

TOWARDS KNOWLEDGE-BASED ECONOMY: MODELLING KNOWLEDGE EXPRESSION ASSESSMENT

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Abstract

Article analyses the factors which stimulated transformations of Traditional Economy to the Knowledge Economy, highlights the basic treats of Knowledge-based Economy (KBE). The main point is stressed to the analysis of knowledge impact manifestation to the development of economy. The author highlights possibility to assess the penetration level of KBE which could manifest through 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. The article presents two theoretically separated groups of Knowledge Expression Assessment Models. Considering shortages of analysed models and seeking to create flexible model for knowledge expression assessment, instrument for the assessment of knowledge expression in KBE is suggested in the article. The structure of evolvent of knowledge expression assessment criteria as well as the possible fields and subjects for application of suggested instrument is declared in the article as well.

JEL classification: A1; D8; M0; O10; O3; O47; P52.

Key Words: Engines of Economy Transformations; Knowledge-based Economy; Knowledge Expression Characteristics; Instrument for Knowledge Expression Assessment

Introduction

Over the past quarter century, the rate of knowledge creation and dissemination has increased significantly. 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. The increased speed in the creation and dissemination of knowledge has led to the rapid speed of modern and efficient production techniques, plus the increased probability of leapfrogging, which has consequently resulted in the world economy becoming much more competitive.

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 Union¹. Strategic goal was defined bearing in mind both external challenges – globalization – and internal constraints – 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 its performance are missing. Ideally, a research-policy agenda should encompass new economic

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.

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 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.). Many different attempts exists 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 OECD², World Bank, APEC³, ABS⁴, UNECE⁵. One of the most structuralized and detailed model for knowledge 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 for 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 the importance to assess the impact of knowledge to economic growth. The unique model for that is missing. From the scientific as well as practical point of view it is important to analyze existing knowledge expression assessment models and to constrain instrument for the knowledge expression assessment.

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

The **aim** of the article – theoretically analyze the specificity of knowledge expression assessment models and create flexible instrument for assessment of knowledge expression in knowledge-based economy.

To achieve this aim four tasks are to be solved:

- To highlight the main factors which stipulated transformations of economy in the 21st century.
- 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 create instrument for assessment of knowledge expression in KBE as well as to present the subjects and fields for it's application.

The **research method** is the theoretical analysis of research and scientific works in this field.

This article is a result of four years studies made by the author. Many of theoretical scientific studies as well as documents of OECD, World Bank, ABS, APEC, UNECE were analysed in order to systemise and present the total scheme of existing knowledge expression assessment models. Study allowed to highlight the peculiarity of knowledge expression assessment as well as to create flexible instrument which could be used not even for scientific purposes however and for making strategic decisions concerning knowledge-based economy development in country.

1. The Main Engines of Economy Transformations in the 21st Century

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

The past several centuries have witnessed several fundamental economic transformations, and each of these economic transformations had fundamental implications for the nature of society. The industrial revolution laid the foundation of the transformation of the economy from agriculture to industry; with it, not only did living standards rise, but also the location of life changed, from rural communities to metropolitan megalopolises. For the last two hundred years, neo-classical economics has recognized only two factors of production: labor and capital. Knowledge, productivity, education and intellectual capital were all regarded as exogenous factors – that is, failing outside the system. *New Growth Theory* is based on work by Stanford economist Paul Romer (1986, 1990) and others who have attempted to deal with the causes of *long-term growth, something that traditional economic model by seeing technology (and the knowledge on which it is based) as an intrinsic part of the economic system. Knowledge has become the third factor of production in leading economies.* In spite of that the first evaluation of knowledge influence to economic growth was mentioned in the Hayek's work in 1945.

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 practitioners to assess the challenges of knowledge-based economy, i.e. to discard the old management models, old paradigms, rules, strategies, recipes for success, etc. The new management challenges, according to J. Naisbitt, L. Thurow, K. Kelly, are associated with economic changes and vice versa – global processes enforce the transformation of enterprises and organizations by reviewing their priorities and strategies of operation. Such attitude of management scientists leads to a new approach in evaluating the factors of the end of the 20th century which stimulate the changes in management and, also, to the expression of new factors in global economy. The changing conditions in global activity motivate the review of specific features of modern management.

