SCIENTIFIC CAPACITY OF PRODUCTS OF INNOVATIVE ACTIVITIES IN LATVIA

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Abstract

One of most important stimulus for development of innovation is scientific capacity. According to the authors viewpoint scientific capacity of products is a base for development of innovations and mainly it consists from intellectual, human, physical and social capital of a company. Authors describe scientific capacity of products and innovation activities in different levels - company, industry (branch) level, national economy and global economy level. The authors presume that it is possible to evaluate scientific capacity in each level, but most attention should be paid to national and company level. Objective of the paper: to compare and describe possible methods for evaluation of scientific capacity of innovative products of Latvia.

Research methodology: The author employs well-established quantitative and qualitative methods of research: grouping, analysis, statistic method, etc. The theoretical and methodological background of the research is formed by, scientific researches and publications, publications from mass media and professional literature; statistical information from legal institutions as well as information collected by the author during the survey. The authors have developed theoretical model for evaluation of scientific capacity of innovative products of Latvia and offered method how to apply it in practice.

Keywords: innovation, scientific capacity, products, model of evaluation.

Introduction

Innovation activities are main priority of European Union as well as of Latvia. Schumpeter (1934) was one of the first authors who emphasized the role of innovation in business and identified it as a process of creative destruction through which wealth was created when existing market structures were interrupted by the introduction of new products or service. Many other world famous authors like M. Porter, P. Drucker, etc. have tackled questions of innovations and significance of innovation capacity.

Innovation, in the form of new products, processes, and ways of managing, underpins the growth of productivity that is necessary for a rising standard of living. Innovative capacity is especially important for advanced nations if they are to support higher wages than developing economies who can rapidly imitate. Innovative capacity in a nation or region is heavily rooted in its microeconomic environment, in areas such as the intensity of scientists and engineers in the workforce, the degree of protection of intellectual property, and the depth of clusters. Innovation also holds the key to solving many of the world's most pressing social challenges such as health care and improving the quality of the physical environment.(HBS, 2001)

There are many economic and social indicators that are regularly compiled and published online, in the press, in statistical abstracts or in journals. Income, prices, interest rates, trade balances, school enrolments are but a few examples. Innovative capacity could be provided regularly as an indicator of technological performance and potential, in much the same way as the indicators mentioned before (Luiz, 1990).

One of most important stimulus for development of innovation is scientific capacity. According to the authors viewpoint scientific capacity of products is a base for development of innovations and mainly it consists from intellectual, human, physical and social capital of a company. Professor Auyang in her researches emphasizes that "capitals are products of technological activities: education, research, development, industry, and other productive works. Some products of these activities, notably high-tech goods and services, are consumed by people and most familiar to them as the essence of "technology." Not all products are consumed, however. Many are plowed back as social investments that expand technological capacities.(Auyang S.Y., 2004).

According to the latest statistics (European Innovation Scoreboard 2008) Latvia are among "Catching-up countries" in development in innovation performance and experiencing a decline in their performance.

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Innovative capacity can be used to measure the temporal dynamics of invention and innovative potential for any period of time. This is particularly important for understanding the process of accumulation of inventions and its dynamics. The dynamics of invention and innovation can therefore be analyzed for activities, sectors, industries, organizations and geographical areas.

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The development in innovation performance has been calculated for each country and for the EU27 as a block using data over a five-year period. This calculation is based on absolute changes in the indicators, as opposed to previous EIS reports where trends were calculated relative to the EU average. All countries, with the exception of Denmark show an absolute improvement in the innovation performance over the period. The Catching-up countries generally perform below EU average on Human resources, with the exception of Lithuania and Poland. Growth performance is average, with five countries growing at a rate below average and Croatia, Latvia, Poland, Romania and Slovakia managing to grow faster than the EU27. In Linkages & entrepreneurship no Catching-up country is performing above the EU27 average but the majority countries have grown faster than the EU27 average with only Latvia and Lithuania experiencing a decline in their performance.(EU innovation Scoreboard, 2008).

For this reason the authors would like to analyze scientific capacity of products and innovations in Latvia. According to the authors viewpoint main scientific capacity can be created by synergy between intellectual capital of the company and its financial capital. Accordingly, it is important to understand all components of intellectual capital and understand possibilities of its evaluation.

