PERSPECTIVES OF LITHUANIA IN KNOWLEDGE-BASED ECONOMY: ASPECT OF NATIONAL INNOVATION SYSTEM ANALYSIS

Rasa Daugėlienė

Kaunas University of Technology
Institute of Europe

Abstract

The value and power of knowledge and importance of information is undeniable in the XXI century. M. Polanyi (1958) stressed that humanity experience the age of great transformations. Processes of knowledge creation, acquisition, dissemination and application create economic value. The result of such transformations could be interpreted as Knowledge-based Economy (KBE). There was highlighted that KBE is not a branch of economy. It was formed because of the need and determination to create knowledge with a view to achieving economic and social welfare which could be used to satisfy the thirst for knowledge. There was stressed in the article that key policy recommendations concerning KBE creation is to strengthen economic and social fundamentals; facilitate the diffusion of ICT; foster innovation; invest in human capital and stimulate entrepreneurship in the country. In order to ensure creation and application of knowledge there should be created stabile and adequate national innovation system (NIS). It is presented as a key measure for KBE problem solving. The *research problem* being solved in this article is: how to assess the penetration of knowledge in the state's economy in order to present Lithuania's perspectives in KBE. *The aim* of the article was to highlight the theoretical constitution of KBE as well as NIS in order to evaluate Lithuania's perspectives in KBE. Seeking to solve scientific problem and to reach the aim, the conception of KBE and NIS was crystallized in the article. In order to evaluate Lithuania's perspectives in KBE there was made analysis of main criteria from the macroeconomic standpoint; analyzed Lithuanian situation from the perspective of Global Competitiveness Index (GCI), Knowledge-based Economy index (KEI) as well as Summary Innovation Index (SII). This analysis allowed highlighting the problematic positions concerning KBE expression in Lithuania.

Keywords:

Knowledge-based economy (KBE); Gross Competitiveness Index (GCI); Summary Innovation Index (SII), Knowledge-based Economy Index (KEI); Innovation; National Innovation System (NIS).

Introduction

As it was stressed by M. Polanyi in 1958 modern humanity experience the age of great transformations. Social processes of knowledge creation, acquisition, dissemination and application create economic value. The in features of society and economy of XXI century are concerned with perception of value and power of knowledge and importance of information. This influenced interest in R&D as well as in implementation of innovations. Vital role was made by information and communication technologies (ICT) (especially in the beginning of 80's when internet was started to use for commercial interests) which stipulate creation and dissemination of new knowledge and its

products. The result of such transformations could be interpreted as Knowledge-based Economy (KBE).

There exist scientific works where basic conception of KBE is presented (Daugėlienė, 2005; Kriščiūnas, Daugėlienė, 2006; Miller, Morris, 1999; Stiglitz, 1999; Knoght, 1944; Hayek, 1945; Romer; 1989; Drucker, 1989; Takeuchi, 1998; Nonaka, 2001; Lundvall, 1999, etc.). This empowers to understand the evolution of complicated economic phenomenon. However it is important to structuralise all these theoretical statements and propose overall opinion of conception of XXI'st century phenomenon.

Plenty works of practicians as well as scientists are presented in order to analyse the situation of

states' economy development towards economy of knowledge (World bank and OECD documents; Balzat, 2005; Herstatt et al., 2007; Johnson et al., 2003; Gera, Weir, 2001, etc.). Kriščiūnas and Daugėlienė (2006) constructed detailed instrument for the assessment of knowledge expression in KBE. It reflects all characteristics of KBE, though such assessment is complicated and need much of time. Methodological principles of short-time and constructive assessments are still missing.

Lithuania is a country which has potential for development of KBE. Despite that it still lagging in creation and implementation of knowledge. One possibility to solve all problems is to create good national innovation system and forecast potential actors who would be responsible for its implementation.

Considering above mentioned aspects the **research problem** being solved in this article should be constructed: how to assess the penetration of knowledge in the state's economy in order to present Lithuania's perspectives in KBE.

The **object of research** is national innovation system as a key measure for KBE problem solving.

The aim of the article is to highlight the theoretical constitution of KBE as well as NIS in order to evaluate Lithuania's perspectives in KBE.

