SCIENCE AND TECHNOLOGY BASED COMPANY, ITS FEATURES AND RELATIONS TO ENVIRONMENT

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Abstract

According to different authors, science and technology based companies could be considered as a crucial chain in transforming research and development investments into economic value. This could impact company's business performance and at the same time the development of country's economy. Moreover, according to today's empirical research, extremely fast innovation and technology development all over the world has a different effect on separate industries.

There is a lot of academic literature where science and technology based company environment assessment issues are described, however, there is a lack of assessment methods and/or ratios/indicators, which show how the company is science, innovation and technology based and even how to identify such kind of company.

This article is divided into structural parts, reflecting: R&D environment analysis based on the case of Lithuania; academic literature overview regarding science and technology based company's environment analysis; definition of S&T based company economic/financial assessment ratios.

After the analysis, a list of ratios/indicators were presented, which empower to identify and/or asses such kind of company. Data availability was the core factor in these indicators creation processes.

Research methods used are based on systematic literature analysis, mathematical statistics methods, logical comparative and generalization analysis.

The type of the article: *Theoretical article.*

Keywords: *science and technology (S&T), determinants of cooperation, innovation, research and development (R&D), economic/financial assessment ratios.*

JEL Classification: *E22, O30, O31, O32, C41.*

1. Introduction

Academic literature authors state that nowadays the emergence of knowledge as one of the factors of production is creating a great impact on internal organization resources and is leading to competitive advantages among organizations. The important feature of knowledge is it being non-exclusive public good, in fact, employing knowledge doesn't stop other people from using it. But what is rare is the ability to use knowledge in ways that ensure growth and economic development. Authors Levi and Jakšić (2012) underlined, that economic growth and development are strongly related to technological change, and the character of new technologies is radically changing the focus of key development factors.

According to Kriaucioniene (2009), the growth of knowledge economy is primarily based on the creation and effective utilization of knowledge. Developing countries have raised their expectations high in terms of development of knowledge economy. Research and Innovation Union scoreboard (2005-2011) shows relative country common strength, which is manifested by knowledge economy innovation drivers like number of graduates, share of population with higher education as well as inherited R&D infrastructure. All of the newly emerged Central and Eastern European countries have stated the knowledge economy as a development priority to be built upon the knowledge-intensive areas. According to the European Commission scoreboard data these countries, including Lithuania, have to overcome unfavorable industrial structure, first of all characterized by separation of the R&D, or knowledge generation, and business, or knowledge utilization sectors.

The triggers of rise and growth of science and technology based companies especially in specific conditions of developing economy, are weakly understood. Since such kind of companies have a significant impact on the country's economy and main innovational development, topic is relevant to today's actual science researches and can be practically implicated under the analysis of basic science, technology and innovation (STI) spread in different economic environment and its members. Mairesse, Mohnen, Hall and Jaffe (2010, 2012) analyzed the importance of science, technology and innovation level measurement and presented systemized list of indicators that could be used to measure technology, innovation level or how much company is science based and/or environment friendly. However, these indicators are more applicable for S&T environment assessment, neither for S&T based company.

According to Erken and Kleijn (2010) and Hülsbeck and Lehmann (2012), there is an ongoing debate about the role of universities in a society challenged by the increased competition in a globalized world. The speed with which global markets evolve makes companies, regions and nations recognize that an effective innovation process is the best way to guarantee competitiveness. In the same way as markets and society become more and more interrelated within the process of globalization, economic competitiveness is more and more concentrated on a regional level.

Finally, Haq (2012) analyzed how integrative knowledge-based development can contribute to economic growth and social development as an important field of research. Author showed how it would be useful for country-specific demands and issues, and the significance of investment in knowledge-based research and the importance of universities in the practice and advancement of integrative approaches of knowledge-based development.

Considering relevancy of recent researches and main issues, which were discussed by science literature authors, main problem is identified – the lack of systemized knowledge and science company evaluation methods, theoretical approaches and core factors, which are the main triggers of science, technology and innovation improvements and these fields development in such kind of companies. The main purpose of this paper is to overview academic literature of science and technology based company assessment, its features and propose evaluation, identification and assessment economic/financial ratios.

