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The Assessment Models of Knowledge-Based Economy Penetration

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The importance of knowledge-based economy (KBE) in the XXI century is evident. In the article the reflection of knowledge on economy is analysed. The main point is targeted to the analysis of characteristics of knowledge expression in economy and to the construction of structure of KBE expression. This allows understanding the mechanism of functioning of knowledge economy.

The authors highlight the possibility to assess the penetration level of KBE which could manifest itself trough the existence of products of knowledge expression which could be created in acquisition, creation, usage and development of them. The latter phenomenon is interpreted as knowledge expression characteristics: economic and social context, human resources, ICT, innovative business and innovation policy. The reason for this analysis was based on the idea that in spite of the knowledge economy existence in all developed World countries a definitive, universal list of indicators for mapping and measuring the KBE does not yet exist.

Two theoretically separated groups of Knowledge Expression Assessment Models are presented in the article. Considering shortages of analysed models and seeking to create flexible model for knowledge expression assessment, instrument for the assessment of knowledge expression in economy is suggested in the article. The structure of evolvent of knowledge expression assessment criteria as well as the possible fields and subjects for the application of suggested instrument is declared in the article as well.

Keywords: *knowledge; knowledge expression; knowledge-based economy; characteristics of knowledge expression in economy; instrument for knowledge expression assessment.*

Introduction

Economic activities associated with the production and utilization of information and knowledge has become an engine of economic growth in the developed market economies, increasingly transforming all the other dimensions of development and the entire society.

Reacting to the later situation in the transforming engines of economic development, European Council in 2000 March in Lisbon adopted challenged plan for the future of European Union[1]. Strategic goal was defined bearing in mind both external challenges – globalization – and internal constrains – Europe's response.

The scope of knowledge economy policy is vast. It is already functioning in the most developed countries, but the analytical tools and indicators for mapping and measuring it's performance are missing. Ideally, a research-policy agenda should encompass new economic institutions and cultures, new technology paradigms and the ICT infrastructure, national and regional innovation systems – and human capital, or the knowledge, skills and other attributes of the workforce (OECD, 1996, 2002). Different KBE assessment methodologies (many of them were not created with intention to assess penetration level of knowledge-based economy elements) have been prepared starting from 1962 (F. Maclup, Hepworth, Small, Garfield, 1985; Leontief, 1993; Spencer, 2003; Landefeld, Fraumeni, 2000; Trewin, 2002; Gera and ec. (1998), Houghton, Sheen, 2000; Dahlman, 2003; Atkinson, 2002 and etc.). Different attempts exist in order to assess the results of knowledge creation and application to economic, social, political or even cultural spheres of countries. Such possible models are constructed by experts of various international organizations like OECD[2], World Bank, APEC[3], ABS[4], UNECE[5]. One of the most structuralized and detailed model for knowledge expression assessment is presented by Dahlman and Chen (2005). Regardless of the variety of possible models the application of these is more or less complicated. This stimulates to search more flexible instrument for knowledge expression assessment which would enable researches as well as practitioners to assess the penetration level of knowledge-based economy.

The **research problem** being solved in this article correlates with assessing of the impact of knowledge for economic growth. From the scientific as well as practical point of view it is important to analyze existing knowledge expression assessment models and to constrain elaborated instrument for the assessment of knowledge expression in the economy.

The **object of research** is knowledge expression assessment.

The **aim** of the article is to elaborate knowledge expression in the economy assessment models.

[1] Where the main idea declared was to create the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. It's a key to stress that the main objectives and priorities of Lisbon strategy were reviewed in 2004 regardless to the present situation of Europe's KBE development.

[2] OECD – Organization for Economic Co-operation and Development

[3] APEC – Asia- Pacific Economic Co-operation

[4] ABS – Australian Statistics Bureau

[5] UNECE – United Nations Economic Commission for Europe

To achieve this aim five tasks are to be solved:

- To emphasize characteristics of knowledge expression in economy.
- To analyze the validity of knowledge expression assessment.
- To systemize and highlight the specificity of existing knowledge expression assessment models.
- To construct instrument for assessment of knowledge expression in economy as well as to present the subjects and fields for it's application.

As the **research method** it was taken theoretical analysis of the scientific works in this field. Documents of OECD, World Bank, ABS, APEC, UNECE were analysed as well.

Reflection of Knowledge in Economy

For the development of knowledge economy macro economical stability is the key condition and starting position. The other not less important factors are functioning of free market, good institutional framework, telecommunications and technologies, encouraging the development of e-activities, stipulation of collaboration of government, industry and higher education institutions and etc. (Daugėlienė, 2005).

The key policy recommendations concerning the Knowledge-based Economy creation and development. OECD (2002) experts states that while specific policy priorities may differ across countries, governments have to adopt a comprehensive growth strategy based on a combination of actions in order to:

- *Strengthen economic and social fundamentals*, by ensuring macroeconomic stability, encouraging openness, improving the functioning of markets and institutions, and addressing the distributive consequences of change.
- *Facilitate the diffusion of ICT*, by increasing competition in telecommunications and technology, improving skills, building confidence and making electronic government a priority.
- *Foster innovation*, by giving greater priority to fundamental research, improving the effectiveness of public R&D funding, and promoting the flow of knowledge between science and industry.
- *Invest in human capital*, by strengthening education and training, making the teaching profession more attractive, improving the links between education and the labour market and adapting labour market institutions to the changing nature of work.
- *Stimulate firm creation*, by improving access to high-risk finance, reducing burdensome administrative regulations and instilling positive attitudes towards entrepreneurship.

The influence of knowledge to the economic development processes could be analysed through the characteristics of knowledge in the economy. In other words, the reflection of knowledge acquisition, creation, usage and dissemination in the economy could be studied through the expression and penetration of it separate elements: human resources, innovation, innovative business and ICT (Figure 1).

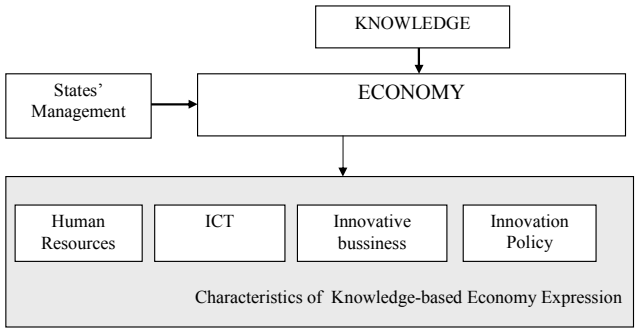

Figure 1. Characteristics of knowledge expression in economy (Kriščiūnas, Daugėlienė, 2006)

The influence of knowledge to the development of economic processes becomes possible just in case of functioning of numeral concrete managerial actions. These actions create the conditions for the development of separate knowledge-based economy elements. Figure 2 represents the reflection of all elements of Knowledge-based Economy.