To achieve this aim five **tasks** are to be solved:

- Systemise the conception of knowledge-based economy.
- Generalize methodology for short-term analysis of KBE expression.
- Highlight the basic threats of KBE expression in Lithuania.
- Highlight National Innovation System as a key measure for KBE development problem solving.
- Systemise perspectives of Lithuania in KBE.

As the **research method** it was taken theoretical analysis of the scientific works and practical papers in this field. Analysis of statistical data was applied as well.

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

- Proposed overall conception of knowledge-based economy.
- Highlighted interlacement of KBE and indexes of assessment of knowledge expression.
- Analysing evolvent of GCI, KEI and SII presented analysis of KBE expression in Lithuania as well as perspectives of Lithuania in KBE.
- Highlighted the main components of National Innovation System (NIS) and structuralised governmental functions organising NIS.

Crystallization of Knowledge-based Economy Conception

Modern management theories emphasize increasingly growing expression of knowledge in development processes. The effect of knowledge on cultural, social and economic development processes has been under consideration throughout all periods of human existence. The first attempts of investment into intellectual capital (Miller, Morris, 1999), however, were noticed only in the 19 century, and the processes of knowledge creation as well as its application in the management of organizations was launched only in the beginning of the 19th c.

According to Stiglitz (1999) the scientific revolution promoted the changes in the field of innovations as well as headlighted the importance of their influence on management processes. P.Drucker, M.Porter, J.Naisbitt, P.Senge et al., as "guru" in management science, also stress the emergence of inevitability of new theories in management and economics which is related to the increased importance of intellectual capital when competitive advantage can be achieved only by creating and applying new knowledge. R.Gibson (1998) encourages theoreticians and practicians to assess the challenges of knowledge-based economy, i.e. to discard the old management models, old paradigms, rules, strategies, recipies for success, etc.

This is proved by the fact that knowledge expression in management processes of enterprises started to be studied scientifically about the year 1989 (P.Drucker's concept "Knowledge workers" (Daugėlienė, 2007 a, b.), and the assessment of the effect of knowledge on the activity of organizations in micro-level was started in about 1994 (Skandia Navigator). Knowledge expression for global development processes, however, was started to be analyzed in scientific works much earlier, in terms of transformation of economic theories. The first scientific considerations about the effect of intangible factor on development processes were started as far back as 1944 in F.Knight's works. Only when the effect of knowledge on the development processes found its place in the economic theories, the effect of their creation and application was started to be analyzed in the (micro) level of the enterprise.

In the course of history the elements analyzed in economic theories and the attitude to the factors stimulating development was changing. The classical economic theory based on resources was transformed into the new development theory (Romer, 1989) which explains the emergence of evolution economics and the importance of developing innovations, technologies and application of knowledge. It became clear that due to globalization processes,

the economic growth in the world is stimulated by new factors: information, knowledge, technologies and innovations. The growth of industries of information and communication technologies (ICT) demonstrates distinct orientation to information and knowledge, rather than material resources. As early as 1945 F.A.Hayek, American economist, called this phenomenon of transformations as the age of knowledge and claimed that the prevailing processes of this age stipulate the formation of new scientific viewpoint to the driving forces of development.

F.Bacon's work "*The Advancement of Learning*" (1906) contains the conception of useful knowledge which stresses that only useful knowledge should be created and developed which, with a view to contemporary management, may be treated as productive. According to Bierly, Kessler, Cristense (2000), Boisot (1998), Kogut, Zander (1992), Lundvall (1999), Maxwell (1984), Miller, Morris (1999), Nonaka, Konno, Toyama (2001), Rhea, Teasdale (2000), in the creation of productive knowledge four essential elements *of knowledge system* are involved: *data, information, knowledge and wisdom* which semantically and hierarchically are different. Different interpretation of their conception determine the contents of new paradigms of knowledge-based economy (e.g. *"information society", "knowledge society", "digital economy", "new economy" or "knowledge-based economy"*). The latter – knowledge-based economy – is a result of economic development due to knowledge creation and application as well as globalization of the end of the 20th century (Castels, 2000), the result which, through the expansion of markets and elimination of geographical isolation, changes not only economic cooperation, but also the mindset of societies (Kriščiūnas, Daugėlienė, 2006) and management principles.

