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HIGH-TECH SECTOR IN LITHUANIA: PRESENT SITUATION AND FUTURE PERSPECTIVES

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Abstract

The scientific problem what systemic ties relate the high-tech sector with other elements of the socio-economic system, and which of these elements mostly hinder the development of this sector is analyzed in this paper. Authors seek to identify the high-tech sector as part of the country's socio-economic system. The paper consists of four parts. The criteria, according to which individual areas of activity are ascribed to the high-tech sector, are analyzed in the first part. There is stated that sectoral and product approaches to the reckoning of activity in the high-tech or other sector is poorly informative. So called horizontal approach is much more acceptable in the case of the search of scientific problem solution in this paper. It is tried to explain how high-tech sector affects individual elements of the country's socio-economic system in the second part. Three main types of impact are marked out and discussed – stimulation of creativity, improvement of other sectors' activity and stimulation of general socio-economic changes. The preconditions for the development of high-tech sector as part of the country's socio-economic system are identified in the third part. They are presented as the components of the value chain metaphor. Statistical data illustrating preconditions for development of the high-tech sector in Lithuania are presented and compared to those of other countries in the last part of the paper.

Keywords:

High-tech, socio-economic system, development preconditions, types of impact.

Introduction

In each stage of economic development there exist areas referred to as modern areas of development. Modern areas are those in which the technologies applied, raw materials used, products or services provided are based on the most recent achievements in science and technology. These areas play an extremely important role. It is considered that it is these areas that for the most part determine the future of the country's economy by changing the existing structure into a more advanced one, which matches the challenges of globalization and which provide better possibilities to more efficiently utilize the available resources.

Theoretical and scientific works and practical studies suggest that in the present stage of world economy development, the areas of high-tech industry and services are also referred to as "modern" in the sense discussed. These are the areas existing at the junction of science and industry and based on direct "conversion" of research results into products or services.

Currently, the sector of high-tech industry and services creates slightly over 2% of export production. The articles requiring a lot of input of raw materials, power, and labor, and which are characterized by rather low value added are dominant. Naturally, Lithuania, as most Middle and East European countries (and not only them), is likely to face the danger of lagging behind such leaders, as USA or Scandinavian countries, where the level of high-tech development forms the basis for economic and social welfare.

Everybody whose practical and scientific interests are related to the country's socio-economic development is fully aware of the danger. The country's strategic documents (Lietuvos mokslų akademija, 2007) provide for specific goals aimed at changing the existing situation and measures to achieve them. The researchers and expert practitioners pay much attention and efforts for addressing the issues of high-tech sector development, nevertheless, the development of this sector remains the most important problem, the solution of which, together

with other steps, requires further theoretical analysis. The problem analyzed in this paper can be formulated in the form of the question: what systemic ties relate the high-tech sector with other elements of the socio-economic system, and which of these elements mostly hinder the development of this sector?

The aim of the paper is to identify the high-tech sector as part of the country's socio-economic system and show the elements of the system mentioned as most influential to the development of this sector.

In pursuing this goal, the paper addresses these problems:

1. The criteria according to which individual areas of activity are ascribed to the high-tech sector, are analyzed.
2. The explanation how high-tech sector affects individual elements of the country's socio-economic system is given.
3. The preconditions for the development of high-tech sector as part of the country's socio-economic system are identified.
4. Statistical data illustrating preconditions for development of the high-tech sector in Lithuania are presented and compared to those of other countries.

In the paper the analysis of scientific literature, statistical data and legal documents, the methods of systemizing and synthesizing of the information obtained were used.

High-tech sector as the activity area

The concept "high technologies" (high-tech) defines such sectors and products in which, compared to other sectors and products, a considerably bigger part of the final cost of the product or service is covered by the R&D expenditure. This index is applied in regard of the sector or product (service); therefore, it is relevant to discuss high technologies sector (sectoral approach) or product (product approach). Together with higher expenditure on R&D, high-tech sector is characterized by:

- high demand for employment of scientific-technical personnel;
- big share of patents and licenses in the value of the enterprise;
- strategic cooperation between enterprises and research centers;
- rapid aging process of technologies applied;
- the need for frequent replacement of facilities, i.e. need for capital, higher than in other areas (Hatzichronoglou, 1996; University of South Florida, 1998; Wojnicka, 2004; Turowski, 2007).