2. A brief overview of Lithuania S&T firms and environment

According to Lithuanian Department of Statistics, it was found that cost of R&D expenditure to GDP ratio increased more than 70% from 0,54 as of 1998 to 0,92 as of 2011; dynamics of the ratio is presented in Figure 1. It could be noticed, that the there is an impact of economic recession period when the cost of R&D expenditure in Lithuania was reduced. However, the largest amount of R&D costs was identified in 2011 and it is expected to have growing cost to GDP ratio in 2012. Also cost of S&T increased from 244 MLTL as of 1998 to 974 MLTL as of 2011 and this shows the importance of STI companies in Lithuania. After the analysis of S&T costs structure, it was found that the main part of all S&T costs depends to fundamental researches and takes 38,2%.

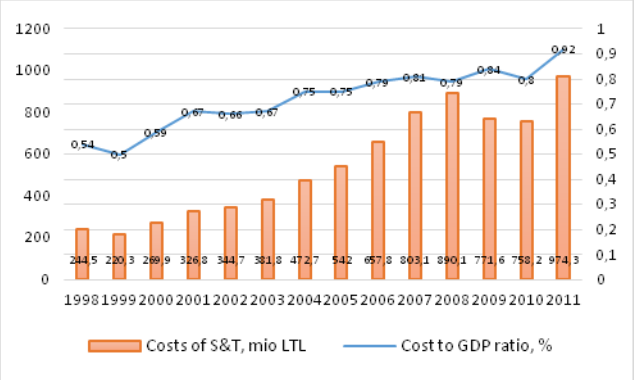

Figure 1. R&D expenditures

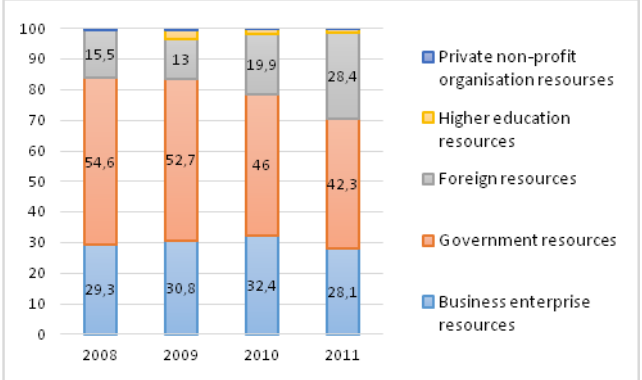

Figure 2. R&D costs acc. to financing resources, %

Source: Lithuanian Department of Statistics

It was noticed, that during 2009-2011 structure was smoothly flat and was structured as follows: 34-38% of fundamental researches, 35% engineering researches and about 26-29% technological development. After the analysis of R&D cost in accordance of financing resources, it was found the main financing resource from 2008 to 2011 was Government budget and consists about 48,9% (averaged). The second very important source is business enterprises, which takes about 30,2%.

According to Kriaucioniene (2009) survey results, science and knowledge based companies represent a highly educated business segment in Lithuania, very much alike to other CEE countries. All the entrepreneurs had at least one higher education degree. This group of entrepreneurs is much more and higher educated to compare with company founders. Meanwhile according to World Bank's scoreboard, Lithuania is one of the modest innovators with below average performance. Relative strengths are in Human resources and Finance support and the relative weaknesses are in Open, excellent and attractive research systems, Linkages and entrepreneurship, Intellectual assets, Innovators and Economic effects.

3. Science, technology and innovation based company indicators

After the overview of academic literature, it was defined, that there are a lot of variables and indicators, which could be used to measure technology, innovation level or how much company is science based and/or environment is friendly for such kind of companies. Hall and Jaffe (2012) were faced to the same problem and systemize a set of factors or observations that tells us something meaningful about underlying phenomenon of science, technology and innovation. After the analysis authors found relationship of the existing indicators to the Key Issues, technology and Innovation (STI) Indicators.