Scientific literature contains ideas that knowledge-based economy is, in the first place, stable market economy characterized by all typical features, its one of the major driving forces being knowledge and IT. As M. Polanyi (1956; 1983; 1994), who devoted much attention to the analysis of development of the conception of knowledge and its influence on the development processes, points out that humanity is currently going through the period of dramatic transformations when *the social processes of knowledge creation, acquisition, propagation and application form economic value and the result is referred to as knowledge-based economy*. ICT helps to develop social relations independent of time and space. The abilities of the individuals, their competence, relations and cultural identity are the essential instruments facilitating survival in the new

world (Rodrigues, 2002). Knowledge-based economy was formed because of several important reasons. Firstly, because of the need and determination to create knowledge with a view to achieving economic and social welfare which could be used to satisfy thirst for knowledge. Also, because of the wish to achieve competitive advantage, thus providing necessary stable economic conditions revealed through the pursuance of effective national policy and maintenance of stable fiscal system as well as effectively functioning market. The latter conditions form the preconditions for the development of policy of innovations, creation and application of communication technologies as well as the development of human resources and innovative business. Such processes can be observed only in the case if favourable conditions for creating and application of knowledge are provided. Therefore, to assess the extent of knowledge expression, the expression characteristics of knowledge-based economy referred to as knowledge expression characteristics should be used.

The growth of knowledge expression in development processes is claimed as being stipulated not only by changing social values and the rise of thirst for knowledge, but also by the variations in management and economic factors. This determined the occurrence of new economic paradigms which focus on the analysis of changes induced by knowledge development and application processes. The rise of knowledge expression was observed during the transitional period from industrial (1830 – the early 20th c.) to postmodernistic (late 20th c.) society when during the efficiency revolution new knowledge was utilized for the improvement of products (Taylor and Ford, 1896). Industrial revolution was a determinant in classifying knowledge as a tool, a process and a product, and the revolution in modern management (from 1989) ascribed knowledge to the essential factor which creates economic value. In analyzing the works by Drucker (1998), Porter (1998), Prusak (1996), Gera et al. (1998), Skyrme D.J. (1997), Houghton, Sheehon (2000), Lamberton, Neitze (1999), OECD (2001), Gera, Weir (2001) it is possible to stress that knowledge-based economy is not a new economic paradigm which came into existance alongside with classical economy. Rather, it is a continuation of classical economic evolution, when material and immaterial advantage was obtained exceptionally by creating new knowledge and applying it in every stage of management.

Many researchers identify the same economic processes by different concepts. Analysing the works of many scientists (Badaracco, 1991; Boisot, 1998; Burton-Jones, 1999; Castells, 2000; Kogut, Zander, 1992; Kriščiūnas, 2002; Krogh, Roos, 1996; Langlois,

2001; Lundvall, 1999; Maturana, Varela, 1984; Myers, 1996; Miller, Morris, 1999; Romer, 1986; 1990; Rugina, 1998; Smyre, 2002; Soete, 2002; Kelly, 1997; Quah, 1998; Atkinson, Court, 2002; 1998; Dahlman, 2003; Foray, Lundvall, 2002; Hapworth, Spencer, 2003; Gera, Weir, 2001; Gudauskas, Koddertizsch, 2002; Landefeld, Fraumeni, 2000; Trewin, 2002) it is important to highlight that knowledge expression in knowledge-based economy manifests itself through six hypothetical knowledge expression characteristics: development and application of new knowledge, human resources, innovations policies, innovative business, ICT potential and utilization, effective governmental policy of the state and efficient market with a stable fiscal system.

As the conclusion of analysed above there could be stressed that KBE it is not a branch of economy. This is economy that makes effective use of knowledge for its economic and social development. This includes tapping foreign knowledge as well as adapting and creating knowledge for its specific needs (Dahlman, 2003). KBE – it is economy friendly for knowledge acquisition, creation, dissemination and usage (Daugėlienė, 2006). This processes could be seen analysing economic and social context of the state; situation of human resources; entrepreneurship, ICT usage and innovation policy.