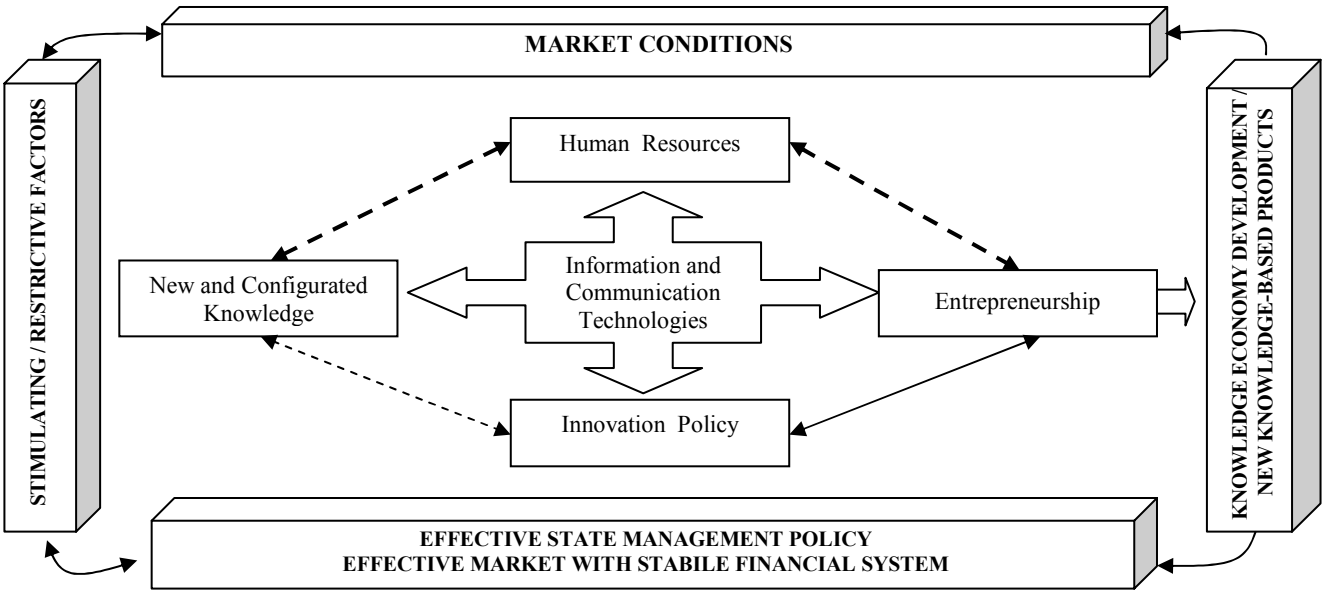

Figure 2. The structure of Knowledge-based Economy Expression (Daugėlienė, 2005b)

The main elements of knowledge economy are human capital, new and configured knowledge, innovation policy, ICT and entrepreneurship. The first condition for the possibility to develop knowledge-based economy is stabile economy (stabile fiscal policy, law inflation, effective money policy and currency policy). Just strong and developed economies can ensure the creation, diffusion and usage of ICT, foster investment in human resources as well as in innovations and stimulate knowledge intensive firm's creation.

Effective states' management policy directly influences the creation of stimulating or restrictive factors, which stipulates or blocks the progress of Knowledge Economy. It is obvious that the most important stipulator of knowledge economy creation is human being. He or she has a good education and abilities not only for usage of created knowledge but create new and meaningful knowledge. Such human being is a part of knowledge society in which significant decisions are made following new knowledge and social norms which are based on ethical and moral values. Therefore Figure 2 represents human resources which consist of the whole of such human beings (Kriščiūnas, Daugėlienė, 2006).

Development of knowledge economy is impossible without the implementation of ICT to the knowledge-based activity. The rapid spread as well as usage of novelties is possible just because of ICT. The latter stipulates creation, commercialization and application of knowledge in all activities of knowledge-based economy.

Usually it is stated that *knowledge-based economy* – it is an 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). Trying to make definition more exact and wider should be said that knowledge-based economy is rather the compatible system of legal and economical preconditions or managerial and economical mechanisms as well as modern technologies and human recourses. This system appears in the process of development of the market economy supported by the new technologies, particular information technologies. The key to remember is that acting in one of these areas alone is not enough to improve growth. Indeed, the policies advocated are mutually reinforcing. The new growth opportunities can only be seized through a comprehensive strategy based on a policy mix that is suited to each country or circumstances.

In order to verify the knowledge-based economy level in different countries, unique assessment model should be prepared. It is important that the model would cover all presented knowledge-based economy characteristics. In the next sections of article the validity of knowledge-based economy assessment will be analysed.

Key Aspects of the Problem of Assessment of Knowledge Expression in Economy

In the most works of scientists (Hepworth, Spencer, 2003; Landefeld, Fraumeni, 2000; Browning, Reiss, 2004; Trewin, 2002; Gera, Weir, 2001; Houghton, Sheehan, 2000; Small, Garfield, 1985; Dahlman, 2003; Dahlman, Chen, 2005; Atkinson, Court, 2002) as well as in the documents of different organizations like OECD, World Bank, APEC, ABS, UNECE as well as in the knowledge economy assessment methodologies prepared by USA scientists is confirmed (in the prefaces of all documents), that in spite of obvious evidences of the knowledge economy existence, the analytical tools and indicators which basically have to overlap the universal assessment model for measuring its performance are missing. At the heart of the knowledge-based economy, knowledge itself is particularly hard to quantify and also to price. We have today only very indirect and partial indicators of growth in the knowledge base itself. An unknown proportion of knowledge is implicit, uncodified and stored only in the minds of individuals. Terrain such as knowledge stocks and flows, knowledge distribution and the relation between creation and economic performance is still virtually mapped. (Daugėlienė, 2005a).

Economic indicators are measures that describe at a glance how an economic system is performing. Since their development in the 1930s, and particularly after World War II, the national accounts and measures such as Gross Domestic Product (GDP) have been the standard economic indicators of the OECD countries. Based on detailed censuses that survey economic activity at the establishment level, they measure broad aggregates such as total production, investment, consumption and employment and their rates of change. These traditional indicators guide the policy decisions of governments and those of a broad range of economic actors, including firms, consumers and workers. But to the extent that the knowledge-based economy works differently from traditional economic theory, current indicators may fail to capture fundamental aspects of economic performance and lead to misinformed economic policies. The *traditional economic indicators* have never been completely satisfactory, mostly because they fail to recognize economic performance beyond the aggregate value of goods and services. *Measuring the performance of the knowledge-based economy* may pose a greater challenge. There are systematic obstacles to the creation of intellectual capital accounts to parallel the accounts of conventional fixed capital. At the heart of the knowledge-based economy, knowledge itself is particularly hard to quantify and also to price. We have today only very indirect and partial indicators of growth in the knowledge base itself. An unknown proportion of knowledge is implicit, uncodified and stored only in the minds of individuals. Terrain such as knowledge stocks and flows, knowledge distribution and the relation between knowledge creation and economic performance is still virtually unmapped.

The OECD has tended to lean towards "harder" technology, innovation and intellectual property; strategic management experts have tended to focus on various aspects of the business process (this is where the knowledge economy literature is mostly to be found). *In order to create a "descriptive" framework or model for knowledge-based economy assessment, statistical, mathematical, econometrical models should be used.* The assessment should include not only the static situation in the state economy concerned knowledge economy, but the main challenge for the scientists and experts is to create model, which could evaluate and dynamics of knowledge economy. *The specificity off such model should be the possibility to do evaluation in time perspective.* The existing models evaluate just the present situation of the state economy, but not are suit-

able for the forecast conclusions.