Sectoral approach. In the classification of OECD economic activities, four types of production are distinquished: high, medium-high, medium-low and low technologies (see Table 1). The areas and fields of production fall into a certain sectoral group in terms of the amount of R&D expenditure in the final value of the product. This division of production fields into sectors is most acceptable because of its simplicity. Theoretically, R&D expenditure in certain fields of production may vary with time, and the field may be requalified, but, practically, since the year 1990 major changes leading to this, have not occurred.

Table 1. OECD classification of products by activity (CPA) (Perspektywy…, 2006)

CPA	Activity	Expenditure for R&D in 1991-1999, % of GDP
	High-tech	
35.3	Aircraft production	13,3
30	Office machinery and computers	9,2
32	Radio, television and communication equipment	8,0
24.4	Pharmaceutical products, chemicals for medicine	10,5
33	Medical, precision and optical instruments; watches and clocks	7,7
	Medium high-tech	
34	Motor vehicles, trailers and semitrailers	3,5
24 without 24.4	Chemicals, chemical products and man-made fibers	3,1
31	Electrical machinery and apparatus n.e.s.	3,9
29	Machinery and equipment n.e.s.	2,1
35.2, 35.4, 35.5	Other transport equipment	2,9

Remark: Lithuanian Department of Statistics also presents data according to this classification (Statistics Lithuania, 2007)

Product approach. Here, the share of R&D expenditure in the total value produced is measured not as an average for each field, but, rather, for individual products of different fields. This approach is based on expert measurement of different products. This is regarded as an essential shortcoming of this approach,

because of the resulting subjectivity element. In addition, the application of product approach does not allow comparison of the information obtained with other statistical production indexes made up for each sector.

The OECD list (Table 2) of high and medium-high technologies products comprises several hundreds of articles of different fields of industry. The table shows their codes according to the NACE (Nomenclatures des Activites de Communite Europeene).

Table 2. Subgroups of products ascribed to high-tech sector according to OECD classification (Perspektywy…, 2006)

Aircraft production	
35.5	35.31.1; 35.31.2; 35.31.3; 35.31.4; 35.31.5; 35.31.9; 35.32.5; 35.32.7; 35.33; 35.34; 35.35
Office machinery and computers	
30	30.01.12; 30.01.2; 30.02.11; 30.02.12; 30.02.13; 30.02.21; 30.02.22; 30.02.23; 30.02.24
Radio, television and communication equipment	
31-32	32.11.1; 32.11.2; 32.11.3; 32.11.4; 32.12.1; 32.12.2; 32.12.3; 32.13; 2.14; 32.15.1; 32.15.2; 32.17; 32.21; 32.22; 32.23; 32.24; 32.25; 32.26.1; 32.26.2; 32.26.3; 2.26.4; 32.26.5; 32.27.1; 32.27.2; 32.27.3; 32.31; 2.32; 32.33; 32.34; 32.36; 32.37.1; 32.37.2; 32.37.3; 32.37.4; 32.37.5; 31.22;
Pharmaceutical products	
24.4	24.41.4; 24.42.1; 24.42.2
Chemical products	
23-24	24.13.1; 24.13.2; 24.12.2; 24.2; 23.31; 23.32; 23.33; 23.35-
Medical, precision and optical instruments	
33	33.11.1; 33.11.2; 33.11.3; 33.11.4; 33.11.8; 33.15.3; 33.15.5; 33.15.6; 33.15.7; 33.12; 33.23; 33.24.11; 33.24.12; 33.24.13; 33.24.14; 33.25.2; 33.25.4; 33.25.7; 33.25.8; 33.26.1; 33.26.2; 33.26.3; 33.26.4; 33.29.2; 33.29.6; 33.27; 33.28.1; 33.28.2; 33.28.3; 33.28.4; 33.28.5; 33.28.6; 33.28.7; 33.28.8; 33.28.9; 33.30; 30.31; 33.41.3; 33.41.4; 33.42.1; 33.42.2; 33.42.3
Electrical machinery	
31	32.18; 31.62.11; 31.62.12; 31.62.13; 31.62.14; 31.62.15; 31.62.16; 31.62.21; 31.62.22; 31.62.23; 31.62.24; 31.62.25; 31.62.71; 31.62.72; 31.62.73; 31.62.74
Non-electrical machinery	
29	29.11.23; 29.41.4; 29.41.5; 29.41.6; 29.56.7; 29.56.57
Machinery and equipment	
29	29.61; 29.62; 29.63; 29.64; 29.65; 29.66; 29.67; 29.68