Methodology for the Short-term Analysis of Knowledge-based Economy Expression

Normally, in seeking to determine the extent of effect of any phenomenon and development trends, assessment models are used. In order to forecast the perspectives of Lithuania in KBE there could be applied instrument for the knowledge expression assessment presented by Kriščiūnas and Daugėlienė in 2006. Despite of particularity of suggested model there were selected other possible appellative criteria for assessment of states' economy condition. These are:

- Group of **macroeconomic criteria** (GDP level; level of employment and unemployment, inflation). This was selected in order to examine the tendencies of states economy growth. The main analysed criteria was fluctuation of GDP.
- **Gross competitiveness index** (GCI) and its' evolvent presented and calculated by World Economy Forum.
- **Knowledge-based economy index (KBEI)** and its' evolvent presented by World Bank.
- **Summary Innovation Index (SII)** and its' evolvent presented by Innobarometer.

Possible interlacement of Knowledge-based economy and enumerated indexes could be explained using modelling (Fig. 1).
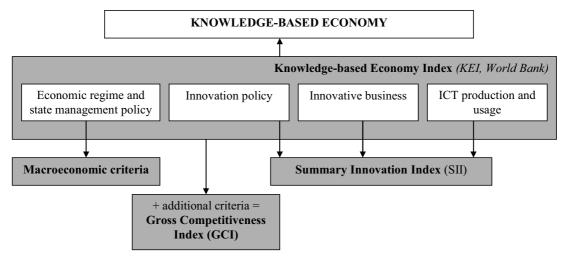

Fig. 1. Interlacement of KBE and indexes of assessment of knowledge expression

Gross competiveness index (World Economic Forum, 2007) – a highly comprehensive index for measuring national competitiveness, taking into account the microeconomic and macroeconomic foundations of national competitiveness. It is important to stress that GCI reflects the level of knowledge penetration in state's economy. Especially through pillar which are concerned with a level of individuals education and innovations.

Experts of World Economic Forum define competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country. The GCI captures many different componets, each of which reflects one aspect of the complex reality. All componets are grouped in 12 different pillars called the 12 pillars of competitiveness. These pillars are:

- Institutions – the institutional environment forms the framework within which private individuals, firms, and governments interact to generate income and wealth in the economy.
- Infrastructure – the existence of high-quality infrastructure (effective modes of transport

for goods, people, and services – such as roads, railroads, ports and air transport)is critical for ensuring the efficient functioning of the economy, as it is an important factor determining the location of economic activity and the kinds of activities or sectors that can develop in an economy. High-quality infrastructure reduces the effect of distance between regions, with the result of truly integrating the national market and connecting it to markets in other countries and regions.

- Macroeconomy – the stability of the macroeconomic environment (inflation rate, public finances, interest payments, GDP) is important for business and for the overall competitiveness of a country.
- Health and primary education – a healthy workforce is vital to a country's competitiveness and productivity. In addition to health, this pillar takes into account the quantity and quality of basic education received by population.
- Higher education and training – quality higher education and training is crucial for economies that want to move up the value chain beyond simple production processes and products. This pillar measures secondary and tertiary enrolment rates as well as the quality of education as assessed by the business community.
- Goods market efficiency – countries with efficient goods markets are positioned to produce the right mix of products and services given supply-and-demand conditions, and such markets also ensure that these goods can be most effectively traded in the economy.
- Labor market efficiency – the efficiency and flexibility of the labor market are critical for ensuring that workers are allocated to their most efficient use in the economy.
- Financial market sophistication – an efficient financial sector is needed to allocate the resources saved by nations's citizens to its most productive use.
- Technological readiness – this pillar measures the agility with which an economy adopts existing technologies to enhance the productivity of its industries (ICT access and usage, ICT – friendly regulatory framework, ICT penetration rates).
- Market size – the size of the market affects productivity because large markets allow firms to exploit economies of scale.international trade as a substitute for domestic demand in determining the sizeof the market for the firms of a country.

- Business sophistication – business sophistication is conductive to higher efficiency in the production of goods and services. Business sophistication concerns the quality of country's overall business networks, as well as the quality of individual firms's operations and strategies.
- Innovation – technological innovation. They are particularly important for economies as they approach the frontiers of knowledge and the possibility of integrating and adapting exogenous technologies tend to disappear.