The main factors which stipulated the transformations of economy scope could be presented in such chain of events (not necessarily in the presented sequence):

- The change of values and conditions of works. Handed work amounts declined obviously starting from the 1900 year (USA: 1900 – 85%; 2000 – 24% and the prognosis for the future in 2025 – 12%);
- The emergence of knowledge workers category (Drucker, 1989). This is the workers which duties are directly concerned with the imperative performance of high qualification works;
- The increases of international cooperation of enterprises as well as more efficient participation in the local business networks;
- Increased interest in R&D as well as in creation and implementation of innovations;
- The understanding of the values of specific knowledge and implementation of them to the processes of activities of enterprises and organizations;
- The increase of demand of high qualified workers;
- The increase of ICT dissemination which stipulates the creation and spread of knowledge as well as ensures the decline of knowledge dissemination costs;
- Acceleration of production internationalisation; as well as shortening of life circle of products and technologies;
- The openness of world economy. This stipulates the growth of foreign direct investments;
- The need to transfer the production processes to the more advantaged areas of economy.

These and more of other hidden factors stipulated the big changes in the nature of economy as well as in understanding of public welfare. The changes were concerned with the growth of importance of knowledge acquisition, creation, usage and dissemination. The latter phenomenon stipulated more effective implementation of knowledge in different fields of activities. The growth of demand for knowledge creation and its application as well as understanding of real value of such processes stipulated the emergence of products of knowledge transformations. This is a reason why the effectiveness of knowledge expression could be assessed measuring the potential of human resources, the situation of innovation policy and innovative business as well as ICT penetration to the spheres of countries activities.

2. Characteristics of Knowledge Expression in Economy

Knowledge-based economy is not a branch of economy. It was formed because of the need and determination to create knowledge with a view to achieve economic and social welfare which could be used to satisfy thirst for knowledge. There was a big 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. KBE covers all of country spheres: economical, social, and cultural. For the development of knowledge economy macro economical stability should be the key condition and starting position. The other not less important factors are functioning of free market, good institutional framework, strengthening the competition of 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 based economy expression. In other words the reflection of knowledge acquisition, creation, usage and dissemination in the economy should be studied through the expression and penetration of separate elements: human resources, innovation, entrepreneurship and information and communication technologies (ICT). The whole level of knowledge expression in the economy could be evaluated through the assessment of position and penetration of enumerated elements in economy (Fig. 1).

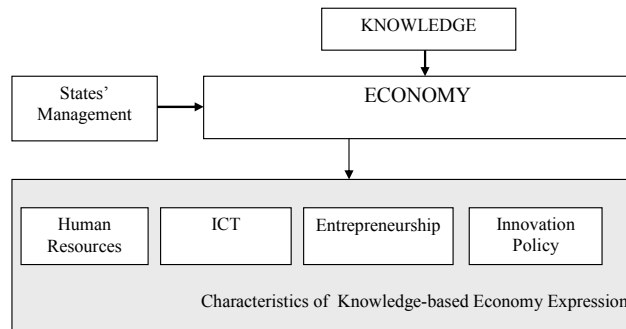


Fig 1. Characteristics of knowledge expression in economy (Kriščiūnas, Daugėlienė, 2006)

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.

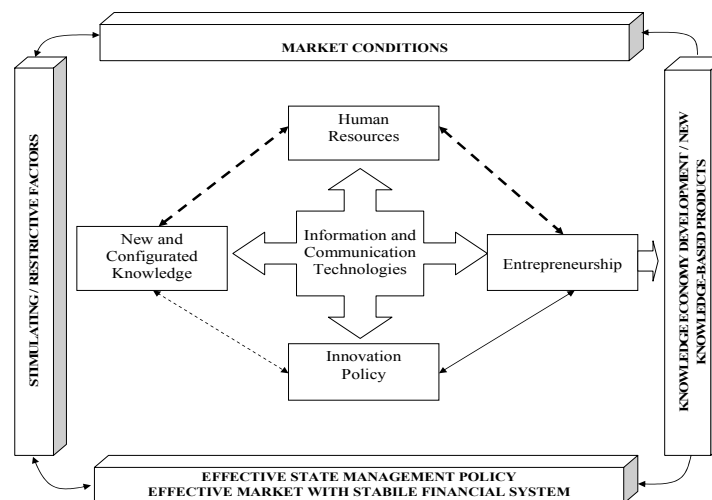


Fig. 2 The structure of Knowledge-based Economy Expression

The main elements of knowledge economy are human capital, new and configured knowledge, innovation policy, ICT and entrepreneurship. The first condition for 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 Fig. 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 there is presented 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 resources. 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.