Horizontal approach. The approaches discussed above are based on the ascription of the industry branch or individual article to a particular sector on the basis of the single quantitative index (R&D expenditure share in the final value of the product); this is, as a rule, related to the subjective approach of the estimators. The horizontal approach aimed at supplementing the mentioned quantitative index with the qualitative criteria, e.g. potential commercial exploitation. According to this criterion, such branches, as biotechnology, information-communication technologies, space technologies or materials engineering are to be ascribed to the high-tech sector. The results of these branches find a wide application in other branches of industry, i.e. they can be successfully sold.

In Japan there exists another understanding of high technologies, where their definition is considerably closer to the horizontal, rather than to sectoral or product approach. Though Japan uses R&D expenditure index, it is, however, associated with technologies which can serve as the basis for radical changes in economic facilities (e.g. microelectronics, biotechnology, development of new materials). The Japanese approach is aimed at basic technologies characteristic of long-term and multi-scope applications (Perspektywy…, 2006).

Another example of horizontal approach may be the definition used by NC Board of Science and Technology, North Carolina, USA, combining sectoral and product approaches with the terminology of American Electronics Association. According to this definition, high technologies are such technologies which facilitate the work of highly-skilled employees engaged in developing research-oriented products. They include microelectronics, manufacture of precision equipment, biotechnology, i.e. technologies which are directly connected with research, engineering or IT.

Why high-tech?

Despite the fact that the contribution of industries ascribed to high-tech sector into GDP is not very big even in leading countries in this respect, the economic

perspectives of the countries are mostly measured in terms of development level of this particular sector. The importance of technical advance as the factor determining long-term growth in modern economy is highlighted in both theoretical works and practical studies. For example, according to P.A. Samuelson, two-thirds of USA economic growth is determined by such interrelated factors as education, innovations and technological advance. As far back as 1957, R.Solow proved that economic growth depends on the level of engineering and technology by 80% (Turowski, 2006).

In measuring the so-called Growth Competitive Index, the World Economy Forum considers economic advance as one of the essential indexes (J.Blanca et al., 2004). According to its own methodology, this organization divides the countries of the world into core innovators and non-core innovators. The GCI (Growth Competitiveness Index) for these groups is measured on a different basis:

- for core innovators: GCI=1/2 of technology index, ¼ of public institutions index, ¼ of macro-economic environment index ;
- for non-core innovators: GCI=1/3 of technology index, 1/3 of public institutions index, 1/3 of macro-economic environment index;

Technology index (TI) is also measured differently:

- for core innovators: TI =1/2 of innovations sub-index, 1/2 of ICT sub-index;
- for non-core innovators: TI=1/8 of innovations sub-index, 3/8 of technologies transfer sub-index, ½ of ICT sub-index.

Even though these indexes do not directly refer to high-tech sector, its impact on the growth index is obvious due to the fact that enterprises of this sector appear to be highly innovative. The high-tech enterprises are also characteristic of rather active cooperation with research institutions and other partners. This fact is essential in measuring sub-index of technology transfer which accounts for almost half of technology index of the non-core innovators.

The question how the high-tech sector is important for the economic development of the countries may be answered in the following way: the analysis of theoretical and practical research sources shows that development of high-tech products and services acts as a catalyst of economic development. This effect is characteristic of the following features:

1. The effect is of a long-term nature. It means that development and manufacture of high-tech products do not yield profit unless the need of these products is identified by other production sectors and society at large.
2. The effect is permanent. The countries regarded as leaders of high-tech development and production, have long been rated highest in competitiveness, living standards, GDP and its growth. Beyond doubt, it is not that this accomplishment is the result of high-tech sector alone; nevertheless, the correlation is obvious.
3. The effect is multi-directional, i.e. the operation of high-tech sector affects different areas of economy of the country by stimulating and transforming them so that qualitatively new level of economic and social development can be achieved.

