructure. Using the law of legislation government can implement its central functions as well as shared functions directly concerned with government right to manage the systems of R&D funding .
- As SWOT analysis of Lithuanian R&D infrastructure pointed there are quite many weaknesses which are concerned mainly with shortage of R&D funding and absence of social dialogue between academic society, private sector and government. However

the opportunities for development of R&D intrastructure were highlighted as well. Existing Lithuanian NIS is institutional – based one. Linear funding model, strong bureaucratic control, still missing collaboration between R&D infrastructure elements – these threats could be interpreted as the main weaknesses of our NIS. The first step in order to develop Lithuanian R&D infrastructure as well as NIS is to change attitudes of society to innovations. Second, to organise clear and transparent infrastructure of institutions of business, academic, research as well as government. Most important is to create environment which would be friendly for R&D funding. This is the state's liability. Next steps should be made considering venture funds, S&T parks creation, etc.

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Rasa Daugėlienė

Mokslinių tyrimų ir eksperimentinės plėtros infrastruktūros pozicija Lietuvos inovacijų sistemoje

Santrauka

Atsižvelgdami į XXI amžiaus pasaulio ekonomikos transformacijas (Melnikas, 2007) bei reaguodami į naujuosius žinių ekonomikos iššūkius (Kriščiūnas, Daugėlienė, 2006), mokslininkai bei praktikai plačiai analizuoja būdus, kaip pakeisti visuomenės požiūrį į inovacijas, jų kūrimą bei taikymą praktikoje. Kaip sukurti aplinką, palankią šiam siekiui įgyvendinti. Vienas iš galimų sprendimo būdų – sudaryti patrauklias sąlygas vykdyti mokslinius tyrimus bei juos taikyti praktiškai. Šiam tikslui būtina sukurti tvirtą mokslinių tyrimų ir eksperimentinės plėtros (MTEP) infrastruktūrą. Daugelis mokslininkų pabrėžia, kad atliekamų mokslinių tyrimų kiekis sąlygoja teigiamus pokyčius tiek visuomenėje, tiek šalies ekonomikoje. Atsižvelgiant į tai, pagrindinis šio straipsnio tikslas yra išgryninti MTEP infrastruktūros sampratą, teigiant, kad ši yra viena svarbiausių nacionalinės inovacijų sistemos (NIS) sudedamųjų dalių. Kaip teigiama Johnson, Edquist ir Lundvall (2003) moksliniame darbe, vis dar nepakanka teorinių studijų apie NIS sampratą.

Daugelis mokslininkų (Dreher, 1996; Freeman, 1995; Lundvall, 1985; Metcalfe, 1995; Nelson, 1993; Patel, Pavitt, 1998; Kriaučionienė, Jucevičius, 2000; Kalvet, 2001; Nauwelaers, Veugelers, Looy, 2003; Ringland, 2003; Johnson, Edquist, Lundavll, 2003; Paterson, Adam, Mullin, 2003; Balzat, Pyka, 2005; Roos, Ferstrom, Gupta, 2005; Herstatt, Tiwari, Buse, 2008; Kriščiūnas, Daugėlienė, 2006) savo darbuose pateikia iš dalies vienodus NIS apibrėžimus. Bando ne tik detalizuoti jos elementus, tačiau apibrėžia ir mokslinių tyrimų bei eksperimentinės veiklos sampratą. Nepaisant to, nepavyko aptikti tiksliai apibrėžtos NIS koncepcijos bei iškristalizuotų jos dedamųjų, o taip pat išgryninto MTEP infrastruktūros apibrėžimo. Atsižvelgiant į tai, straipsnyje keliama mokslinė problema: kaip išryškinti MTEP infrastruktūros ir NIS sąsajas, siekiant pateikti rekomendacijas Lietuvos NIS transformacijoms?

Siekiant išspręsti minėtą problemą, straipsnyje keliamas tikslas – išryškinti MTEP infrastruktūros ir NIS sąsajas bei pasiūlyti rekomendacijas, kaip galima būtų transformuoti Lietuvos NIS. Tikslui pasiekti keliami keturi uždaviniai: susisteminti MTEP infrastruktūros sampratą; išryškinti pagrindinius NIS elementus; nagrinėjant žinių srautų pasiskirstymą NIS, išryškinti hipotetines MTEP infrastruktūros ir NIS sąsajas; pateikti rekomendacijas Lietuvos NIS transformacijoms.