Intellectual capital of a company as a part of a product scientific capacity

It is widely accepted that intangible (knowledge or intellectual) assets are the major drivers of corporate value and growth in most economic sectors, but the measurement of these assets has eluded so far managers, accountants, and financial analysts valuing investment projects (Feng Gu, Broauh, 2001).

In general, taxonomies of intellectual capital acknowledge three primary types of capital: human capital, structural capital, and customer capital. Another way to distinguish various perspectives on intellectual capital involves the degree to which they explicitly equate intellectual capital with knowledge (Van Buren, 2006). Efforts to address the measurement challenges surrounding intellectual capital fall into two basic, but overlapping types. The first type is focused on measuring the *stocks*, or the quantities, of intellectual capital. A second basic type of measurement goes beyond approximating the value of the stocks of intellectual capital themselves to estimating the value of the goods and services they produce or create. (Van Buren, 2006).

Intellectual capital can be defined as consisting of human and structural capital. Structural capital can be decomposed into organizational and customer capital (Edvinsson and Malone 1997) or internal and external relations. In this context, intellectual capital is the value generated from resources not conventionally found in the financial balance sheet (Mouritsen et al, 2005).

Many authors describe intellectual capital and its parts (see Figure No 1). According to Saudah Mark E. Van Buren elective Intellectual Capital Indicators are (Van Buren, 2006):

- Human Capital (Management experience, Organizational learning measure, Management credibility etc.),
- Process Capital (Strategy execution, Quality of decisions, Percent of company effectively engaged with customer etc.),
- Innovation Capital (Number of copyrights/trademarks, Number of patents used effectively, R&D productivity etc.);
- Customer Capital (Market growth, Customer needs met, Marketing effectiveness, Market share etc.).