Knowledge assessment could be defined as the evaluation of the ability of an enterprise, industry, economic sector, a city, region, or nation to create, access, assimilate, diffuse, and use knowledge (OECD, 1996). According to this the seeking indicators of that ability is the main task of forming the model. But for many indicators that apply to knowledge assessment, there are no accepted international standards that prescribe for a given country or sector whether the present value of the indicator is adequate or too low to achieve its developmental goals. As there is no single path to development, so there is no easy way to determine, for example, whether two countries with similar values for their knowledge-based indicators are in fact at the same stage of development. How many Internet servers per capita should a developing country have? Which is of higher priority: increasing Internet access in schools or in research labs? How many biotechnologists, software engineers, or patent attorneys does a country need? Some of these questions made little sense or had quite different answers a decade ago, so no one can trace the trajectories of countries that have made different choices.

In the knowledge-based economy, problems emerge with the conceptual framework of the national accounts. Not least is the issue of subsuming knowledge creation into a measurement system designed for traditional goods and services. The pace of change complicates the task of measuring aggregate output and raises questions about the use of input measures as output indicators. Factors which are not sufficiently incorporated into the national accounts framework include qualitative changes in products, the costs of change and rapid product obsolescence.

Knowledge is not a traditional economic input like steel or labour. When traditional inputs are added to the stock of economic resources, the economy grows according to traditional *production function "recipes"*. For example, more labour can increase GDP by an amount that depends on current labour productivity, or more steel can increase production of autos, housing or tools by predictable amounts according to the current state of the arts. New knowledge, in contrast with steel or labour, affects economic performance by changing the "*recipes*" themselves – it provides product and process options that were previously unavailable.

While new knowledge will generally increase the economy's potential output, the quantity and quality of its impact are not known in advance. There is no production function, no input-output *"recipe"* that tells, even approximately, the effect of a "*unit*" of knowledge on economic performance. Knowledge, unlike conventional capital goods, has no fixed capacity. Depending on entrepreneurship, competition and other economic circumstances, a given new idea can spark enormous change, modest change or no change at all. Increased resources devoted to knowledge creation are likely to augment economic potential, but little is known as to how or how much. Thus the relationship between inputs, knowledge and subsequent outputs are hard to summaries in a standard production function for knowledge.

It is also difficult to stabilize the price of knowledge by the trial and error discipline of repeated transactions in the market. There are neither company knowledge records nor census of knowledge creation or exchange. In the absence of knowledge markets, there is a lack of the systematic price information that is required to combine individual knowledge transactions into broader aggregates comparable to traditional economic statistics. In knowledge exchanges, a purchaser has to gauge the value of new information without knowing exactly what it is he is to buy. New knowledge creation is not necessarily a net addition to the economically relevant knowledge stock, since it may render old knowledge obsolete.

There are four principal reasons why knowledge indicators, however carefully constructed, cannot approximate the systematic comprehensiveness of traditional economic indicators:

- there are no stable formulae or "recipes" for translating inputs into knowledge creation into
- outputs of knowledge;
- inputs into knowledge creation are hard to map because there are no knowledge accounts analogous to the traditional national accounts;
- knowledge lacks a systematic price system that would serve as a basis for aggregating pieces of knowledge that are essentially unique;
- new knowledge creation is not necessarily a net addition to the stock of knowledge, and obsolescence of units of the knowledge stock is not documented.

The problem of developing new indicators is itself an indication of the unique character of the knowledge-based economy. Were we faced with trivial modifications to the traditional accounting system, a few add-on measures might suffice. To fully understand the workings of the knowledge based economy, new economic concepts and measures are required which track phenomena beyond conventional market transactions.

Subject to the precision and qualitative assessment of penetration of knowledge-based economy depends (Landefeld and Fraumeni, 2000):

- effective anticipation of states taxes as well as expenses;
- the anticipation of states development strategies seeking to dispense effectively the financial recourses for the development of KBE;
- the anticipation of technology policy as well as legislation and rules of taxes;
- the anticipation of investments to the physical and human capital as well as to the R&D support.

Assessment of Knowledge Expression in economy could be divided into two groups (Daugėlienė, 2005b):

- *macro level assessment* or assessments concerned with a *comprehensive assessment of knowledge expression.* These are performed seeking determine the potential of knowledge acquisition, creation, dissemination and usage in the level of state. Evaluating the business and economy climate of foreign country as well as making strategic solutions according development of country the comprehensive assessment of knowledge expression is the most purposeful;
- *micro level assessment* or assessments performed in order to determine the potential of knowledge acquisition, creation, dissemination and usage. These assessments should be useful for organiza-

tions which are seeking to ensure effective development of productive knowledge-based activity as well as nationally and internationally enhance competitive advantage. Such assessment is identified as *sectorial assessment of knowledge expression* when the penetration level of one or several characteristics of knowledge expression in the economy segment should be assessed.

Diversity of Knowledge Expression Assessment Models

Comparing the level of knowledge economy development in different countries knowledge expression in economy assessments are made by international organizations, states' institutions, statistic departments and other institutions in cooperation with scientists. The specificity of conclusions of assessment depends on estimators purposes as well as on the chosen aspect of knowledge expression (possibilities for development of ICT, human resources, innovation policy, entrepreneurship separately or whole). Mostly all assessments could be divided in to two groups: comprehensive and sectoral. The assessments of expression of characteristics of ICT, innovations, human resources, entrepreneurship as well as social and economic situation evaluations usually are emphasized in the documents of OECD, World Bank, UNECE, APEC, ABS.

All analyzed knowledge-based economy models could be classified into two groups which are different concerning standpoint of analysis (Figure 3):

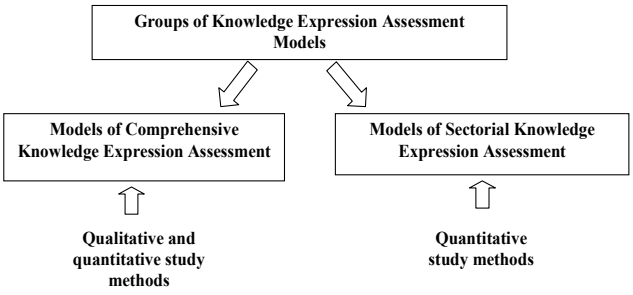

Figure 3. Groups of Knowledge Expression Assessment Models (Kriščiūnas, Daugėlienė, 2006)

In the first case (comprehensive assessment) the common situation of knowledge economy is evaluated on the basic ground. Therefore the essential elements off knowledge econtomy or as it should be called characteristics of knowledge expression are analyzed:

- *context dimension or economic incentive and Institutional regime* (state management situation; the stability of state's market as well as financial system);
- *human capital dimension* (the potential of human capital development);
- *ICT infrastructure***:** producing and usage;
- *innovation System* (the assurance of innovation policy);
- *innovative business dimension* (Entrepreneurial activity tendencies).

In the second case (sectorial assessment) the assessment of knowledge expression is issue oriented. In this case the identification of penetration level of one knowledge expression characteristics is the object of assessment. The assessment could be directed to the ICT, R&D, human recourses, patents and so on. The later assessment models mostly are based on the one index principle. Once a set of indicators has been decided upon, it is theoretically possible to create an index to reflect the intensity with which an economy is knowledge-based. The use of a single figure index, if valid, would facilitate comparative analyses and could become an important indicator of economic performance. However, before an index can be developed, each indicator would require an appropriate weight to be assigned to it. This in turn relies on the existence of a sound and generally agreed model which defines and prioritizes key elements of a KBE. As Mohnen & Dagenais (1998) noted, a major obstacle to constructing an index from a compilation of survey data is how to combine various measures of the same concept. This problem is compounded when the index is used over time, as the framework on which it is based needs to change in order to remain relevant. According to ABS method a single index would present an over-simplified and possibly misleading representation of the extent to which an economy or society is knowledge-based.

