ISSN 1822 – 8402 EUROPEAN INTEGRATION STUDIES. 2009. No 3

ENCOURAGEMENT OF THE RELATIONSHIPS SCIENCE – BUSINESS THROUGH ESTABLISHMENT OF CENTERS FOR TECHNOLOGY TRANSFER IN BULGARIA (THE CASE OF THE UNIVERSITY OF ROUSSE)

Daniela Yordanova, Veliko Ivanov, Kiril Barzev,
Ivan Kolev, Georgi Mitev, Daniel Bratanov
University of Rousse

Abstract

The High Education reform in the Republic of Bulgaria is aiming at transforming the High Schools into integrated centers for science and education, capable of adequately facing the challenging times and investing in more and more qualitative scientific work in every sphere of the social and economic life.

The long period during transition caused demolition of old built relationships and connections between the scientific research work and the real practical requirements of the business. The firms suffer form insufficient financial recourses have limited possibilities to apply new technologies and to order new developments related with their concrete practical problems.

It is important to pay attention to the possibilities for new technological solutions application into the practice in order to enhance the competitiveness of Bulgarian firms and to provide researchers with up to date problematic for their scientific work. For realization of that goal a necessity of new type of innovation and technology transfer infrastructure establishment is being determined.

The article presents a profound analysis of the tendencies in scientific research, the education system and innovation strategies in Bulgaria and in particular of the University of Rousse "Angel Kanchev". We base our choice on the structural idea of knowledge-based economy which is seen as analytically useful by Cooke and Leydesdorff (2006). They link the knowledge generation to the knowledge exploitation system (mainly companies) and repulses the perception that only industries with heavy concentration of knowledge assets should be in the focus of the research.

The aim of the article is to introduce to the scientific society that in Bulgaria is being worked on that scientific problem and to share the experience in establishment of Technology transfer office (TTO) in the University of Rousse, in building up the connections between the business and scientific workers and to promote a good practice which can be implemented in European Union (EU) member state, due to the financial possibilities, given by the Structural funds. The tasks placed for the solution of the article's aim are: to elucidate the necessity of technology transfer enhancement between the science and the practice, to analyze the Bulgarian environment and the condition of technology transfer between higher education institutes and business, to estimate the possibilities for technology transfer through establishment of TTO with the use of EU financial sources and to give an example of good practice by sharing the experience, gained during the implementation of EU funded project and to estimate the multiplication possibilities.

Special attention is paid on the positive results after the establishment of the Technology transfer office in the University, accomplished with the financial support of the European Union, PHARE program.

Keywords:

Innovations, Research, Education, Science, Technology Transfer Office (TTO), European Union's funding programs.

Introduction

Contemporary economic development is characterized by rapid technological change leading to knowledge generation that highly intensifies the competition between organiizations (Castells, 2000). It increases even more the significance of knowledge creation, exchange and transfer for market players. Thus, every company must be able to employ effectively knowledge as a tool for achieving a long term competitive advantage (Lager & Horte, 2002). Studies investigating the new knowledge creation, exchange and transfer focus primarily on research and development (R&D) intensive industries such as information and communication technology (ICT) and biotechnology (Orstavik, 2004).

Science nowadays becomes much more global and its influence on the human beings life becomes much more considerable. Scientific innovative products can be utilized by new relations between already achieved scientific and research results at one hand and society needs from other. Those needs could be summarized as solving considerable needs of industry, human resources management, national identity, Bulgarian history and culture and at least but not last – the natural resources management.

Development of engineering sciences and innovations and provision of new scientific knowledge is key factor of this process.

Knowledge plays the basic role in the economic process. (Bologna Process, 2005). The winners on the market are those who know. Nations gifted with more knowledge are more competitive.

For the European Union (EU) one of the key challenges is to overcome the knowledge transfer problem (Morgan, 1997). Relative to Japan and the US, for example, the EU has a poor record of converting scientific and technological knowledge into commercially successful products and services, that is an inability to transfer knowledge from laboratory to industry and from firm to firm (Commission of the European Communities (CEC), 1993).

Recent research into national and regional innovation systems (Braczyk, Cooke, and Heidenreich, 2000) has shown that differences in innovative capacities between countries and regions are linked to the institutions which promote learning and technology transfer activities (Bartlett, Čučković, 2006). These in turn depend upon the existence of networks of institutions and firms that permit reciprocal exchange of knowledge and information (Morgan, 1997; Audretsch, 2005). Such reciprocal exchanges are facilitated where the institutional structure is flexible enough to permit interaction between research institutes, university science departments and industrial enterprises.