The latter feature calls for more detailed elucidation. Figure 1 illustrates three main trends of the effect of the results (products and services) of high-tech sector:

- promotion of creativeness;
- improvement in operation quality of other (low and medium-low technologies) sectors;
- promotion of general socio-economic changes.

Promotion of creativeness. The high-tech sector is distinguished among other branches of production by its creativeness, e.g. relatively biggest number of technological and technical innovations is created and finds application in this particular sector. In the creative process there operate two forces supplementing and stimulating each other. On the one hand, the intensity of research and development determine the fact that the products developed in the high-tech sector are subject to aging, and their life-cycle gets shorter. On the other hand, rapid aging of the product and shortening of its durability leads the enterprises to increase expenditure on research aimed at developing new modern processes and products.

With growing intensity of scientific research, the supply of goods and services characteristic of competitiveness, unique properties and high added value is also growing. Technical and technological innovations accompanied by the occurrence of new, unknown products and processes or/and modification of the already existing ones are generated. New products and services are marked by higher efficiency, wider application, and ability to perform new functions. More often than not, the new products or services resemble the old ones only by their names, due to the increased complexity (e.g. number of constituent parts) and all technical as well as other essential parameters. In addition, irrespective of the sophistication of structure, the trends for minimization of measurements, as well as increase of precision, efficiency, reliability, ergonomics and feasibility are evident (Nowakowski, Szymoniuk, 1998).

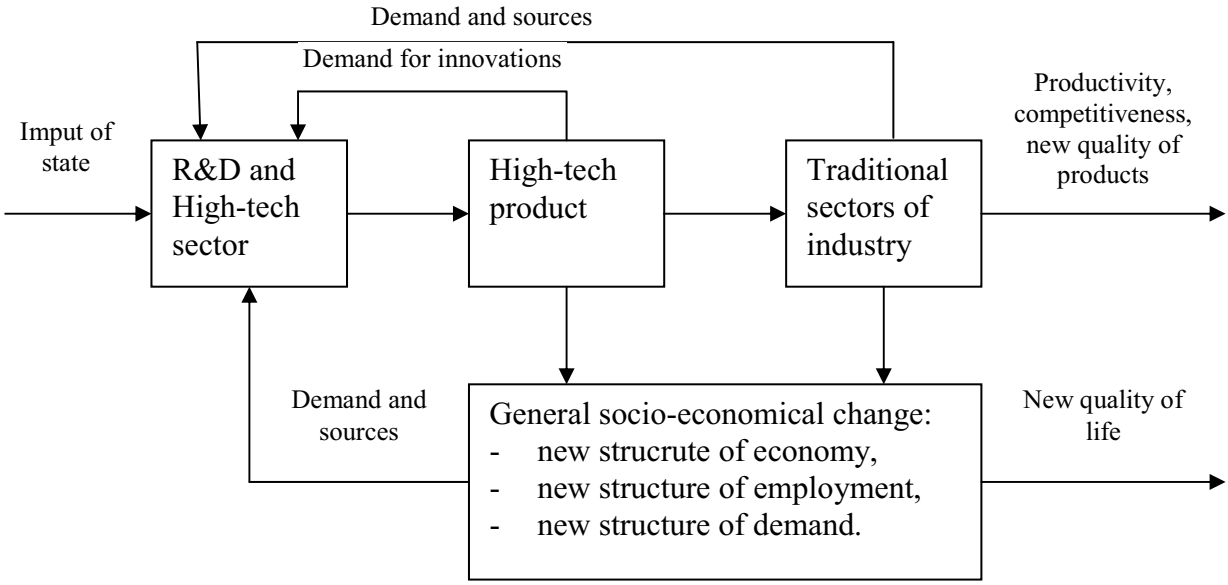

Fig. 1. Three main trends of the results of high-tech sector

Development of other sectors. Rapidly growing introduction of modern technologies into the market serves as a source for technological advance in the economy at large. Though the areas of economy belonging to medium-low sectors (agriculture, food industry, textile, land transport, etc.) do not produce technically elaborate products, their competitiveness for the most part is the result of achievements of the areas belonging to high-tech sector.

The introduction of products of the high-tech sector into the market causes the rapidity of technical advance in all economy. This progress is also promoted by the fact that innovations based on new technologies in one area of activity lead to search for innovative solutions in other areas (Turowski, 2005).