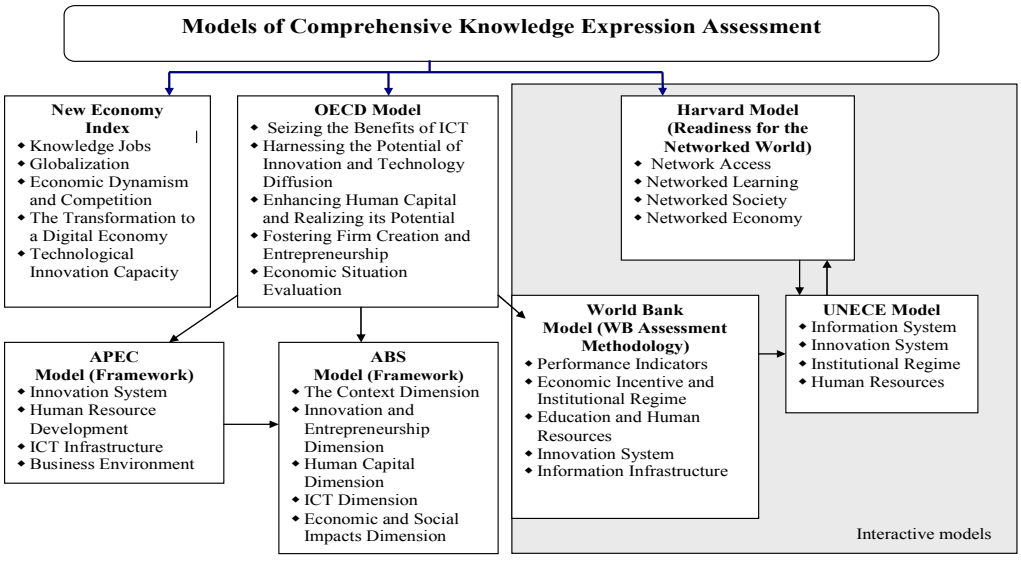

Figure 4. Models of Comprehensive Knowledge Expression Assessment (Daugėlienė, 2005a)

Models of Comprehensive Knowledge Expression Assessment

It is important to stress, that theoretically distinguished two kids of knowledge expression models even if they are presented as two separate instruments for assessment in practical use are tightly connected.

The main treat of this group of models (Figure 4) is that all models analyses the penetration of same knowledge expression characteristics and the same criteria groups. The later could be systemized into five groups**,** where the assessment is stressed on:

- government management as well the financial stability what explain the states possibility to create knowledge economy;
- the usage of information and telecommunication technologies in all spheres of activity (starting from the households, enterprises, government);
- human recourse potential;
- innovation Policy assurance as well as the measures of stimulation of innovation creation;
- development of entrepreneurship.

Models of Comprehensive Knowledge Expression Assessment are presented by OECD (starting from 1996), Atkinson, R.D. and Court R. H. – New Economy index (starting from 1998), World Bank (starting from 1998), ABS (starting from 1999), APEC (starting from 1999), experts of Harvard University (starting from 2000) and UNECE (starting at 2002). The assessment methodology of UNECE has been active in promoting the creation of a knowledge-based economy in the countries in transition. Here New Economy Index – concentrates the evaluation basically on the whole countries level of economy development and stresses, that there should be analyzed these characteristics: knowledge jobs, globalization, economic dynamism and competition, the transformation to a digital Economy, technological innovation Capacity. OECD assessment methodology – involve all the elements of knowledge economy as well as APEC or ABS. These are constructed considering framework of OECD. However the latter models specifically are created for KBE assessment. World Bank KAM (Knowledge Assessment Methodology) embraces all the knowledge expression characteristics. Interactive internet-based KAM is prepared too. UNECE model embraces Harvard model plus Global Knowledge-based economy Index (which is attributed to the group of sectorial knowledge assessment models).

Summarizing the main advantages of given knowledge expression assessment models there should be highlighted some details. *The first characteristic* which should be evaluated is *context dimension* or as it interpreted in different models: performance, economic, legal incentives dimensions (state management situation; the stability of state's market as well as financial system). The economic stability is very important seeking to ensure the development of state's policies and especially to ensure the creation, dissemination and profitable usage of knowledge. *The second dimension* should be analyzed is *human capital dimension*. Accordingly there should be analyzed and other dimensions like *ICT* infrastructure (producing and usage), *innovation system* (the assurance of innovation policy) and *entrepreneurship* dimension (entrepreneurial activity tendencies).

Models of Sectorial Knowledge Expression Assessment

The second group of models of knowledge expression assessment is models of sectorial assessment. Essential feature of these models which makes them different from models for comprehensive assessment is methodic of models application. Some of them are econometric models (Griliches, 1990; Greenwood, Hercowitiz, Krussel, 1997; Benhabib, Spiegel, 2000). The application of these is based on mathematical statistical calculations. Others designed for the assessment of potential of knowledge usage (KI; Machlup methodology) or knowledge creation and dissemination (Information Society Index; INEXSK and others).

Theoretically there is the possibility to classify models of sectorial knowledge expression assessment. Classification is based on assessment orientation or specification (Daugėlienė 2005a; Kriščiūnas, Daugėlienė, 2006).

- *Specific assessment (oriented on subject)* indexes. Growth Competitiveness index (GCI), Science Citation Index (Small, Garfield, 1985), Regional Economic Architecture (REA) method (basically concerned with the assessment of human capital dimension with deep point on employment and skills indicators), Human Development Index (HDI) belong to this category.
- *Basic Assessment based on one index (all knowledge expression characteristics).* Final result of calculation is single coefficient. The weakness of this assessment method is concerned with the problematic identification of penetration level of different knowledge expression characteristic. Knowledge-based Economy Index (KBEI) and Global Knowledge-based Economy Index (GKEI) could be assigned to this group.
- *Assessment orientated to ICT infrastructure*. Indexes which calculation is concentrating on the issues correlated with ICT usage in all activity forms. In the scientific literature we could find four types off such indexes: F. Machlup Assessment Methodology (1962), Information Society Index (Gifford, 1999), Networked Readiness Index (NRI), INEXSK Model (Mansell, Wehn, 1998).

Theoretically there is the possibility to separate knowledge expression assessment models. However together with comprehensive knowledge assessment models usually some of sectorial knowledge assessment models are applied in practice. Such incorporated methodology ensures the quality of knowledge expression assessment in the states' as well as organizational level. Though presented models could be applied effectively if criteria and methodology of assessment would be specified. Groups of criteria and separate criteria usually are detailed. Lack of information makes knowledge expression assessment very complicated. The calculation of extracted criteria is very complicated even in some cases it is impossible to find certain expression of selected criteria. Consequently the application of presented models is

almost or in some cases absolutely impossible.

Presented analysis stipulates to suggest adjusted and appended instrument for the assessment of knowledge expression in economy.

Elaborated Instrument for the Assessment of Knowledge Expression in Economy

KBE penetration could be assessed using the instrument which includes the properly selected criteria enabling quantitatively assess the results of knowledge acquisition, creation, usage and dissemination (Daugėlienė, 2005a; b). In order to assess the penetration level of knowledge-based economy:

- the penetration of main elements of KBE should be assessed;
- the criteria should be selected which makes it possible to assess the results of the products of knowledge acquisition, creation, usage and dissemination (human resources, innovation policy, innovative business as well as ICT);
- the elements of KBE are interpreted as knowledge expression characteristics.