These arguments are especially relevant in the case of transition economies, where the legal system may not fully protect intellectual property rights, and where old relations of trust have broken down as research teams have been dispersed and disrupted, where foreign direct investment is low, and where large domestic enterprises may be protected from the force of oligopolistic market competition (Bartlett, Čučković, 2006; Zahra, 1996). In these circumstances it is likely that there will be low levels of knowledge transfer both between businesses and between research institutes and business entities. This suggests a role for government intervention to stimulate the application of inventions and provide a boost to the level of innovation activity activities. In former transition economies most of the problems related with relationships and trust continue even after the existence of proper functioning of legal system.

The article discusses the problems concerning technology transfer between the higher education institutions in Bulgaria and firms, the necessity of creation of intermediary institutions for technology transfer and the possibilities for pointed problems solution with the financial aid of the EU.

There is no experience in establishment of technology transfer infrastructure among the Bulgarian Higher Education Institutes (HEIs). Bulgarian firms lack the innovation application experience, corresponding to market lows.

The aim of the article is to introduce to the scientific society that in Bulgaria is being worked on that scientific problem and to share the experience in establishment of Technology transfer office (TTO) in the University of Rousse, in building up the connections between the business and scientific workers and to promote a good practice which can be implemented in EU member state, due to the financial possibilities, given by the Structural funds.

The tasks placed for the solution of the article's aim are:

1) To elucidate the necessity of technology transfer enhancement between the science and the practice.

2) To analyze the Bulgarian environment and the condition of technology transfer between HEIs and business.

3) To estimate the possibilities for technology transfer through establishment of TTO with the use of EU financial sources.

4) To give an example of good practice by sharing the experience, gained during the implementation of EU funded project and to estimate the multiplication possibilities.

The research object chosen for the article is TTO in the University of Rousse, established with the financial support of the EU.

The used research methods include induction, deduction, analysis and synthesis.

Technology transfer form Bulgarian high schools to entrepreneurs – problems and challenges after the changes in the economic and political environment. Tendencies, resulting from the Bulgarian membership in the EU

Bulgaria has reached a stage of economic development which requires intensive focus on effective education, research and realization of high level of innovations. The economic factors and prerequisites for such a shift are already visible. During the past 15 years under the pressure of structural changes within the Bulgarian economy the organizational and institutional structure of the innovation system lost touch with market reality. A competitive technology transfer network has to be created to respond to the technology and innovation

needs of the industry.

The introduction of innovations, new technologies and the development of the industrial units innovation potential have the decisive importance for the sustainability of the Bulgarian production, thus improving the employability and achieving economical growth.

During the last few years the industrial companies in Bulgaria are under increasing pressure to meet customer demands and compete successfully on the united European markets. The current market trends are: increasing international competition, shorter product life cycle, higher quality requirements and higher delivery reliability. In addition to these market trends, technological developments also play a role offering new opportunities for applying innovative manufacturing tools, new strategies for product and process design and development. The ability of a company to adapt advanced technologies for planning and manufacturing is vital in today's dynamic global market.

The analysis of official Bulgarian institutions concludes that the existing Bulgarian companies very rarely use and apply innovative technologies and products. Being already EU member, it is vital to improve the competitiveness of Bulgarian enterprises and to increase their ability to resist to the pressure of competitors and market forces. The introduction of research innovations, new technologies and the development of the enterprises innovation potential have the decisive role for strengthening of the Bulgarian production, thus increasing the employability and achieving economical growth.

The investments in research and development activities, in technological development and innovations mostly influence on the productivity and the level of added value of products and services, offered by the companies on the market (CEC, 2004).

In the European Commission's report of ***innovation performance*** (CEC, 2009) Bulgaria is pointed as a catching-up country with innovation performance well below the EU average (Table 1). Finland, Ireland, Cyprus and Bulgaria are the best improving EU countries within their peer groups (Table 2).

Bulgarian rate of improvement is one of the highest of all countries and it is a growth leader within the Catching-up countries. Relative strengths, compared to the country's average performance, are in Human resources, Finance and support and Economic effects and relative weaknesses are in Linkages & entrepreneurship and Throughputs.

Over the past 5 years, throughputs and finance and support have been the main drivers of the improvement in innovation performance, in particular as a result from strong growth in Private credit (25.2%), Broadband access by firms (21.5%), Community trademarks (67.6%) and Community designs (31.0%). Performance in Economic effects has hardly grown, in particular due to a decrease in New-to-market sales (-5.7%) and New-to-firm sales (-3.1%).