Ieškant atsakymo į pirmąjį uždavinį, buvo analizuoti Johson, Edquist, Lundvall (2007), OECD (1994), Romer (1990), Kriščiūno ir Daugėlienės (2006) ir kt. moksliniai darbai, taip pat OECD (1994; 1997), Europos Komisijos (2003), Frascati (2002) parengtos studijos. Siekiant apibrėžti MTEP infrastruktūros sampratą bei išryškinti jos dedamąsias, pasiūlyta požiūrių į MTEP infrastruktūrą klasifikacija bei hipotetinis MTEP infrastruktūros modelis. Atilikus mokslinių bei ekspertinių darbų analizę, buvo prieita prie išvados, kad pagrindiniai MTEP infrastruktūros elementai yra mokslinių tyrimų ir eksperimentinės veiklos finansavimo sistema, žmoniškųjų išteklių struktūra bei patentų sistema. Konceptualus MTEP infrastruktūros suvokimas tiesiogiai priklauso nuo požiūrio į šį reiškinį. Tai gali būti institucinis arba funkcinis požiūris.

Analizuojant studijas, kuriose nagrinėjama inovacijų politikos ir NIS samprata (Freeman, 1982; Lundvall, 1988; Nelson, 1988; Lundvall, 1992; Nelson, 1993; Edquist, 1997, 2005; Balzgat, Pyka, 2005; Johnson, Edquist, Lundvall, 2003; Johansson, Karlsson, Backman, 2007; Roos, Fernstrom and Gupta, 2005; Metcalfe, 1995; Patel, Pavitt, 1994 ir kt.), iškristalizuota hipotetinė NIS konstrukcija, joje detalizuojant galimus elementus. Straipsnyje teigiama, kad egzistuoja du galimi požiūriai į NIS: institucinis ir rinkos dalyvių. Kaip parodė gerosios praktikos pavyzdžių analizė, daugelio šalių NIS yra sukurtos pabrėžiant institucinį požiūrį, tai yra teigiant, kad inovacijų kūrimui ir pritaikymui, kartu pačiu ir mokslinių tyrimų ir eksperimentinės veiklos plėtrai didžiausią įtaką daro valstybės institucijos. Tuo tarpu teoriniuose darbuose dažniausiai pasitaiko NIS modelis, kuriame akcentuojami rinkos dalyviai, o institucijos traktuojamos, kaip priemonė NIS kurti. Straipsnyje detalizuoti pagrindiniai ir specifiniai NIS elementai, tarp jų išryškinant MTEP infrastruktūros vietą.

Hipotetinės sąsajos tarp NIS ir MTEP infrastruktūros išryškintos analizuojant žinių srautus nacionalinėje inovacijų sistemoje. Susistemintas žinių srautų NIS modelis, kuriame detalizuojami MTEP infrastruktūros elementai. Daug dėmesio skiriama vyriausybės funkcijų detalizavimui. Manoma, kad viena iš pagrindinių vyriausybės prievolių, naudojantis legislatyvos teise, sukurti palankią aplinką MTEP vykdymui. Vadovaujantis Adam ir Mullin (2003) darbu, išryškintos pagrindinės ir dalinės vyriausybės funkcijos.

Siekiant pateikti rekomendacijas Lietuvos nacionalinei inovacijų sistemai transformuoti, analizuoti Suomijos, Švedijos, Australijos (Roos, Fernstrom, Gupta (2005), Pietų Afrikos, Kinijos, Lotynų Amerikos (Pateson, Adam, Mullin, 2003), Indijos (Herstatt, Tiwari, Buse, 2008) bei Estijos (Kalvet, 2001) gerosios praktikos pavyzdžiai. Atlikus Lietuvos MTEP infrastruktūros SWOT analizę, išskirti pagrindiniai trūkumai, galimybės, stiprybės bei grėsmės. Identifikuota, kad viena iš silpniausių sričių Lietuvoje yra mokslinių tyrimų ir eksperimentinės veiklos finansavimo situacija bei socialinio dialogo tarp vyriausybės, akademinės visuomenės ir verslo sektoriaus stygius. Straipsnyje išskirta, kad Lietuvos nacionalinė inovacijų sistema yra institucijomis grįsta, taip pat stebimas griežtas linijinio finansavimo modelis bei biurokratinė kontrolė. Ryšys tarp MTEP infrastruktūros elementų irgi nepakankamas. Straipsnyje teigiama, kad pirmasis žingsnis siekiant transformuoti Lietuvos MTEP infrastruktūrą, yra keisti visuomenės požiūrį į inovacijas. Antrasis - sudaryti aiškią ir skaidrią institucinę infrastruktūrą. Visų svarbiausia yra sukurti palankią aplinką moksliniams tyrimams ir eksperimentinei veiklai finansuoti.

Raktažodžiai: *moksliniai tyrimai ir eksperimentinė plėtra (MTEP); MTEP infrastruktūra; nacionalinė inovacijų sistema (NIS).*

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