Instrument for the assessment of knowledge expression covers:

- an evolving of criteria of knowledge expression assessment;
- its application methods.

The requirements for the instrument are:

- it should be flexible in order to consider different purposes of assessment;
- it should be appropriate to assess the penetration of all characteristics of knowledge expression;
- it should precise define criteria of assessment;
- search or calculation of statistical expressions of criteria should be not complicated;
- could be used as effective instrument seeking to format effective states' management policy which would be favourable for the creation and usage of knowledge;
- could be used as instrument for the highest level of executives seeking to analyse the conditions of knowledge expression not only inside of organization but and outside it.

The instrument for the assessment of knowledge expression could be applied in some cases: both inside and outside of country or organization (Daugėlienė, 2005a).

Considering the limits of the article just construction of evolvent of knowledge expression assessment criteria groups will be presented (Figure 5).

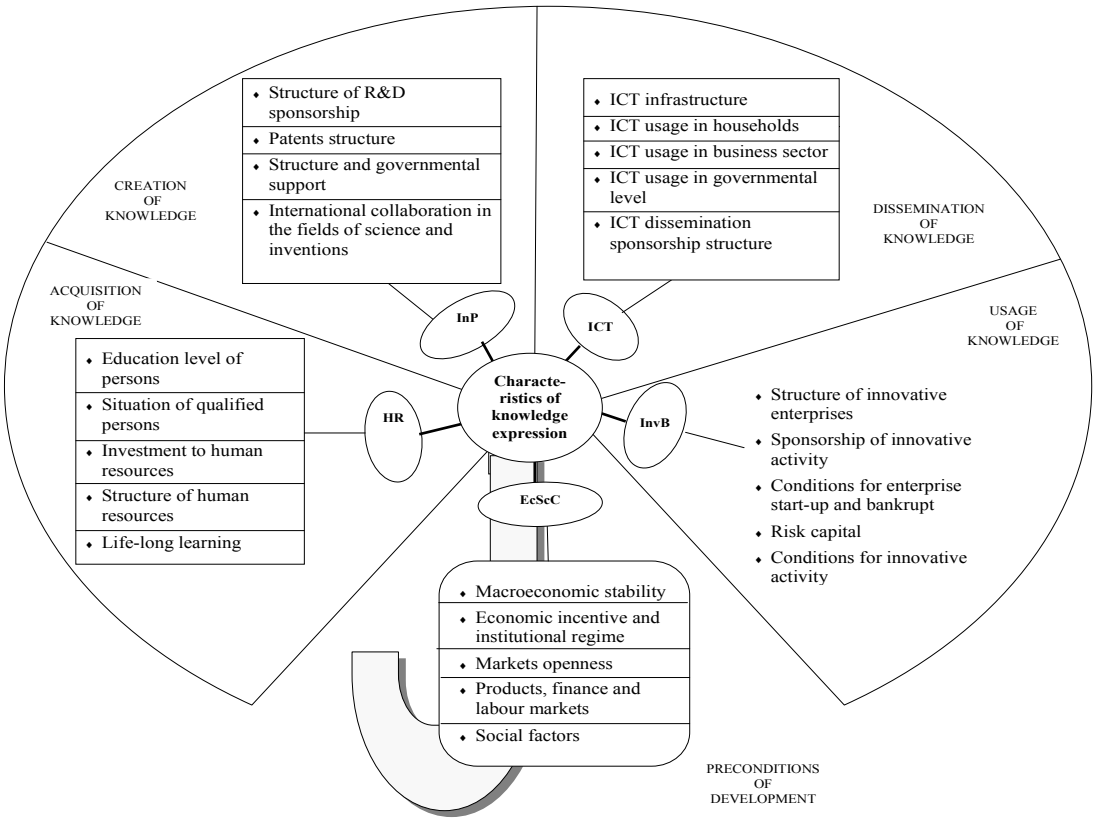

Figure 5. Evolvent of knowledge expression assessment criteria groups (Daugėlienė, 2005a)

It has been discovered that to carry out the knowledge expression assessment, the potential of socio-economic conditions has first to be assessed. The proposed technique to do this is by means of assessment of *socio-economic context*.

To establish *the knowledge acquisition* conditions and quality the assessment of the development of *human resources* is proposed. To *assess the conditions* for knowledge creation, the assessment of *innovations policy* in the country is proposed. To determine the efficiency of *knowledge application* – the assessment of development of *innovative activity* should be carried out. To define the

quality and conditions for *knowledge dissemination* the assessment of *application of information and communication technologies should be employed*. Since the specific character or knowledge expression assessment in the first place depends on the purpose of assessment, two types of assessment are proposed: *concentrated* and *extended*. *In the case of concentrated assessment* 37 criteria and in the extended – 142 criteria to be assessed are listed (Daugėlienė, 2005a).

Instrument for the assessment of knowledge expression in economy: application fields

Instrument for the assessment of knowledge expression is applicable for the comprehensive and sectorial assessment of the knowledge expression in economy (Figure 6); as well as constructed to be flexible for different subjects (Daugėlienė, 2005a; Kriščiūnas, Daugėlienė, 2006).