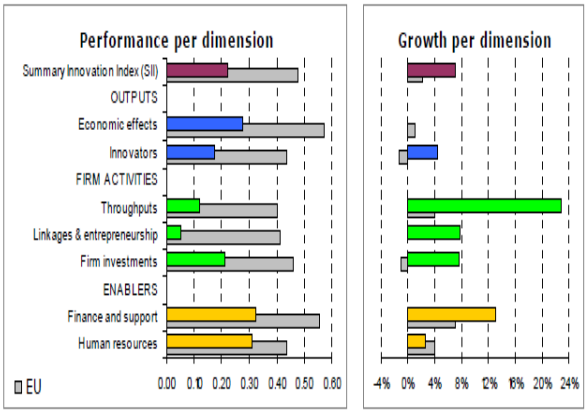
Table 1. Innovation growth leaders

Group	Growth rate	Growth leaders	Moderate growers	Slow growers
Innovation leaders	1.6%	Switzerland (CH)	Germany (DE), Finland (FI)	Denmark (DK), Sweden (SE), United Kingdom (UK)
Innovation followers	2.0%	Ireland (IE), Austria (AT)	Belgium (BE)	France (FR), Luxembourg (LU), Netherlands (NL)
Moderate innovators	3.6%	Cyprus (CY), Portugal (PT)	Czech Republic (CZ), Estonia (EE), Greece (GR), Iceland (IS), Slovenia (SI)	Italy (IT), Norway (NO), Spain (ES)
Catching-up countries	4.1%	Bulgaria (BG), Romania (RO)	Latvia (LV), Hungary (HU), Malta (MT), Poland (PL), Slovakia (SK), Turkey (TR)	Croatia (HR), Lithuania (LT)

Average annual growth rates as calculated over a five-year period.

Table 2. Comparison of Bulgarian growth with EU

BULGARIA



This raises the issue of the better involvement of the HEIs into the process of innovation application into the practice.

In the early years of transition, the public institutes geared towards innovation and applied science has been abolished (OECD, 1999). New structures performing mainly applied research or functioning as intermediaries between science and industry have not been created on large scale. The Bulgarian system has not yet recovered from this loss. Despite of many successful individual activities of cooperation, in 2006 there was no clear cut profile of institutes, supporting structures and even joint initiatives, neither within the Academy of Science nor within the Universities, which would promote efficient construction of knowledge and transfer of results. Moreover, Bulgaria lacked market oriented research institutions that intimately understand the needs of industry. A major reason for that is the lack of demand for industry for advanced research and, even worse, the lack of absorptive capabilities in industry. However, the problem is even more basic. (Beatson, Hodson, Kaari, Koch, Kolarova, 2008).

The network of higher schools in Bulgaria (population 7.8 million) involves universities, specialized higher schools and colleges. They offer different degree-level educational programmes and various opportunities for the acquisition of higher education. The colleges are independent entities that could be public or private or within the structure of the HEIs. The total of 51 accredited HEIs includes 36 public and 14 private institutions. For the 2003-2004 academic year there were 195 666 students in public universities and 32 802 in private universities.

Research and development (R&D) expenditure shrunk from 2.7% of the Gross Domestic Product (GDP) in 1989 to 0.2% of the GDP in 1996 and leveled off at about 0.5% of the GDP in 2003-2004. The same trend, though at a slower pace, can be seen in the dynamics of employment in R&D and the number of public and private organisations performing R&D (European Science Foundation, 2008). Universities receive funds from the government as a block grant, which they are free to spend as they wish; they are also free to raise their own funds and spend those as they wish without limit. Approximately half of the public funding allocated to research is spent in the higher education sector. The research system is primarily based on direct budget support. Competitive research programmes, though active since 1990, have increased their weight in the system since 2004. The Bulgarian National Science Fund is the main programme-based funding instrument and was established by the Bulgarian Government in 1990. As of 2006, however, its contribution is dwarfed by the nine times larger direct institutional support facility through the central government budget. The main portion of the public funds for research is allocated to the academies. (CEC, 2009)

In addition to this funding in 2007 a grant scheme "Establishment of Technology Transfer Offices at Bulgarian Public Research Organisations Grant Scheme" funded by Phare – Economic and Social Cohesion Programme was introduced to HEIs. (Ministry of Economy and Energy, 2005). The grant scheme was focused on improvement of the competitiveness of Bulgarian enterprises and promotion of higher-growth innovation environment, through improvement of the innovation infrastructure and know-how at national level. The expected result was establishment of Technology Transfer Offices (TTOs) at Bulgarian Public Research Organisations (PROs) that act as:

- Promoters of the potential innovations of PROs.
- Information and contact points for enterprises that need innovation service.
- Intermediate bodies between providers and adopters of technology.