Presented pillars are classified into three groups: basic requirements – key for factor – driven economies; efficiency enhancers – key for efficiency – driven economies; innovation and sophistication factors – key for innovation – driven economies.

Knowledge-based economy index (KEI) (KAM, World Bank, 2008) - takes into account whether the environment is conducive for knowledge to be **used effectively** for economic development. It is an aggregate index that represents the overall level of development of a country or region towards the Knowledge Economy. The KEI is calculated based on the average of the normalized performance scores of a country or region on all *4 pillars related to the knowledge economy* - **overall performance of the economy,** economic incentive and institutional regime, education and human resources, the innovation system and ICT:

- Overall Performance of the Economy (Average Annual Gross Domestic Product (GDP) Growth; Human Development Index (HDI);
- The Economic Incentive and Institutional Regime (Tariff & Nontariff Barriers; Regulatory Quality; Rule of Law);
- Education and Human Resources (Adult Literacy Rate, Secondary Enrolment, Tertiary Enrolment);
- The Innovation System (Researchers in R&D, Patent Applications Granted by the US Patent and Trademark Office, Scientific and Technical Journal Articles);
- Information and Communication Technology (ICT) (Telephones per 1,000 people; Computers per 1,000 people; Internet Users per 1,000 people)

*Summary Innovation Index (SII) (*European Innovation Scoreboard, 2005) - the innovation indicators are assigned to five categories and grouped in two main themes: inputs and outputs:

- Innovation inputs – innovation drivers (measure the structural conditions required for innovation potential); knowledge creation (measure the investments in R_D activities,

considered as key elements for a successful KBE); innovation & entrepreneurship (measure the efforts towards innovation at the level of firms).

- Innovation outputs – application (measure the performance, expressed in terms of labour and business activities, and their value added in innovative sectors); intellectual property (measure the achieved results in terms of successful know-how).

Summary Innovation Index as well as GCI and KEI are expressed as one number index. This allows keeping the methodology as simple as possible, with equal weighting applied to all indicators. Using mentioned indexes it is possible to compare all countries as well as to highlight in which field (knowledge creation, application or dissemination) country is leading or lagging.

Analysis of Knowledge-based Economy Expression in Lithuania
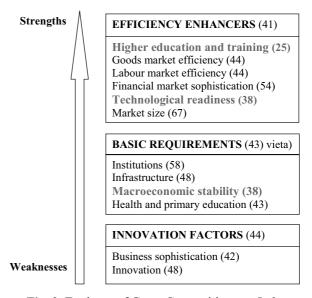
The basic idea of this analysis is positivism. It is important to stress areas in which Lithuania is leading and where there are some gaps. Supposedly analysis will help to propose ways how it is possible to solve highlighted problems and develop areas where Lithuanians can be proud about.

Analysing growth tendencies of GDP in period of 1990 – 2007 positivistic tendencies could be emphasized. The growth of GDP in mentioned period was obvious and rapid. According to Lihuanian Department of Statistics there was calculated 10000 mln. Lt. in 1993 as in 2007 this amount grew up to 95000 mln. Lt. *These tendencies allow making the conclusion that Lithuania has the potential for economic stability and growing in the future* (despite other problems which raised in the end of 2007. It is big inflation).
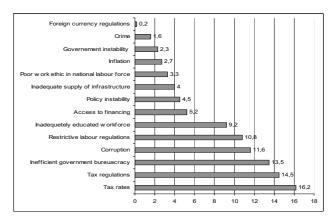
World Economy Forum (2008) highlighted similar situation about Lithuanian macroeconomic stability. There was stressed that according basic requirements criteria group macroeconomic stability is quite in positive position (Fig. 2).

The leading countries considering competitiveness in the world are USA (1st position), then Switzerland, Denmark, Sweden, Germany, Finland, Singapore, Japan, United Kingdom, Netherlands, etc. Lithuania is in 38th position from total 122 world countries. As it is stressed in Fig. 2, the *best situation* in Lithuania is with *efficiency enhancers*. Especially *highlighting higher education and training* as well as *technological readiness*. The lagging area concerned with innovation factors. As it was emphasized in European Trend Chart on Innovation (2005) Lithuanians are those who use and apply innovations instead of new

creation and then application. The most problematic factors for doing business in Lithuania according World Economy forum are tax rates, tax regulations, inefficient government bureaucracy, corruption, restrictive labour regulations, inadequately educated workforce, etc. (Fig. 3).