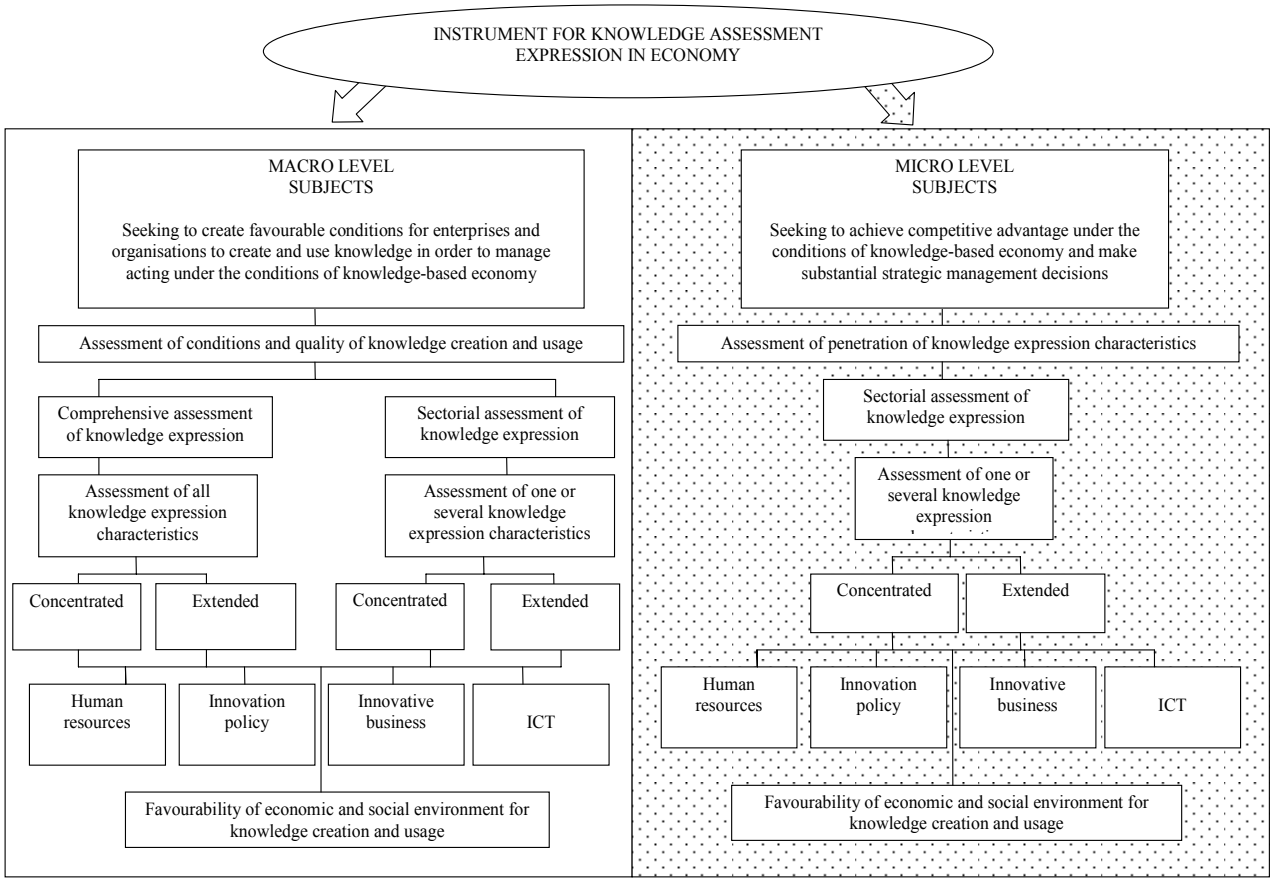

Figure 6. Application fields of Instrument for the assessment of knowledge expression in economy

Accurate and qualitative knowledge expression assessment stipulates (Landefeld, Fraumeni, 2000):

- the creation of adequate strategy for the states' development (macro level). The *subjects of macro level* (Daugėlienė, 2005a) (governments, departments of governments, subdivisions of international organizations, municipalities) seeking to constrain favourable environment for organisations to create and use knowledge in order to manage acting under the conditions of knowledge-based economy should be interested in assessment of conditions and quality of knowledge creation and usage.
- the growth of organisations' competence create and apply knowledge inside and outside of country (micro level). The *subjects of micro level* (Daugėlienė, 2005a) (business, manufacturing and other organizations; business associations; scientific and research organizations; universities) seeking to achieve competitive advantage under the conditions of knowledge-based economy and make substantial strategic management decisions should be interested in assessment of penetration of knowledge expression characteristics.

Presented analysis demonstrated the complication of assessment of knowledge-based economy penetration which manifests through the knowledge expression characteristics. However it is possible to constrain systemic instrument which allows assessing the results of knowledge acquisitions, creation, usage and dissemination.

Conclusions

- The statement 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 mecha-

nisms, modern technologies and human resources, the system resulting from development of market economy and different technologies, in particular, information technologies. The system is rather intricate because it does not lead to economic or social result if any single element of the system is ignored. It is essential for the state to have a clearly defined innovations policy which could operate as the stimulating measure for knowledge development and application.

- Knowledge expression assessment could be carried out by establishing the penetration extent of knowledge-based economy characteristics. Therefore, the preconditions of formation of knowledge-based economy and factors are constructed as the characteristics of knowledge expression.
- The knowledge expression assessment models being accounted can be divided into 2 groups. The first group comprehensive knowledge expression assessment models which consist of models comprising as many as possible knowledge expression characteristics. The second group is sectorial knowledge expression assessment models which sectorially comprise knowledge expression characteristics.
- The knowledge expression assessment models currently taken into account fail to sufficiently elaborate the principles and methodology of assessment, therefore, a created instrument for knowledge expression assessment is proposed, which defines the evolving of knowledge expression assessment criteria as well as methods for its application. The latter is of both scientific and, in particular, practical value.
- It has been discovered that to carry out the knowledge expression assessment, the potential of socio-economic conditions has first to be assessed. The proposed technique to do this is by means of assessment of socio-economic context. To establish the knowledge acquisition conditions and quality the assessment of the development of human resources is proposed. To assess the conditions for knowledge creation, the assessment of innovations policy in the country is proposed. To determine the efficiency of knowledge application – the assessment of development of innovative activity should be carried out. To define the quality and conditions for knowledge dissemination the assessment of application of information and communication technologies should be employed.
- The application of the created instrument for knowledge expression assessment is effective in making managerial decisions in the level of the state, enterprises and organizations. Instrument proposed to apply in combination of quantitative as well as qualitative assessment methods. The proposed instrument is applicable for two subject groups.
- In macro level, seeking to create favourable conditions for companies and organizations to develop and apply knowledge as well as operate in knowledge-based economic conditions, the instrument for knowledge expression assessment should be applied for international organizations, governments, state departments and municipalities. In micro-level, in seeking to gain competitive advantage under the conditions of knowledge-based economy and making strategic management decisions, the instrument should be applied for business associations, business organizations, R&D institutions, also, to industrial, business, etc. enterprises.

References

1. Atkinson, R.D. The 2002 State New Economy Index: Benchmarking Economic Transformation in the States / R.D. Atkinson, R. H. Court. Progressive Policy Institute, 2002. 54 p. Prieiga per internetą: http://www.neweconomyindex.org/states/2002/PPI_State_Index_2002.pdf
2. Benhabib, J. Human Capital and Technology Diffusion. FRBSF Working Paper / J. Benhabib, M.M. Spiegel, No 2003-02. 2002. 49 p.
3. Browing, J. Encyclopedia of the New Economy / J. Browing, S. Reiss, 2004**.** Prieiga per internetą: http://hotwired.wired.com/special/ene/
4. Dahlman C. J. Using knowledge for development: a general framework and preliminary assessment of China // *China's future in the knowledge economy: engaging the new world* / Ed. Grewal B., Xue L., Sheehan P., Sun F. 2003. 35-66 p. Prieiga per internetą: www.developmentgateway.org/node/130667/sdm/docview?docid=423767
5. Dahlman, C. J. The Knowledge Economy, the KAM Methodology and World Operations / C. J. Dahlman, D. H. Chen. The world Bank, Washington DC 20433, 2005.
6. Daugėlienė R. Peculiarities of Knowledge-based Economy Assessment: Theoretical Approach / Daugėlienė, R., Kriščiūnas, K. // *Juxtaposition of European Union Enlargement and Lisbon Processes. Proceedings* / Ed. K. Kriščiūnas. Kaunas: Technologija, 2004, p. 15 -24.
7. Daugėlienė, R. Theoretical Modeling of Instrumentarium for the Assessment of Knowledge Expression in Knowledge-based Economy. Doctoral dissertation. Kaunas, 2005a. 127 p.
8. Daugėlienė, R. Transformation of the Economy: the Expression of Knowledge-based Economy Penetration and the Assessment Models // Wissensbasierte okonomie im zeitalter des internet. Technische Universitat Koszalin, Kompetenzzentrum EU – Osterwiterung am BiG Greifswald. 2005b, p. 25 – 45.
9. Daugėlienė, R. Innovation as the Engine of Knowledge-based Economy Development / Daugėlienė, R., Bolšakovs, S. // 6th Annual International Scientific Conference "Knowledge Society and Implementation of Lisbon process in Europe and Latvia". Proceedings. Riga, 2005. 148 p.
10. Daugėlienė, R. The Assessment Peculiarities of Human Resource Impact to the Knowledge Economy's Development / R. Daugėlienė, L. Volodzkiene // *Enlarged European Union in House of Europe: New Internal and External Problems. Proceedings* / Ed. By Kriščiūnas K. Kaunas: Technologija, 2004, p. 46-61.
11. Dutta, S. The Networked readiness Index 2003-2004: Overview and Analysis Framework / Dutta, S., Jain, A.// *The Global Information Technology Report 2003-2004: Readiness for the Networked World.* Chapter 1. Oxford University Press, 2004, p. 3-22.
12. Foray, D. The knowledge-based economy: From the economics of knowledge to the learning economy / D. Foray, B.A. Lundvall // *OECD Employment and Growth in the Knowledge Based Economy*. Paris, 1996.
13. Gera, S. The Knowledge-based Economy and Economic Growth: theory and empirical evidence / Gera, S., Weir, T. // *New Economy Issues* Paper No 3, Department of Industry, Science and Resources. Canberra, 2001.
14. Hepworth, M. A Regional Perspective on the Knowledge Economy

in Great Britain / Hepworth, M., Spencer, G. // *Report for the Department of Trade and Industry.* London, 2003.