Technology transfer possibilities by using TTO

The success of technology transfer depends on proper development and effective use of networks, relationships and enhancement of trust between providers and adopters of technologies at regional level. They are the pre-condition for knowledge cluster (KC) formations, which are fundamental for regional competitiveness.

KC formation gives firms the strategic knowledge infrastructure, which stimulates entrepreneurship and risk initiatives that are linked to the innovation process and knowledge generation. Another KC advantage is the effective and sustainable coordination of industrial initiatives with the other main engines of development (universities, government, investors) (Antonova, 2008; Paskaleva&Antonova, 2009).

The beginning of the KC formation in North Central Planning Region (NCRP) in Bulgaria began when a group of researchers from University of Rousse prepared a project proposal which was approved and a grant contract was signed. The project funding facilitated the establishment of TTO in the University and aimed enhancement of the communication between scientists and representatives of the business, who are interested in innovation application in their firms.

The TTO provides solution of few major problems into the innovation application process:

- Choice of appropriate research subject, related with real practical problems, instead of choices, related with subject considering educational process.
- Feasibility analysis of ideas related to RTD/ innovations – including evaluation of innovative ideas or innovations, with respect to their potential to be introduced in the economy. This stage might include variation of analyses and evaluations - technical evaluation, financial evaluation, economic evaluation and intellectual property evaluation.
- Analyses into the firms in respect with their innovation need (RTD demand of the enterprises).
- Provision of consultancies and assistance for proper communication between the entrepreneurs and researchers.

The need of establishment of such units is determined by the following problem. Bulgarian universities researchers in general and researchers at the University of Rousse in particular have always been very active in the development of new technologies and innovative products, due to their everyday teaching, training and investigating duties and responsibilities regarding students and especially PhD students. Nevertheless, there is a tendency in leading research that is done just for the aims of the teaching process and it is not still market oriented. During the recent years researchers do not always comply with the market demands for innovations. Although the research community of the University of Rousse has a considerable number of technology transfers, innovations, patents and other research and technological developments successfully introduced into practice, there is still much to be done

for the commercializing of the University research innovation products.

The mission of the TTO in the University of Rousse is to facilitate the technology transfer process between the adopters of technology and the providers of technology in order to contribute to closing the gap between the private enterprises in Rousse region, North Central Planning Region (NCPR) and Bulgaria as a whole and the providers of innovations form University of Rousse and form the Rousse region by matching the technological needs of enterprises with innovation and research outputs of PROs that are ready for commercialization, for the benefit of the public, while seeking income for the PROs and the inventor/creator, as well as enhancing industrial liaison and supporting regional economic development. TTO is considered to be often capable managing these relationships through higher levels of social and human capital in comparison to research organisations, thereby enhancing knowledge flows (Sirmon & Hitt, 2003).

The project target groups are researchers, representing the University of Rousse and the Union of Scientists-Rousse as technology, know how and knowledge providers on one hand, and small and medium enterprises (SMEs) from the NCPR looking for innovations to solve their production problems and representing the industrial market sectors like vacuum technology sector, manufacturing, agriculture, information and communication sector, power engineering, transport, light industries and others.

Based on the Needs Assessment Study elaborated within this project and based on international practices, the scope of activities of a TTO encompasses six activity fields:

1) Intellectual property, patents and licenses
2) Consulting and services
3) Starting a spin-off company – Assistance in the spin-off process
4) Material sales
5) Policy mainstreaming
6) Networking

The possible solutions of the organizational structure of this type of units are two - as a department at University or as an independent legal entity (for example, association or foundation). In the case of legal independence the possibilities for organisation are several: 1) wholly owned by PRO, 2) with the main shareholder – PRO, and open for other shareholders, like associations of industries or 3) SMEs or owned by several PROs acting in the same technology field.

The University of Rousse Technology Transfer Office is legally established as a structural and functional unit of the Research and Development Centre (R&DS) with a decision of the University Academic Board and with the relevant documentation, including statute, structure, internal rules, Management Board, mission, strategic and operational objectives clearly defined.