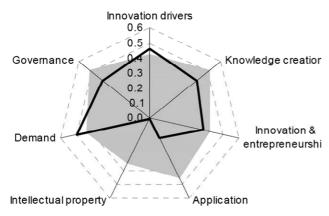**Fig. 2.** Evolvent of Gross Competitiveness Index (Lithuania, 2007 – 2008)

Fig. 3. The most problematic factors for business in Lithuania

World bank presenting Knowledge Assessment Methodology every year calculate knowledge economy index which was called as KBEI. Leading countries here are Finland and Denmark. Lithuania represents 31st position among 137 world countries where *leading position* is in *human resources* as well as in *ICT infrastructure. Lagging area* as it was stressed above is

creation and implementation of *innovations.* However there could be emphasized that Lithuania rose by 12 positions in comparison with 2006. That could be interpreted as positive development and going further.

Analysis of evolvent of Lithuanian SII presents adequate situation (Fig. 4).

Fig. 4. Evolvent of Lithuanian summary innovation index (according Innobarometer, 2005)

Lithuania ranks 24th place out of 33 world countries (European Innovation Scoreboard, 2005). Its peer countries for performance include Spain and Slovakia. Its average performance masks large differences by category. It performs slightly above the EU average for innovation drivers, due to good performance on all education indicators except for life-long learning, and it has relative strengths in innovation and entrepreneurship, where it ranks 16th. Lithuania suffers from extremely low levels of business R&D, which is partly compensated by excessive levels of university R&D funded by business. Performance on patenting is near the bottom, but as with other new member states intellectual property rights is linked to knowledge creation, where Lithuania's performance is below average. Despite presented statements trend results are generally favourable, except for ICT investment and employment in high tech service (European Innovation Scoreboard, 2005).
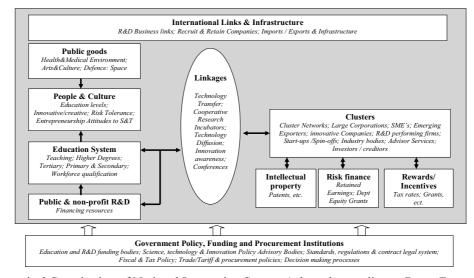
Lithuania has an above average performance on innovation demand even with per capita incomes less than half the EU average. The good performance is due to high levels of capital investment, an above average youth share, near average buyer sophistication, and a below average share of firms who state that a lack of demand is a barrier to innovation.

National Innovation System as a Key Measure for Knowledge-based Economy Development Problem Solving

In the above presented chapters there were highlighted KBE areas where Lithuania is lagging, all analysed indexes allowed to make the same picture – Lithuania mostly is lagging in innovation policy creation and implementation. Considering that the main steps could be presented how to solve mentioned problems. These are:

- Enhance the consciousness of individuals about innovations.
- Construct clear and transparent institutional infrastructure as well as stimulate partnership of government, academic society and business (triple – helix).
- Form adequate state's innovation policy.
- Pay attention to the implementation of innovation strategy.

All enumerated steps directly concern with formulation of national innovation system (NIS). Theoretical construction of NIS is presented in Figure 5 (according to Roos, Ferstrom and Gupta, 2005).
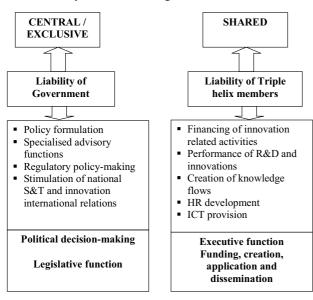

Fig. 5. Theoretical Constitution of National Innovation System (adapted according to Roos, Fernstrom and Gupta, 2005)

Actually Lithuania does not have transparent and good working NIS. It could be stress that Lithuanian NIS 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 make innovations "live" creating new products or services.