15. Houghton, J. A Primer on the Knowledge Economy / Houghton, J., Sheehan, P. // *Centre for Strategic Economic Studies*. Victoria University, Melburne. 2000.
16. Kirkman, G.S. The Networked readiness Index: Measuring the Preparedness of nations for the Networked World / G.S. Kirkman, C., A.,Osorio, J., D. Sachs, // *The Global Information Technology Report 2001-2002: Readiness for the Networked World.* Chapter 2. Oxford University Press, 2002, p. 10-29.
17. Kriščiūnas, K. Žiniomis grįstos ekonomikos link: žinių raiška ir skvarba / K., Kriščiūnas, R., Daugėlienė / Monografija. Kaunas, Technologija, 2006, 222 p.
18. Landefeld, J.S, Measuring the New Economy / J.S., Landefeld, B. M., Fraumeni // Paper presented at the May 5, 2000 meeting of the BEA Advisory Committee. 2002. Prieiga per internetą: http://www.bea.doc.gov/bea/about/newec.pdf
19. Lighting the Way: Knowledge Assessment in Prince Edward Island // *National Academy Press*, Washington, D.C., 1999. Prieiga per internetą: http://www.nap.edu/openbook/030906435X/html/R1.html
20. Machlup, F. Knowledge: Its Creation, Distrubution and Economic Significance. Princeton University Press, Princeton, NJ, 1984.
21. Malhotra, Y. Measuring Knowledge Assets of Nation: Knowledge Systems for Development // *Research Papers prepared for the Invited Keynote Presentation at meeting „Knowledge Systems for Development"*. New York City. New York, 2003.
22. Mansfield, E. Intellectual property protection, foreign investments, and technology transfer: Germany, Japan, and the United States // *Discussion Paper 19, International Finance Corporation*, Washington D.C., 1994.
23. Neef, D. The Knowledge Economy: An Introduction // *The Knowledge Economy* / Ed. D. Neef. Butterworth-Heinemann. Boston, 1998.
24. New Economy and APEC, 2001 / APEC, 2001. 210pp. Prieiga per internetą: http://www.apec.org/apec/publications/all_publications/economic_committee.html
25. OECD Science, Technology and Industry Scoreboard 2001: Towards a knowledge-based economy. OECD, 2001a. Prieiga per internetą: http://www1.oecd.org/publications/e-book/92-2001-04-1-2987/index.htm
26. OECD The Knowledge-Based Economy. Paris, 1996. p. 44. Prieiga per internetą: http://www1.oecd.org/pdf/M00005000/M00005208.pdf
27. OECD: The new Economy beyond the hype. The OECD Growth Project. Paris, 2001 (b). Prieiga per internetą: http://www1.oecd.org/publications/e-book/9201091e.pdf
28. Porter, M. E. Competitive Strategy: Techniques for analyzing industries and competitors / M. P. Porter. The free Press, 1998. 397 p.
29. The Knowledge Assessment Methodology and Scorecards**.** 2002. Prieiga per internetą: http://www1.worldbank.org/gdln/Programs/kam2002/methodology.htm
30. Trewin, D. Measuring a Knowledge-based Economy and Society: Discussion Paper An Australian Framework. Commonwealth of Australia. 2002, p. 48. Prieiga per internetą: http://www.ausstats.abs.gov.au/Ausstats/free.nsf/Lookup/4F8E59034103E624CA256C230007DC05/$File/13750_aug%202002.pdf
31. UNECE. Towards a Knowledge-based Economy. Country Readiness Assessment Report: Concept, Outline, Benchmarking and Indicators. UNECE. New York – Geneva, 2002, p. 72. Prieiga per internetą: http://www.unece.org/ie/enterp/documents/coverpagregion.pdf

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Žiniomis grįstos ekonomikos skvarbos vertinimo modeliai

Santrauka

Žiniomis grįstos ekonomikos (ŽGE) svarba XXI amžiuje neabejotinai didelė. Todėl straipsnyje gvildenama žiniomis grįstos ekonomikos raiškos problema. Siekiant aiškumo dėl žiniomis grįstos ekonomikos funkcionavimo specifikos, sisteminamos žinių raiškos ekonomikoje charakteristikos. Analizuojama galimybė vertinti žinių raiškos laipsnį ekonomikoje. Sisteminami naudojami žinių raiškos vertinimo modeliai, siekiant pamatyti jų trūkumus. Kaip pagrindinis straipsnio mokslinio tyrimo rezultatas pristatomas žinių raiškos vertinimo instrumentarijus bei galimos jo taikymo sritys.

Anot žymaus filosofo M. Polanyi, žmonija išgyvena didžių transformacijų laikotarpį, kai socialiniai žinių kūrimo, įgijimo, sklaidos ir panaudojimo procesai sukuria ekonominę vertę, o rezultatas įvardijamas kaip žiniomis grįsta ekonomika. Informacinės ir komunikacinės technologijos (IKT) padeda plėtoti socialinius santykius, nepriklausomus nuo laiko ir erdvės. Mokslinėje literatūroje išryškinama, kad žiniomis grįsta ekonomika – tai pirmiausia stabili rinkos ekonomika su visais jai būdingais bruožais, o viena iš pagrindinių jos varomųjų jėgų – žinios ir informacinės technologijos.

ŽGE susiformavo dėl kelių esminių priežasčių. Pirmiausia, dėl visuomenės poreikio ir noro kurti žinias, siekiant ekonominės ir socialinės gerovės, o toje gerovėje tenkinant smalsumą, taip pat dėl konkurencinio pranašumo siekimo, užtikrinant būtinas stabilios ekonomikos sąlygas, pasireiškiančias efektyvios valstybės politikos vykdymu, stabilios finansų sistemos ir efektyviai funkcionuojančios rinkos palaikymu. Pastarosios sąlygos sudaro prielaidas inovacijų politikai plėtoti, informacinėms ir komunikacinėms technologijoms kurti ir taikyti, žmogiškiesiems ištekliams bei novatoriškam verslui vystyti. Tokie procesai stebimi tik tada, jei sudaromos palankios sąlygos kurti ir panaudoti žinias. Todėl žinių raiškos skvarbai įvertinti, naudotinos žiniomis grįstos ekonomikos raiškos charakteristikos, jas įvardijant kaip žinių raiškos charakteristikas.