Another phenomenon occurring in economy in general caused by innovativeness and creativeness of the high-tech sector is also significant. The introduction of new products and services into the market initiates not only their life-cycle, but also dissemination of information about them. The success of the product or service stipulated by the activity of high-tech sector results in the so-called imitation, i.e. the move by other companies to produce analogous products or services. This move, though, fails to enhance the value of the invention itself, but it tends to spread knowledge and increase potential for implementation. The growth in the number of such "imitators" encourages competition not only between them, but, also, between high-tech developers and manufacturers, as it shows the necessity to proceed with the research and further development of products, processes and services. In this way, every innovation becomes the basis for the creation of the following one. K.Kelly (2001) compared this to a chain reaction: one successful innovation may produce tens or hundreds of other innovations.

Promotion of general socio-economic changes. The country's economy is a complex socio-economic system characterized by a particular structure typical to the country's stage of development. The structure of economy is understood as the picture of its individual elements reflecting both present situation and future development trends. The structure represents proportions of separate parts of economy and their interrelationship.

A specific role in the formation of the country's economy structure at the present stage of development of global economy is played by industrial areas and branches based on manufacture and application of high technologies. "Modern" areas in this sense have existed and do exist in each stage of economic development. Modernness is expressed by the innovative technologies applied as well as innovative raw materials and products manufactured. The areas and branches of industry normally play the role of a driving force in economy as a whole. Their existence and growth for the most part result in changes in economic structure and enhanced efficiency of exploitation of resources.

Technical advance which is the primary cause of birth of new areas of industry, have a positive effect on the efficiency of new as well as old branches of industry. The essential feature of the developing branches and fields of industry is their capability to penetrate other areas and branches leading to restructurization of economy of the country (region, group of countries) and creating favorable conditions for growth of productivity; as a result, there occur new requirements for labor force, new consumption habits and capacity, new attitude to ergonomics,

safety, durability of products and other characteristics (Neelankavil, Alaganar, 2003).

The development of high-tech sector and penetration of its results into traditional branches is related to positive changes with respect to competitiveness in the structure of employment: the demand for low-skilled and narrow specialization workers declines, and that for high-skilled workers grows. Even in the 70's most of the OECD countries saw an increasing growth in the number of high-skilled mental workers compared to the one of low-skilled workers, while the number of physical workers in all the countries was constantly decreasing. The study carried out in 50 countries demonstrates that the tolerance rate R2 between the input of modern industries (electronics, precision mechanics, machine building, chemistry, publishing and paper production) into the general output of production and the number of skilled workers engaged in these branches is higher than 0.6 (Turowski, 2006).

New structure of employment contributes to the implementation of high-tech achievements in other areas of industry and, equally, to the improvement of productivity and competitiveness of the country. It is important, however, to emphasize that several negative effects of this phenomenon are also evident. The reality of developed countries show that due to the absorption of the results of high-tech sectors, employment in other sectors decreases, though the output of these sectors is by no means diminishing, but, rather, is growing. Accordingly, productivity of human resources is also growing; however, the degree of their exploitation is decreasing, which has a negative impact on the sector's competitiveness. In addition, employment decline may cause the growth of income disproportion, which is also regarded as a negative tendency in economic development (Turowski, 2006).

Development of high-tech sector affects not only general efficiency of the country's economy, but, also, causes changes in the demand structure of the goods and services supplied. This is related to the fact that high-tech sector's products characterized by high innovativeness) develop additional demand, thus, contributing to the emerging new needs of the consumers (or consumption). Consequently, the importance of value of consumer goods quality also grows, the products characterized by high rate of processing and consumer parameters, time, labor and environment-saving effect are in great demand. The consumers become increasingly aware of the growing demand for such products and rise in quality standards, so, their expectations also grow. They become more demanding in assessing the products and less tolerant for differences between expectations and declared features of goods.

Prerequisites for high-tech sector development in Lithuania

In assessing the importance of high-tech sector for economic development of the country as well as unsatisfactory results of this sector in Lithuania, it is essential to analyze the preconditions for improvement. The necessity of the sector's development is highlighted in strategic development documents of Lithuania; nevertheless, the country's government has been under permanent pressure because of inactivity.