A management structure is established in TTO to ensure that work is carried out in a timely way, using state-of-the-art technologies, and that the work is always based on strong scientific principles. R&DS (the TTO principal) is responsible for scientific coordination, for overall financial, administrative, contractual, and technical management. In the TTO is employed a number of staff with the requisite project management expertise gained from past EU-funded project coordination.

The TTO works very close with the scientific laboratories, based on the University campus.

Another support for successful development of the link "Science - Business" is the fact that Rousse University has established Entrepreneurship Center in 2008 within the structures of the Research and Development Sector next to TTO. This Center has already achieved some results, which enforce the knowledge transfer of the academics to business (Pavlov, 2008).

Project implementation results

After the legal establishment of the TTO and organizational and infrastructural provision the main efforts were focused on attraction of the target group representatives and popularization of the TTO activities.

The results might be generalized in few directions:

Data base development and maintenance. Three main data sources (innovative technology offers; laboratories and research equipment; and company's technology requests) are included in it. The access to the published on the TTO Web site specialized information is protected by the Intellectual Property Rights Law and is provided to external users on a fee-paid basis. The TTO Internet address is available and accessible for use to innovation providers and technology adopters.

Organisation of Seminars & Workshops. These events are part of a wide information campaign aiming to provoke interest in TTO. Three seminars and two workshops were organized. The seminar's topics included robotics and rapid prototyping, vacuum and nano- technologies, alternative energy sources, ecological aspects of transport, food biotechnologies and ecological agriculture. The aim of the seminars was to provide possibilities for meeting, discussion and presentation of representatives of both target groups. During the seminars research teams presented 10 innovations and 7 firms presented their activities and innovation needs. The seminars were attended from more than 250 firms, which received the possibility to communicate with researchers, working in their industry field, to discuss common problems and to set the beginning of a partnership.

In result of the accomplished communication in one firm was carried out **rapid prototyping innovation** and **analyses of RTD demand** in 4 companies was realized.

For future functioning of the TTO the team of experts **developed methodologies** for economical, financial,

technical and intellectual property right analysis. These methodologies were used during the market readiness evaluation of presented from university research teams innovations.

The following **innovation's analyses and evaluations** were carried out:

- Financial feasibility analysis of rapid prototyping, rapid manufacturing & rapid tooling technologies, ready for introduction in a company from the light or manufacturing industry;
- Technical feasibility analysis of vacuum technologies, ready for introduction in a company from the manufacturing sector;
- Economic feasibility analysis of resource-saving technologies, ready to be introduced in a company from the manufacturing sector;
- Intellectual property protection feasibility analysis of the innovation aspects of agriculture, ready to be introduced in a company from the agricultural sector;
- Technical feasibility analysis of the emergency risk management technologies, ready to be introduced in a company from the high disaster risk manufacturing sector;
- Financial feasibility analysis of the alternative energy resources, ready to be introduced in a company either in a company from the transport sector, or from the sector of power engineering.

After finalizing the feasibility analysis the level of their practical applicability was defined. The developed analysis and evaluations become the basis for the TTO team to make contacts with SMEs and industries, interested in the implementation of these innovations into their production.

For preliminary attraction of entrepreneurs and researchers and **informational campaign** was carried out. During the project the spread information materials include 2000 leaflets, 500 CDs, 500 DVDs and 100 posters.

Conclusions

The project already has positive consequences in few areas:

1) Developed prototype in resource saving technologies area, which was applied in a real firm.
2) Created robot for crisis management, which is being applied with Directorate General Civil protection in the Ministry of Emergency situations. The robot is functioning in cases of disasters as fire, earthquake, explosives dismantle etc.

The financial aid of the EU, in particular PHARE program is useful and encourages the introduction of innovations in the real business. The possibilities, provided by Structural funds, especially European Regional Development Fund in its part for innovation enhancement and European Social Fund as financial aid for improvement of the quality of research are determinant for future connection between science, research and competitiveness of SMEs not only in Bulgaria, but in EU as whole.

The future possibilities for development of the TTO in the University of Rousse are related with improvement of quantity and quality of provided services, further filling in of the database with new innovation ideas and deepening of the relationship with enterprises.

It is essential for the experts and managing board of TTO to continue with their efforts for establishment of KC in NCPR.

Improvement of the quality of provided services is in direct dependency of the qualities and knowledge of the team of experts, working in the TTO. That's why the continuous training and improvement of their knowledge and skills will be crucial for the future work of the TTO.