3. Validity 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 ir kt. (1998); Houghton, Sheen (2000); Small, Garfield (1985); Leontief (1993); Dahlman (2003); Atkinson (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. The OECD concluded in its major program of work on the Knowledge-Based Economy, that: “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, uncoded 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, 2005).

Economic indicators are measures that summaries 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 suitable for the forecast conclusions.

The knowledge assessment could be defined as the evaluation of the ability of an enterprise, an industry, an economic sector, a city, a region, or a 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 summarize 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 resources 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:

- *macro level assessment* or assessments concerned with a *comprehensive assessment of knowledge expression*. These are performed seeking to 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 to 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 organizations 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.

4. The Specificity 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 sectorial. 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 divided into two groups which are different concerning standpoint of analysis (Fig. 3):

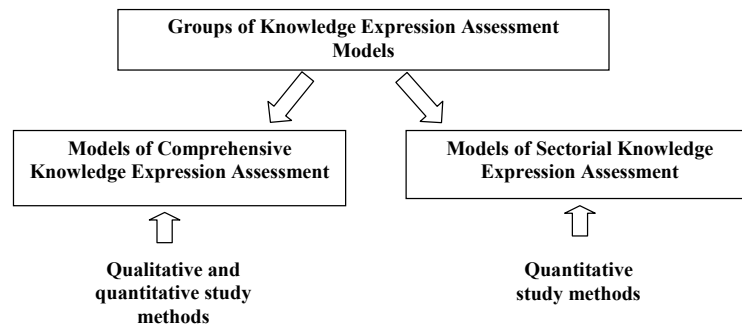


Fig. 3. Groups of Knowledge Expression Assessment Models

In the first case (comprehensive assessment) the common situation of knowledge economy is evaluated on the basic ground. Therefore the essential elements of knowledge economy 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 resources, 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.

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

Models of Comprehensive Knowledge Expression Assessment (Fig. 4)