Table 1. Key Issues for STI Indicators

Issue	Current Indicators	Possible additional indicators
Growth, Productivity and Jobs	Value-added; Exports; International royalties; Foreign direct investments	Innovation revenues; Innovation cost savings; Service sector innovation
STI activities	R&D expenditures by the sector and performing organization; Degrees; Postdocs; Education spending; Test scores; Technology alliances	Capital investment for innovation; Design investment
STI talent	Enrollment; Degrees; Occupations (by country of origin)	Training for innovation adoption and diffusion
Private Investment, Government Investment and Procurement	Public expenditures broken down in various ways	
Institutions, Networks and Regulations	Contract R&D; ATP, SBIR, STTR Mfg. extension	Birth and death for innovative startups; Survey evidence on abandoned projects (as in CIS)
Global STI Activities and Outcomes	International Co-authoring; Trade in R&D; Royalties; Foreign direct investment; Foreign enrollment	Improved collection of cross-border R&D investment
Subnational STI Activities and Outcomes	R&D data; Patent data; Student Scores; S&E doctorate holders	Innovation survey data on sources of knowledge
Systemic Changes on the Horizon	Consumer attitudes	See above

Source: adapted by the authors with reference to Hall and Jaffe (2012)

According to Hall and Jaffe (2012), it is therefore worthwhile to ask to what extent gaps in the existing data and indicators constitute important barriers are not gaps in the data. Investment in R&D is a major driver of productivity growth, and the rate of return to both private and public R&D

investments is relatively high. Despite this relationship being clear on average, innovation is a very risky process, so that there is a lot of variance in the results of all innovation efforts. Even if better STI Indicators will not provide answers to the core questions, there remain important improvements:

- Better coverage of the service sector in R&D and innovation surveys;
- Implementation of innovation surveys, with eventual expansion to include measures of cost savings associated with process innovation;
- Collection of information on investments in equipment and software in support of innovation;
- Collection of information on design efforts;
- Collection of information on training of employees for diffusion and adoption of innovations;
- More timely publication of indicators and availability of micro data to researchers;
- Collection and maintenance of data by grant-making agencies on individual grants and researchers in such a way that can be linked to other data sources.

However, it must be emphasized, that answering questions below or questions which could be answered after the analysis of existing requires not just data but modeling and analysis.

To understand the relations with the environment authors Hall & Jeffe (2012) presented a schematic overview of the STI System (please see Figure 3).

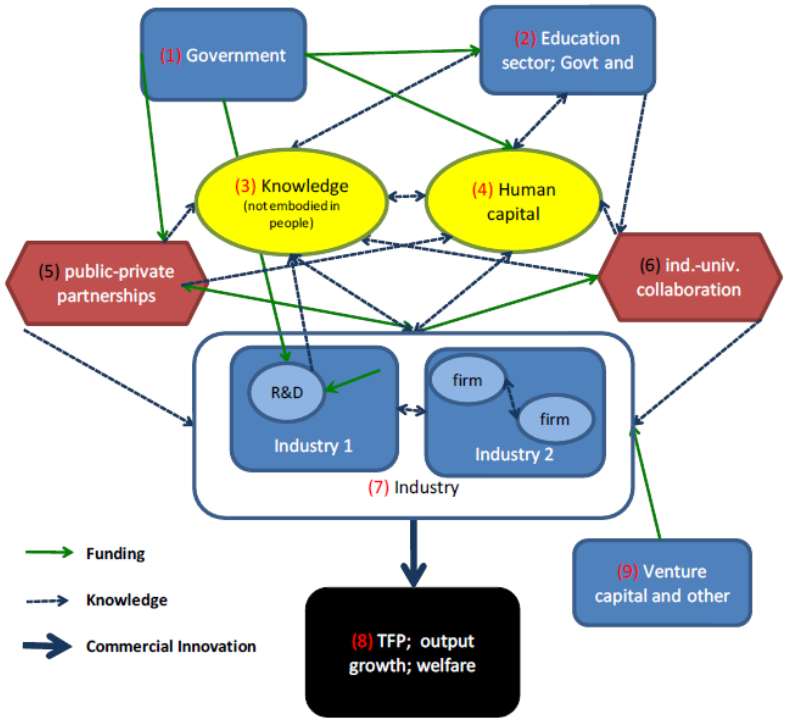

Figure 3. Schematic overview of the STI system
(by Hall & Jaffe, 2012)

The overview of STI indicators and STI system shows, that almost all indicators are designed to assess science, technology and innovation environment issues, however the purpose of this article is to summarize the S&T based companies features. In accordance to this aim, several core features are described below.