It should be stressed that most critics overestimate the importance of funding research and scientific development, as the only factor leading to success. Finance is, beyond doubt, very important, but far from panacea. Consolidating the experience of different countries and international organizations, the following generalized elements influencing the creation of value added in high-tech sector, can be distinguished (OECD, 2006):

1. The government policy in financing, export, human resources, etc.
2. Assessment of the effect of these policies;
3. Real volume and structure of R&D funding;
4. Real amount and quality of human resources and situation in training;
5. Possibility to participate in R&D globalization process.

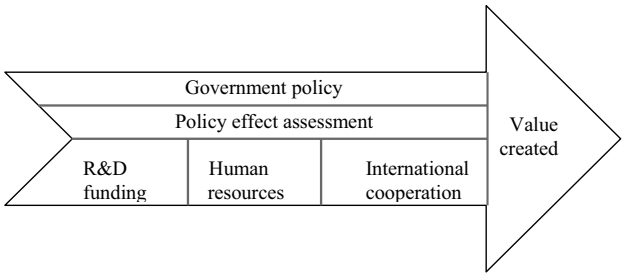

Fig. 2. Value creation chain metaphor adapted for high-tech sector

Government policy. Several main areas, for which the policy pursued by the government is essential for high-tech development, can be differentiated, because market economy mechanisms fail to assist in reaching the desired goals. Firstly, it is the reform of public research institutions. This is supposed to increase the interest of these institutions (in the first place, universities) to community and economy needs. Secondly, it is promotion of R&D carried out in several directions:

- direct funding;
- indirect financial support (research tax deductions, establishment of foundations, etc.;

- programs worked out for enterprises groups (e.g. small or medium- size companies).

Thirdly, it could be promotion of implementation of innovations (i.e. practical application of research results). In the present stage, the partnership between business companies themselves, business companies and research institutions or regional (international) cooperation are of the utmost importance. Besides, the innovations policy itself is supposed to reflect the challenges of intensified globalization processes and increasingly growing role of services in economy.

Together with the policy of promotion of implementation of research results, the state's viewpoint to ensuring human resources for this sector and creating favorable conditions for international cooperation is very important for high-tech development. These policies will be discussed bellow.

Assessment of the effect of policy. This element ensuring functioning of the high-tech sector is rather new. The growth of importance of assessing the effect of policy is stipulated by the increased growth of the importance of the policy itself. Assessment acquires a decisive impact for the efficient management of public funds allocated for R&D. It has been observed that development tendencies of relations of high-tech sector enterprises with research institutions as well as consumers of the products of these enterprises lead to create and apply sophisticated tools of policy assessment. The viewpoint that it is necessary to abandon the so-called institutional, one-time assessment and pass over to periodical continuous actions seems to dominate. Besides, the impact of globalization has to be reflected in the practice of policy assessment: international propagation of information on assessment methods and their results should be encouraged, comparative analysis of assessment results on an international scale should be carried out and institutional as well as legal basis of this assessment should be worked out.

Funding of R&D. As mentioned above, a driving force for high-tech sector is research; therefore, the importance of funding is doubtless. Currently, the EU states are facing the task that R&D funding in a few coming years should amount to 3% of GDP (i.e. USA level). The growth of the amount of funding is not the only trend of development of this area. The funding structure is also changing: between 1990 and 2003, the expenditure of the services sector on research grew by 12%, while that of the production sector accounted for only 3%. Currently, the expenditure of the services sector for this purpose accounts for 25% (OECD, 2006).

Development of human resources. The growing demand for highly skilled workforce in the areas of engineering and technologies is witnessed throughout the world. The demand for graduates involved in science and technologies is also growing incessantly. Paradoxically, the number of graduates in these areas has been declining at present in the USA and EU; therefore, many countries have been taking measures to motivate the young people to take up studies aimed at science and technologies. Apart from this, study program reforms and quality improvement programs are in progress; also, new flexible study forms are being introduced. Human resources policy has to be aimed at developing demand for highly skilled workers and researchers, particularly, in Europe, where the number of researchers engaged in industry is lagging well behind that in the USA and Japan. There is one more trend in addressing the problem of human resources, i.e. attraction of women to research. In most developing countries, women account for only 30% of engineering graduates and 25-35% of researchers (OECD, 2006).