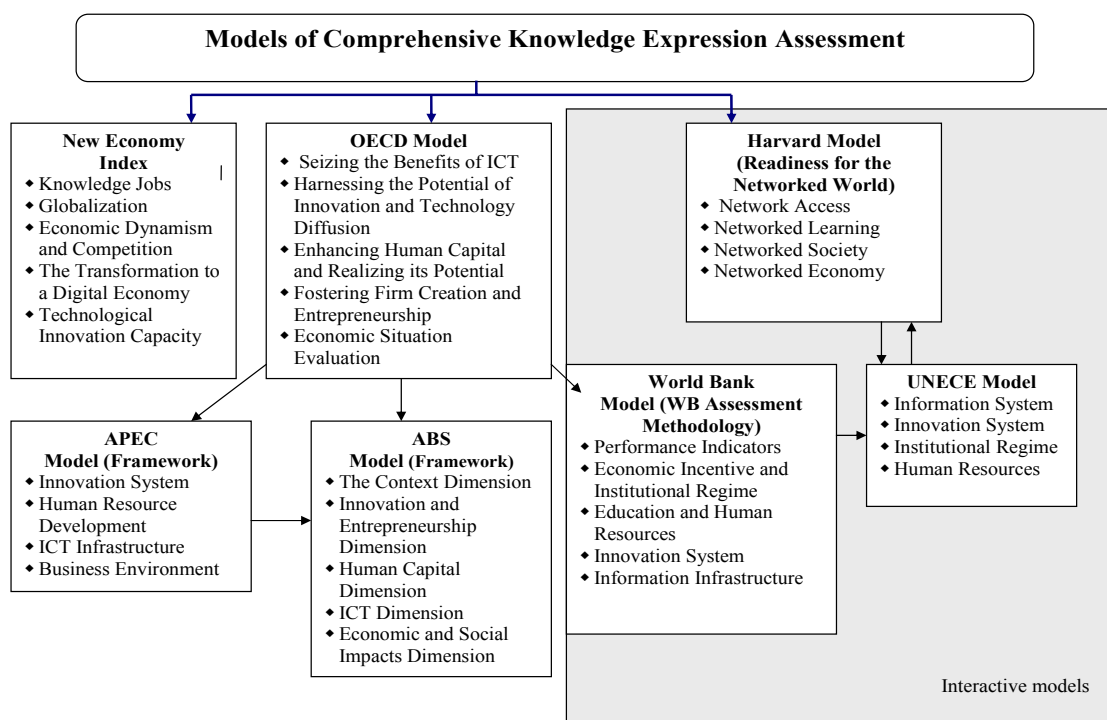


Fig. 4 Models of Comprehensive Knowledge Expression Assessment

The main treat of this group of models (Fig. 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;
- developoment 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 treats off 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, Hercowitz, Krussel, 1997; Benhabib, Spiegel, 1994; 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 possibility to classify models of sectorial knowledge expression assessment. Classification is based on assessment orientation or specification (Daugėlienė 2005a; Daugėlienė, Kriščiūnas, 2004) (Table 1).

- *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).

Table 1

Groups of Models of Sectorial Knowledge Expression Assessment

Specific assessment (oriented on subject)	Basic Assessment based on one index (all knowledge expression characteristics)	Assessment orientated to ICT infrastructure
<ul style="list-style-type: none"> – Growth Competitiveness index (GCI) – Science Citation Index (Small, Garfield, 1985) – Regional Economic Architecture (REA) – Human Development Index (HDI) – Knowledge Index (KI) – Nelson-Phelps technology spread model (1990) – Greenwood, Hercowitz, Krussel Investment to the technology development model (1997) – Benhabib, Spiegel development of finance and impact of human capital to the growth of economy model (1994; 2002) 	<ul style="list-style-type: none"> – Knowledge-based Economy Index (KBEI) – Global Knowledge-based Economy Index (GKEI) 	<ul style="list-style-type: none"> – F. Machlup Assessment Methodology (1962) – Information Society Index (Gifford, 1999) – Networked Readiness Index, NRI INEXSK Model (Mansell, Wehn, 1998)

Theoretically there is 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 knowledge-based economy.

5. Instrument for the Assessment of Knowledge Expression in Knowledge-based Economy

Knowledge-based Economy penetration could be assessed using instrument which includes the properly selected criteria enabling quantitatively assess the results of knowledge acquisition, creation, usage as well as dissemination (Daugėlienė, 2005a; 2005b). 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 (Daugėlienė, 2005):
- an evolvent 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 precisely 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 favorable 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 (Fig. 5).