ISSN 1822-6515
ECONOMICS AND MANAGEMENT: 2010. 15

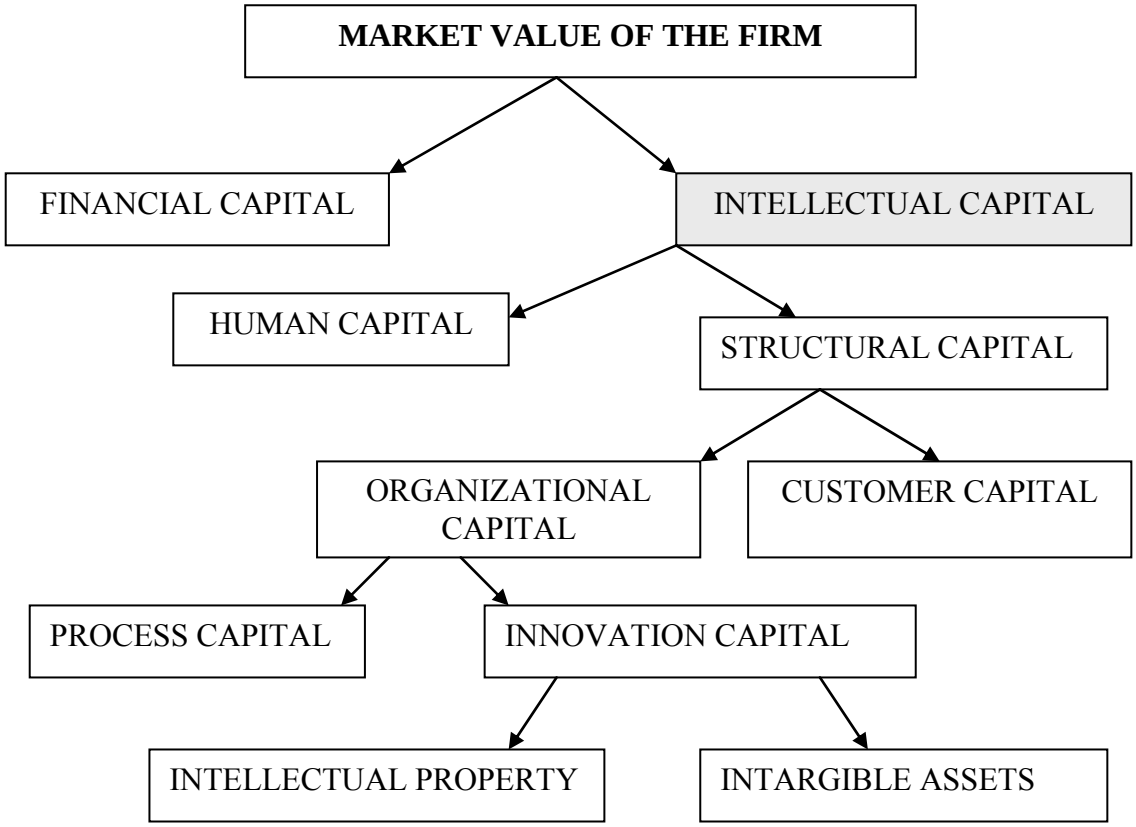

Figure 1. Division of a firm's market value (Edvinson, 1997).

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There are a lot of definitions describing the meaning *knowledge*. In the Longman Dictionary of Contemporary English knowledge is explained as the facts, skills, and understanding that one have gained thought learning or experience.

As we know the knowledge is not separable from human capital. Therefore the following definition will characterize core of knowledge: "Knowledge is the result of learning. Knowledge is the internalization of information, data, and experience. Tacit Knowledge is the personal knowledge resident within the mind, behavior and perceptions of individual members of the organization. Explicit Knowledge is the formal, recorded, or systematic knowledge in the form of scientific formulae, procedures, rules, organizational archives, principles, etc., and can easily be accessed, transmitted, or stored in computer files or hard copy (Magidenko, Gaile-Sarkane, 2006).

Authors assessed the above-mentioned definition and the following conclusions can be made:

- The knowledge is part of Human Capital and it is usually in the context of human expertise used in solving problems;
- Basic components (elements) of knowledge are information (data) and experience (learning skills and/or „judgment").

Philosophically it means that gaining of knowledge is endless process for human being. According to the authors point of view knowledge can be considered as the transformation of information and value added. Knowledge can be used to create new information and new knowledge (Magidenko, Gaile-Sarkane, 2006).

Knowledge as a part of a product scientific capacity

Knowledge is not an entity by itself; it has to be connected with things, phenomena or relations. It is knowledge *about* something rather than knowledge *per se*. Therefore, knowledge must be explained by showing how its flow contributes to making something useful to somebody or something.

Enlarging Edvinsson diagram (see Figure No 1) of organization market value the author offers to review the intellectual capital of organization. As it is known the intellectual capital consist form Human Capital and Structural capital which consists form Customer Capital and Organizational Capital. According to analysis of different scientific elaborations the Human capital directly influences Structural capital of organization and, by using of knowledge and other resources, creates Structural capital (see figure 2).