Involvement in globalization process. Until recently, the trend of R&D development was far less internationalized than others. Currently, globalization in R&D area is of double character. Firstly, the processes of adjustment of products created in some countries to the markets of other countries; secondly, researches connected to developing high-tech sector are transferred to such countries as China, Singapore, Taiwan or Israel. Unlike in low technologies, the factors determining such processes are not costs, but, rather, human resources.

Assessment of preconditions for high-tech sector development in Lithuania

The scope of this work restricts the possibility of more comprehensive analysis of high-tech sector development in Lithuania, i.e. to identify the reasons of the current situation or to give more precise future forecasts. Even the identification of the current situation is impeded by inadequacy of statistical information supplied by different sources. For example, The OECD issued review (OECD, 2007) indicates that in the year 2006, almost half of the state funds allotted to research was distributed through universities, while, according to the data of the Lithuanian Department of Statistics (Statistics Lithuania, 2007) , only 5,3% of expenditure for R&D formed the funds of universities.

This chapter will give assessment of high-tech sector development in two aspects:

1. high-tech sector dynamics within several recent years and,
2. high-tech sector's situation within the context of other countries.

The main assessment indexes will be export of industries of high and medium-high technologies,

direct foreign investment into these areas, the share of value added in the common value created in processing industries, R&D funding and indexes illustrating training of human resources.

As it was mentioned above, the main driving force for high-tech development is R&D; therefore, the funds allotted are recognized as the essential index of future perspectives of this sector. Unfortunately, Lithuania in this respect and other Central and East European countries (and not only them) lag behind the leading countries (Table 3). No essential changes in Lithuania since the time indicated in the Table 3 occurred: in the year 2006, the funds allotted for R&D accounted for 0.76% of the whole GDP (Ragauskas, 2007). Other EU countries cannot boast of major achievements in increasing this index, either. The situation may be improved by "3% Action Plan" adopted in EU in 2003, which provides for raising this index to 3% (i.e. reaching the USA level).

Table 3. Expenditure for R&D and export of high-tech sector in 2004 of some EU countries (Perspektywy …, 2006)

Country	EU (25)	CZ	DK	EE	IE	CY	LV	LT	LU	HU	MT	FI	SE	GB
Expenditure for R&D, % of GDP	1,92	1,89	2,52	0,82	1,17	0,35	0,38	0,68	1,78	0,95	0,27	3,48	3,98	1,88
Export share of high-tech sector, %	18,2	13,5	14,8	9,9	29,1	15,9	3,2	2,7	29,1	24,6	55,9	17,7	13,8	22,7

There is another paradox the explanation of which requires a more comprehensive analysis: high-tech export size by no means depends on the index discussed above (Table 3). The high-tech sector's export amount of such countries as Malta, Cyprus or Luxemburg is disproportionately big compared to their expenditure for R&D. Lithuanian high-tech and medium high-tech sectors create around a fifth of all value added in processing industry. This is a fairly low figure, besides, its growth is rather slow: 19.2% in 2003, 20.1 in 2004, 20.1 in 2005, 20.8 in 2006 (Statistics Lithuania, 2007). The export development indexes of high-tech and medium-high tech sectors represented in Table 3 indicate that export growth rate of some branches of this sector (e.g. office machinery, computers, or motor vehicles) are higher than the average growth rates of all industry. The growth rates of direct investment into high-tech and medium high-tech sectors are also higher than average (Fig. 3).

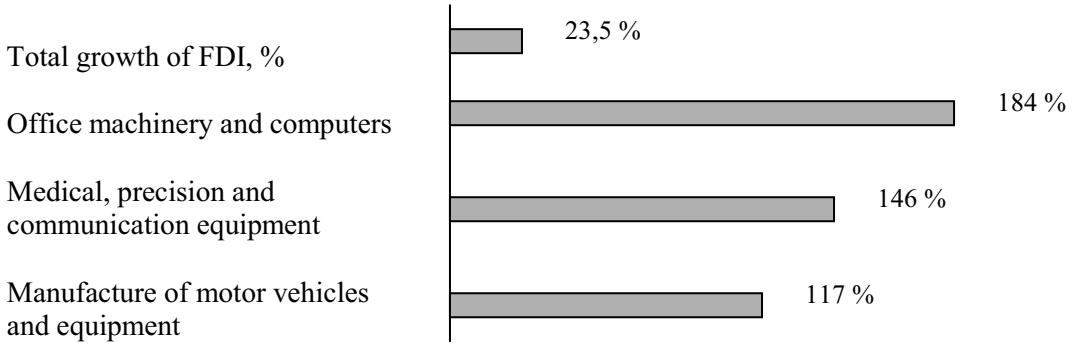

Fig. 3. Total growth of FDI into some of Lithuanian high-tech and medium high-tech sector areas between 2003 and 2006 (according to the data of Lithuanian Department of Statistics).