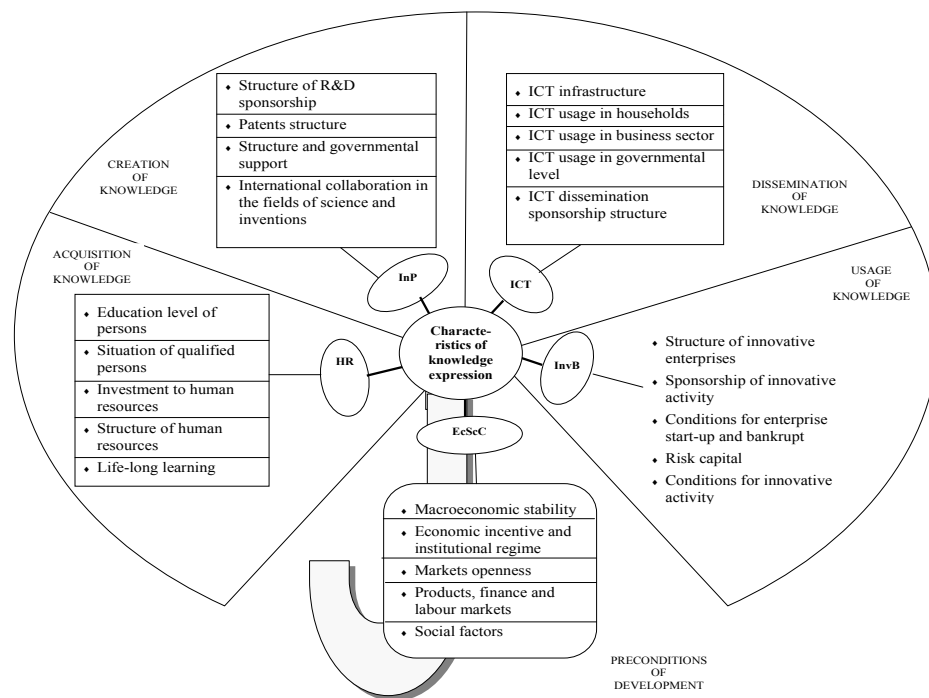


Fig. 5. Evolvent of knowledge expression assessment criteria groups (Daugėlienė, 2005a)

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 (Fig. 6); as well as constructed to be flexible for different subjects (Daugėlienė, 2005a; Kriščiūnas, Daugėlienė, 2006).

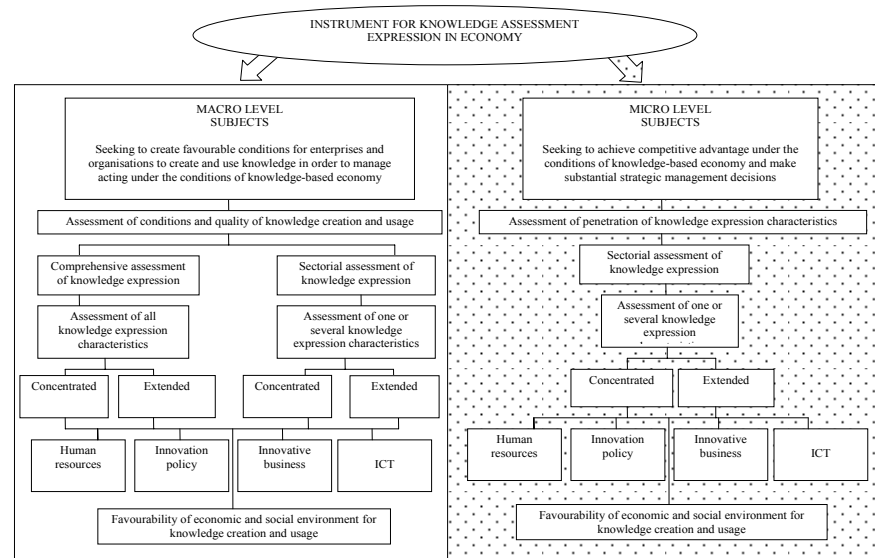


Fig. 6. Application fields of Instrument for the assessment of knowledge expression in economy

Accurate and qualitative knowledge expression assessment stipulates (Porter, 1998; 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 showed 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 to assess the results of knowledge acquisitions, creation, usage and dissemination.

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. The system is rather intricate because it does not lead to economic or social result if any single element of the system is ignored. Only the presence of all of them enables the economic transformation of the country or region towards knowledge-based economy.
- The preconditions and factors of this economy, i.e. the efficient state government policy and the efficient market with a stable financial system are pointed out. The latter ensures knowledge generation and development of factors stimulating its usage, also, hinders the emergence of limiting factors and ensures competitive favourable operating conditions in the market; development of new and configured knowledge, the productivity of which depends on human resources stimulating development of innovative business. The expansion of the latter together with the advance of knowledge in the life of society is possible through the development of information and communication technologies and their effective application. 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 should 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 construed as the characteristics of knowledge expression.
- Knowledge expression models which were accounted in the literature do not cover all problematic of knowledge expression assessment still. The latter could be interpreted as non-structuralized as well as narrow purpose of the assessment oriented. The knowledge expression assessment models being accounted can be divided into 2 groups. The first group comprehensive knowledge expression assessment models which consists 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. In carrying out comprehensive assessment of knowledge expression, however, the models of both groups should be commonly used.
- The knowledge expression assessment models currently accounted fail to sufficiently elaborate the principles and methodology of assessment, therefore, a created instrument for knowledge expression assessment is proposed, which defines the evolvent 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.

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