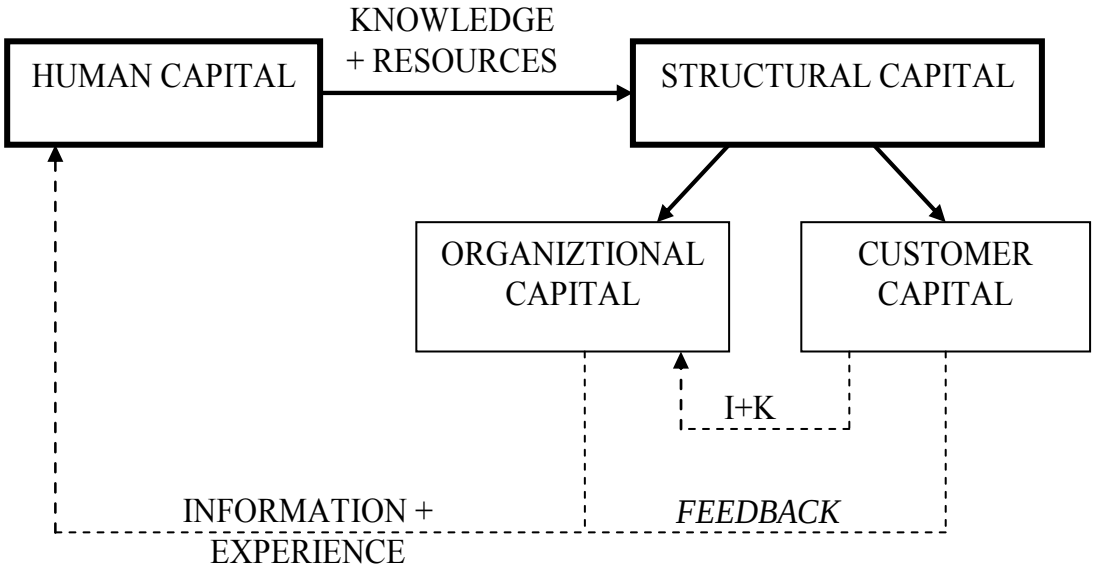

Figure 2. Interaction between Human and Organizational capital
(Magidenko, Gaile-Sarkane 2006)

In this process of interaction feedback from Customer Capital and Organization Capital to Human Capital is information and experience what can be transformed again to knowledge.

Therefore it the author recommends innovate two important elements in knowledge management of organization:

- *Intensity of knowledge* (knowledge flow, value added etc.);
- *Knowledge culture* of organization (the way how the knowledge is created, adapted, fixed, used and passed on etc.).

Knowledge culture refers to human (human capital) activities (understanding of information and transformation it into knowledge, developing of criteria for valuing of knowledge, human activity, classified experiences, encoding of knowledge and information, way of communication etc.). The culture of knowledge creation directly effects intensity of knowledge what transforms in Structural Capital.

The authors offer to evaluate intensity of knowledge in the organization and describe it with simplified formula:

$$KI = \frac{f(CC) + f(OC)}{f(KCL)}, \qquad (1)$$

Where: KI – Knowledge intensity;
CC – Customer Capital;
OC – Organizational Capital;
KLC – Knowledge Culture of organization.

Knowledge and information are prime commodities in today's 'knowledge-economy' where economic enterprises are increasingly knowledge-based and technological driven. Organizations have a large proportion of their investment in intangible assets. Increasingly, however, it is being recognized that

intangible assets and intellectual capital are the keys to attaining competitive advantage for the knowledge firms (Soudah et al., 2005).

Scientific capacity of products and innovation activities

As the intellectual capital consists of human capital and structural capital, and structural capital consists of organizational capital and customer capital, but development of new products and innovations usually are based on voice of the customer, the authors concludes that knowledge is the most important asset in development of new products. At the same time there is a question why Latvia is in last place in the European Union in innovation performance? Should the result of innovation process be based mainly on financial and intellectual capital? Are there any factors what influence scientific capacity of products and innovations?

According to authors' viewpoint, development of innovation activities depends on many components indifferent levels of national economy.

$$LI = f(GM, NM\ , IDL\ , CDL, CC) \rightarrow \max, \qquad (2)$$

Where: LI – level of innovations in the country; GM – situation in global market; NM – Situation in national market; Industry development level in the country; CDL – company development level; CC – Characteristic of Customers in the country.

Accordingly scientific capacity of the product could be evaluated by different approaches:

- Company level;
- Industry (branch) level;
- National economy level;
- Global economy level, etc.

In company level scientific capacity can be measured by company intellectual resources and access to financial resources. During fast economic growth companies invested their financial resources in company development and mostly in markets with fast return on investments (ROI). According to statistics, in general, the investment growth rates in national economy were two times lower in 2007 compared to 2006, which was determined by both, slower investment dynamics in several sectors and also decrease of investment volumes in the trade sector, as well as transport and communications sector by 16.6% and 15.5% respectively, testifying sensitivity of investors against fluctuations of domestic and external demand. According to the provisional data, in 2008 positive investment dynamics remained in the primary sectors and public services sectors. In 2008, investments in education and health care sectors increased almost by 25%. The investment volumes in other sectors compared to 2007 were smaller. A particularly large decrease of investment volumes was in energy sector – by 31.5%, financial services – by 40.4%, operations with real estate – by 23.2% and construction – by 16.8%. Those are mainly real estate market related sectors in which investment process largely depends on accessibility to external financing (National report, 2009).