In order to shape character and results of NIS essential steps should be implemented (Roos, Fernstrom, Gupts, 2005; Balzat, et. Al., 2005):

- identify region – specific advantages, paying close attention to existing networks, firms, clusters and supply chains;
- identify complementarities, scrutinizing the region's assets in capabilities, infrastructure, upstream and downstream resources and skill;
- identify what is missing;
- use incentives, networking support and regulation.

Here the main function should be done by government. Its liability is to ensure the functioning of triple – helix. The functions of government (according to Paterson, Adam and Mullin, 2003) which is responsible for the construction and implementation of NIS are systemised in Fig. 6.

Fig. 6. System of functions of government organising NIS

All functions of government which should be implemented could be systemised into two basic groups. It is central or exclusive functions which are exclusive liability of government and directly are concerned with political decision-making as well as legislative function. And the second group of functions could be named as shared functions where responsible partners are members of triple-helix. These functions involve execution of legal acts, funding, creation, application and dissemination of innovation products or services.

Perspectives of Lithuania in Knowledge-based Economy

Taking into account presented analysis perspectives of Lithuania in KBE are positive.

Innobarometer (2005) presented Lithuanian innovation mode. There was stressed that Lithuania's R&D initiatives mostly are orientated to adaptation of already created products / services not for creation of new. Innovations are not strategic object of business sector and that should be changed. Despite mentioned the tendencies of adaptation of innovations are common for many of EU countries.

Essential threats of Lithuanian national Innovation System are:

- linear funding model which is strongly bureaucratically controlled;
- shortage of horizontal interplay between governmental sectors which directly use R&D;
- missing of precise R&D funding mechanism;
- closeness of institutions of governmental sector.

However positive first steps are made already. The main initiatives towards innovation development in Lithuania are:

- creation of national innovation platforms as well as clusters;
- studies of economy development;
- complex programmes;
- valleys' of knowledge economy;
- other initiatives.

The main challenge for Lithuania is whether or not to strongly encourage innovation diffusion or to encourage both creative innovation and innovation diffusion. Several indicators are positive, including close to average levels of ICT investment and total innovation expenditures, and above average performance on several education indicators. The greatest current weaknesses are in cooperation by SMEs and in broadband penetration rates as well as in intellectual property and risk capital area. Any way, Lithuania has quite high demand for innovations (Innobarometer, 2005: 58 % of population is friendly for innovations) and great human beings potential for innovation creation and dissemination. As it was stressed in the works of Herstatt, Tiwari and Buse (2008) as well as in working paper of Johson, Edquist and Lundvall (2003), first of all there is a need to change attitudes of society to the modification of innovations.

Conclusions

- A new approach was suggested that knowledge-based economy is the result of economic development based on knowledge management as a harmonized system of legal and economic prerequisites and managerial as well as economic mechanisms, modern technologies and human resources, the system resulting from development

of market economy and different technologies, in particular, information technologies. Knowledge expression in KBE manifests itself through six knowledge expression characteristics: human resources, innovation policy, innovative business, ICT potential and usage, effective governmental policy of the state and efficient market with a stable fiscal system.

- It was stressed that in order to assess the expression of knowledge in economy or penetration level of KBE in short-term period, there could be used macroeconomic criteria, gross competitiveness index (GCI); knowledge-based economy index (KEI) and summary innovation index (SII). Theoretical analysis allowed highlighting interlacement of KBE and indexes of assessment of knowledge expression.

- Analysis of indexes values enabled to highlight areas in which Lithuania is leading and lagging. All of indexes proved the same: that the most lagging area of Lithuania is innovation policy as well as we are the leaders considering human resources and quite positively developing in usage of ICT.

- National Innovation System was presented as key measure for KBE development problem solving. The vital role in creation and implementation of NIS was assigned to government. Before construction of NIS each government should identify region, complementarities, what is missing as well as to use incentives. Composition and regulation of NIS first of all is liability of government. Then other actors of state should be involves (business and academic society). Role of members of Triple Helix is essential.

- Perspectives of Lithuania in KBE are positive. There are enough potential (human recourses). The weakest area is in missing of real actions and measures considering implementation of ideas of NIS.

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