Paprastai, siekiant nustatyti kokio nors reiškinio poveikio laipsnį bei vystymosi tendencijas, pasitelkiami vertinimo modeliai. Žinių vadybos mokslinėje literatūroje gausu organizacijų intelektinio bei žmogiškojo kapitalo potencialo vertinimo modelių, įgalinančių įvertinti žinių kūrimo ir panaudojimo sąlygas įmonės ir organizacijos viduje, ir tokiu būdu kurti žinių srautų vadybos modelius. Tačiau žiniomis grįstos ekonomikos konkurencijos sąlygomis tokio vertinimo modelio taikymas yra nepakankamas.

Nagrinėjant esamus žinių raiškos vertinimo modelius, matyti, kad juose analizuojami reiškiniai ir procesai yra žinių įgijimo, kūrimo, panaudojimo ir sklaidos rezultatai. Šios žinių savybės realizuojamos naudojant žmogiškuosius išteklius, kuriant ir taikant IKT, plėtojant novatorišką verslą bei inovacijų politiką. Daugelyje mokslinių darbų (Hepworth, Spencer, 2003; Landefeld, Fraumeni, 2000; Browning, Reiss, 2004; Trewin, 2002; Gera, Weir, 2001; Houghton, Sheehan, 2000; Small, Garfield, 1985; Dahlman, 2003; Dahlman, Chen, 2005; Atkinson, Court, 2002), taip pat tarptautinių organizacijų (OECD, Pasaulio banko, ABS, APEC, UNECE) atliekamuose žinių raiškos vertinimuose teigiama, jog, nepaisant akivaizdžių žiniomis grįstos ekonomikos raiškos įrodymų bei bandymų vertinti atskirų žinių raiškos charakteristikų skverbties laipsnį, kokybinių ir kiekybinių metodų bei detalaus, visuminio, daugeliui situacijų tinkamo žinių raiškos vertinimo modelio vis dar nepavyko sukurti. OECD parengtose žinių raiškos vertinimo ataskaitose akcentuojama, kad žinias, kaip pagrindinį žinių ekonomikos raidos bei produktyvios veiklos kūrimo užtikrinimo veiksnį, sudėtinga įvertinti. OECD, Pasaulio banko, APEC, ABS ekspertai siūlo žinių raiškos vertinimo modelius, kurie dar neapima visos vertinimo problematikos, neapibrėžia žinių raiškos vertinimo instrumentarijaus sudarymo bei jo taikymo logikos.

Mokslinėje literatūroje pasitaikantys žinių raiškos vertinimo modeliai teoriškai gali būti sugrupuoti į dvi grupes. Pirmoji – visuminio žinių raiškos vertinimo modeliai. Šie priskiriami žinių raiškos fundamentaliajam vertinimui (vertinamos visos žinių raiškos charakteristikos). Prie šios grupės skirtinas naujosios ekonomikos indeksas, OECD modelis, APEC modelis, ABS modelis, Pasaulio banko modelis, Harvardo modelis bei UNECE modelis. Antroji modelių grupė – sektorinio žinių raiškos vertinimo modeliai. Tai yra į žinių raiškos skverbties nustatymą orientuoti modeliai (dažniausiai vienas indeksas). Šiai grupei priskiriama 15 vertinimo modelių (indeksų). Straipsnyje pabrėžiama, kad esminis šios modelių grupės bruožas – dažniausiai atliekamas vienos žinių raiškos charakteristikos skverbties laipsnio nustatymas, kurio rezultatas – vienas indeksas. Toks vertinimo principas nustatant žinių poveikį vystymosi procesams traktuojamas kaip nepakankamai efektyvus, kadangi vienos

žinių raiškos ekonomikoje charakteristikos skverbties nustatymas neatspindi visuminio ŽGE skverbties šalies lygio.

Esami žinių raiškos vertinimo modeliai negali būti taikomi norint atlikti visuminį ar sektorinį žinių raiškos vertinimą, kadangi šie dažniausiai orientuoti į siaurą vertinimo tikslą, o siūlomi vertinimo kriterijai nepakankamai detalizuoti. Neteko aptikti apibrėžtos vertinimo bei duomenų apdorojimo metodikos. Todėl šiuos vertinimo modelius galima būtų traktuoti kaip nestruktūrizuotus ir nepakankamai apibrėžtus. Nepaisant to, sudarant žinių raiškos vertinimo instrumentarijų, aptinkami vertinimo modeliai yra didžiulis šaltinis, įvairių vertinimo instrumentų sankaupa, įgalinanti suformuoti detalų žinių raiškos vertinimo instrumentarijų.

Straipsnyje laikomasi nuomonės, kad žinių raiškos vertinimo žiniomis grįstoje ekonomikoje instumentarijus – sudėtinga, metodiškai vientisa, daugiakriterė struktūra, kurios efektyvus pritaikymas galimas tik derinant kokybinius ir kiekybinius vertinimo metodus. Kitaip tariant, instrumentarijus suprantamas kaip vertinimo kriterijų išklotinė ir jos taikymo metodika.

Siekiant įvertinti žinių raiškos charakteristikų skverbties laipsnį, siūloma naudoti žinių raiškos vertinimo kriterijų išklotinę, kuri buvo sudaryta vadovaujantis technologijų vystymosi ateityje modelių formavimo ypatumais, taip pat „skėčio“ metafora, kuri įgalino struktūriškai pavaizduoti žinių raiškos vertinimo dedamųjų išklotinę.

Dėl ribotos straipsnio apimties, autoriai pateikia tik žinių raiškos vertinimo kriterijų grupių išklotinės modelį ir apibrėžia galimas žinių raiškos ekonomikoje vertinimo instrumentarijaus taikymo sritis, detalizuoja subjektus, kuriems tokia analizė būtų reikšminga ir naudinga.

Instrumentarijus siūlomas taikyti atliekant žinių raiškos – įgijimo, kūrimo, panaudojimo ir sklaidos – vertinimus valstybės bei įmonių ir organizacijų lygmeniu. Akcentuojama visuminio ir sektorinio vertinimo galimybė. Instrumentarijų taikyti siūloma dviem subjektų grupėms. Makrolygmeniu, siekiant sudaryti palankias sąlygas įmonėms ir organizacijoms kurti ir panaudoti žinias bei veikti žiniomis grįstos ekonomikos sąlygomis, žinių raiškos vertinimo instrumentarijų siūloma taikyti vyriausybėms, vyriausybės departamentams, savivaldybėms, tarptautinių organizacijų padaliniams. Mikrolygmeniu, siekiant įgyti konkurencinį pranašumą žiniomis grįstos ekonomikos sąlygomis ir priimti pagrįstus strateginius vadybos sprendimus, žinių raiškos vertinimo instrumentarijų siūloma taikyti verslo, gamybinėms ir kt. organizacijoms, verslo asociacijoms, mokslo tyrimų institucijoms ir universitetams.

Straipsnyje siūlomos dvi galimos žinių raiškos vertinimo instrumentarijaus taikymo sritys – žinių raiškos ekonomikoje nustatymas, atliekant visuminį vertinimą makrolygmeniu; ir žinių raiškos charakteristikų skverbties laipsnio vertinimas, atliekant sektorinį vertinimą mikrolygmeniu.

Raktažodžiai: *žinios, žinių raiška, žiniomis grįsta ekonomika, žinių raiškos ekonomikoje charakteristikos, žinių raiškos vertinimo instrumentarijus*.

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