As possibilities for fundraising and financing of the TTO activity shall be considered not only incomes, coming form the TTO's clients but also the grant schemes, announced under the Operational programme Development of the Competitiveness of the Bulgarian Economy 2007-2013.

References

Antonova, D. (2008), Development of Competitive Advantage by Formation of Regional Knowledge Clusters, Studii Economice, Analele Universitatii E.Murgu Fascilola II, Anul XV, Nr.1, ISSN 1584-0972, Romania, pp.105-112

Audretsch, D. (2005), Mansfield's missing link: the impact of know- ledge spillovers on firm growth, Journal of Technology Transfer, 30 (1/2): 207-210.

Bartlett W., Čučković N. (2006), Knowledge Transfer, Institutions, and Innovation in Croatia and Slovenia, Social Research Journal for General Social Issues (Društvena istraživanja Časopis za opća dru tvena pitanja), issue: 3 / 2006, pages: 371399. On-line: www.ceeol.com.

Beatson, M., Hodson, A., Kaari, R., Koch, P., Kolarova, D. (2008), Policy Mix Peer Reviews: Country Report: Bulgaria, CREST European Union Scientific and Technical Research Committee, On-line: http:// www.eurosfaire.prd.fr

Bologna Process (2005), National Report Bulgaria., On-line: http://www.bologna- bergen2005.no/EN/ national_impl/00_Nat-rep-05/National_Reports-Bulgaria_050311.pdf

Braczyk, H-J., Cooke, P. and Heidenreich, M. (1998), Regional Innovation Systems, London: UCL Press. ISBN: 0-415-30369-9.

Castells, M. (2000). The Rise of the Network Society, Blackwell Publishers. Treatment: 546.

Cooke, P., Leydesdorff, L. (2006). Regional Development in the Knowledge-Based Economy: The Construction of Advantage, Journal of Technology Transfer 31: 5-15.

CEC (1993) Growth, Competitiveness, Employment, CEC, Brussels.

CEC (2004), Science and Technology Institutions and Science and Technology Policies in the EU Acceding Countries – Challenges for the development of the Knowledge- Based Economy,

CEC (2009), European Innovation Scoreboard 2008 - Comparative analysis of innovation performance, ISBN 978-92-79-07319-9, On-line: http://www.proinno-europe.eu

European Science Foundation (2008), Status and Developments of Social Science Research in Central and Eastern Europe, Strasbourg, ISBN: 2-912049-78-4.

Lager, T., Horte, S. (2002). Success factors for improvement and innovation of process technology in process industry, Integrated Manufacturing Systems 13(3): 158-164.

Ministry of Economy and Energy (2005), Establishment of Technology Transfer Offices at Bulgarian Public Research Organisations Grant Scheme – Guidelines for Grant Applicants, Ref. BG 2005/017-353.10.06, On-line: www.sme.government.bg/IANMSP/Documents/000000683/BGBG/Guidelines.doc

Morgan, K. (1997), The learning region: institutions, innovation and regional renewal, Regional Studies, 31 (5): 491-503.

OECD (1999), University Research in Transition, Science & Information Technology, vol. 1998, no. 9, p. 31

Orstavik, F. (2004). Knowledge spillovers, innovation and cluster formation: the case of Norwegian aquaculture, Knowledge Spillovers and Knowledge Management. C. Karlsson, Flensburg, P., Horte, Sv. UK, Edward Elgar Publishing Inc.: 204-234.

Paskaleva,M., Antonova,D. (2009) Industrial Networks for Innovative Collaboration in Sweden and Bulgaria, 5th National & International HSSS Conference *From Systemic Thinking to Systems Design and Systems Practice* Xanthi, Greece:201-211

Pavlov, D. 2008. Technostarters and production of renewable energy, Proceedings of Rousse University, Volume 47, book 6.1, p.p.38-42. ISSN 1311-3321, On-line: http://conf.ru.acad.bg/bg/docs/cp/6.1/6.1-6.pdf

Sirmon, D., Hitt, M. (2003). Managing Resources: Linking Unique Resources, Management, and Wealth Creation. Entrepreneurship Theory and Practice 27(4): 339-358.

Zahra, S. (1996). Governance, ownership, and corporate entrepreneurship: the moderating impact of industry technological opportunities, The academy of management journal 39(6): 1713-1735.

Zahra, S. (1996). Technology strategy and new venture performance: a study of corporate-sponsored and independent biotechnology ventures, Journal of Business Venturing 11: 289-321.

The article has been reviewed.

Received in March, 2009; accepted in April, 2009.