In National economy level scientific capacity of products and innovations can be described by many indicators – level of scientific development, education, number of patents per capita (or per 100 companies). According to statistics Number of Patents registered in Latvia decreasing, but still this number is not satisfactory. In 2006 there was 114 registered patents, in 2007-147 but in 2008 number of registered patents reached 206. Better situation is in registration of trademarks. According to latest data number of registered trademarks in Latvia (local and international) in 2007 was 4891, in 2008 was 4649, and in 2009 decreased till 3885 registered trademarks. Number of industrial design applications and registrations under National procedure in Latvia also decreased in last year. Industrial design applications were in 2007-131, in 2008 – 260, but in 2009 – 189. Industrial design registrations in 2007 were registered 97, 2008-135, but 2009 just 132 industrial design registrations were made.

According to statistical information it seems that Latvia is not performing well in development of new products and innovations, but at the same time there are a lot of different activities supported by state. For example implementation of the EU Structural Fund program activity "Activities to encourage motivation for innovations and starting business" has been launched in 2009 to inform the society and raise awareness about innovations (National report, 2009):

- The Latvian innovative business idea competition "Cup of Ideas 2008" has facilitated activity of more than 400 participants, who have prepared and submitted innovative business ideas individually or in teams.

- In 2009, the Investment and Development Agency of Latvia continued to implement the pilot project for the support to authors of innovative business ideas.
- The Enterprise Europe Network in Latvia continues its activities in 2009. The Enterprise Europe Network is the entrepreneurship and innovation support network of EU scale consisting of nearly 600 different partner organizations within more than 40 countries and its goal is to provide informative and advisory support to entrepreneurs in order to facilitate their competitiveness and development in the framework of the European Union, as well as beyond it.
- In 2008, the implementation of the EU Structural Funds program "Support for the Introduction of New Products and Technologies into Production" was launched.
- In 2008, the implementation of the EU Structural Funds program "Development of New Products and Technologies" was launched.
- Other activities, for example "Competence centers", "Business incubator program" etc.

Authors made analysis of factors what influence innovation activities in Latvia and worked out set of models. The development on innovation activities in national level can be described by formula:

$$IA = f[\sum_{i=1}^{25}(\frac{F_i \cdot \alpha_i}{F_{ib}})] \rightarrow R_{\max} \quad , \qquad (3)$$

Where: F_i – Factors what influence innovation level,
i_n =1-25 factors,
α_i - Importance weight of the factors, and $\Sigma \alpha_i$ =1.

Authors have developed methodology for evaluation of α_i and have fixed 25 main factors what influence theses activities. These factors are following: innovations in science and development, innovations from European Structural Founds, Investments form private sectors, investments in higher education, level of development of education in the state, level of rivalry in a market, development of technologies, level of ITT development, technology transfer level, structure of entrepreneurship and small business in the country, level of regional development, risk level of innovations, economic aspects of innovations, innovation policy, price of resources, innovation infrastructure, feedback and other factors.

Based on researches done by authors, the model of scientific capacity of products and innovations was made. In the European Union more than 20% of all products are with high scientific capacity, but in Latvia only 3-4%. This capacity can be described by formula:

$$SCP = \frac{IRD}{SV} \times 100\%, \qquad (4)$$

Where: SCP – Scientific capacity of product;
IRD – Investments in research and development (including laboratories, researches, tests, experiments etc.);
SL – Sales volume of the product per year.

Conclusions

The research helps understand the particularities of scientific capacity of products and methods of its evaluation. There are common problems in the evaluation of scientific capacity in Latvia and many other countries. The authors have summarized different opinions on evaluation of scientific capacity of product, and innovations and following conclusions were made.

Two of main capitals what are involved in development of scientific capacity of products and innovations are financial capital and intellectual capital. Intellectual capital consists of human and structural capital. Structural capital can be decomposed into organizational and customer capital or internal and external relations. The knowledge is part of human capital and it is usually in the context of human expertise used in solving problems. Basic components (elements) of knowledge are information (data) and experience (learning skills and/or „judgment").

Besides financial and intellectual capital there are a lot of different external factors what influence scientific capacity of products and innovations. Accordingly scientific capacity of the product could be

evaluated by different approaches form the company level, from the industry (branch) level, form the national economy level and in global economy level. For each evaluation the approach can be different.

The authors have stated 2 factors what influence innovation level in the country. Also the mathematical model of evaluation of product scientific capacity was presented.

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