These facts show that Lithuanian high-tech and medium high-tech companies are capable of competing in the European and world markets.

The worst situation among all the factors related to development of the sector in question is human resources and their training. Currently, the experts' opinion and data of special studies indicate that properly trained specialists are a more important problem than funding or other factors. For example, the results of a pilot survey of the need for high-tech specialists show that the shortage of specialists is relevant for 75% of employers in biotechnologies, 62.5% in laser technologies, 60.4% in mechatronics, and 81.3% in information technologies (Pocius, 2007). The statistics of training uppermost specialists (doctors of science) shows that Lithuania lags behind not only the leading European countries, but also its nearest neighbors. The number of the maintained theses in three largest universities of Lithuania (in 2003- 118, 2004-129, 2005-163, 2006-115) is only comparable to the number of theses prepared in one Sweden university (Linchoping), i.e. 162, while in Lund university the yearly number of theses is 500, and Stockholm university boasts of as many as 1900 doctoral students (Ragauskas, 2007). The funds allocated for R&D and doctoral studies are also

very different. The same author gives the following figures:

Oxford University - 249.61 thousand Lt/ year for one person,

Berlin Technology University - 244.99 thousand Lt/year for one person,

Lund University – 180.19 thousand Lt/year for one person ,

Royal University of Technology – 119.21 thousand Lt/year for one person,

Stockholm University – 102.22 thousand Lt/year for one person,

Kaunas University of Technology – 13.76 thousand Lt/year for one person.

Due to these reasons, the companies of Lithuanian high-tech sector experience bad shortage of professionals, which is still worsened by training quality, brain-drain and other problems.

Conclusions and generalizations

1. The analysis of criteria according to which certain areas of economic activity are ascribed to high-tech sector, shows that sectoral or product approaches are, in the first place, objective, secondly, they lack informativeness. In this case, horizontal approaches to what is to be ascribed to the high-tech sector are far more acceptable. The definitions discussed in this work and applied in Japan and USA, link its separate elements with characteristics of socioeconomic system of the country, i.e. economic structure, labor structure, high-tech production demand, etc.
2. The effect of high-tech sector on the social system of the country is durable, i.e. felt not at once, permanent and multi-directional. The latter feature means that the high-tech sector affects the country's economy and society by stimulating and transforming them which results in a new level of development. The work differentiates three main trends of this effect: stimulation of creativity leading to meeting the demands of the high-tech sector itself, improvement of other sectors' activity which means transfer of high-tech products and services to lower-tech sectors, stimulation of general socio-economic changes leading to formation of the new economic structure, encouragement of labor force quality improvement and structural changes in the demand for goods and services.
3. The creation of value added in the high-tech sector is more considerably than in other sectors determined by the state's policy of financing, export, human resources and other areas, as well as by reasonable assessment of these policies ensuring feedback between government and the sector's subjects (enterprises, associations, etc.). Funding and structure of R&D are understood as the main factors of the sector's development; nevertheless, the amount and quality of human resources as well as their training should by no means be neglected. At present, there is a lack of highly skilled workforce both in Lithuania and Europe. The urgent need to participate in the process of researches and in the global dissemination of their results is one of the new elements in the preconditions ensuring high-tech sector's development.
4. The review of the current situation in Lithuania gives the explanation of the existence of differing opinions about the future of high-tech sector. On the one hand, the growth of export and flows of direct foreign investment into this sector give hopes that in the future it will occupy the position in the country's socio-economic system equal to that in leading countries. On the other hand, the results illustrating the preconditions for the sector's development (research funding, situation in human resources) are fairly unfavorable. It is obvious that the government actions should be aimed at radical changes in the development of high-tech sector in Lithuania.

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