4. S&T based company's environment drivers

It was noticed, that Figure 3 is a clear evidence of interaction between education sector, government, other industry members and S&T based company. The core issues are knowledge and human capital, which could be considered as a crucial element for whole system. The partnership, or in other words entrepreneurship, must be underlined as a mandatory feature of such kind of company.

Thomos (2001), Martazavi and Bahrami (2012) analyzed both, entrepreneurship as the major resources to produce wealth and Knowledge Based Economy, which relied on manufacturing, distribution and application of knowledge and information. Those two concepts could be considered as a kind of stimulus for development in the world and has led to productivity and economic growth. According to authors, the main reason of research is to increase the efficiency and utilization of human resources and extensive knowledge simultaneously. Leydesdorff (2002) argues, that the most important element in providing value-added in information society is converting knowledge to ability. Author underlines, that from a huge amount of economies just only several could be considered as knowledge-based and basically these economies are based on production, distribution and use of information and knowledge. Martazavi and Bahrami (2012), Kayhan (2010) approve Hitt *et al.* (2001) concept and believe that in entrepreneurship the existing compound products are developed in new methods, new products are commercialized or launched to new markets and new services are provided for customers. Also it was noticed, that Information and Communication Technology (ICT) influenced the fields of science based economies. In other words it approves that knowledge based economy, entrepreneurship and ICT technology innovations are the major factors of modern science and technology based companies' environment. Authors underlined, that organizations are required to identify opportunities, generate ideas and identify resources and direct the main focus in knowledge creation, new products and services and observe intellectual capacity to create new ideas. Meanwhile Landvall (2000) argues, that in the new economy the main attention would be paid to creating knowledge, new products and services not to allocating available sources, therefore it would be irrational for individuals and businesses if they apply their intellectual capacity to re-allocate resources because they can use their intellectual capacity to create new ideas.

Pure attention to university and technology cannot bring the knowledge-based economy, but with a broad and large vision it is possible to use all aspects of the planned economy and also the universal development of knowledge can make this way smoother to evaluate the needs of entrepreneurial activity.

Özdemirci (2011) analyzed the relations between corporate entrepreneurship and strategy process. It was defined, that terms such as intrapreneuring, corporate entrepreneurship, corporate venturing and internal corporate entrepreneurship have been used to describe the phenomenon of intrapreneurship, but the consensus on the concept of entrepreneurship involves creating value and developing opportunity through innovation via the human and capital resources and approves the fact that entrepreneurship is important in science based companies specially in new product innovation (Srivastava, Lee, 2010). Brehm and Lundin (2012) researches showed an additional interesting insight: in contrast to education and scientific research, entrepreneurial activities can serve as a substitute for absorptive capacity.

If to continue analysis of schematic STI system (see Figure 1), another S&T based company feature shall be performance and improvements in industry area taking into account science based cooperation. According to Ardèvol and Masllorens (2011), the theoretical approach is resource based view (RBV) of the firm (Barney, 1991). According to authors, theory states that the essence of the firms' strategy is defined by the own and unique set of resources and capacities of each firm, thus the strategy is spited into the opportunities provided by the environment and restrictions imposed by the organizational weaknesses and strengths, in other words internal assets and capacities. Malecki (1991) argues that innovative agents take part in multiple and complex network relationships with the aim of sharing and acquiring knowledge. In this sense, innovation can be described as a collective process that is increasingly interdependent and interactive.

According to Pathak (2002), Colyvas *et al.* (2002) absorptive capacity is one of the most important conceptual constructs that have emerged in the research on organization in the last decades. There are many researches done taking in consideration external knowledge development and the ways how to exploit them. The simplest way to overcome the first-mover strategy from competitor is to consult with core customers or suppliers about the implementations of performance improvement. That's could be the reasons of universities researches, funded by companies, to generate external spillovers (the impact of spillovers on R&D efforts is analyzed in next chapter).

Meanwhile internal factors were analyzed by Camisón and Forés (2007), who state that these factor are necessary but not sufficient to define the absorptive capacity of the firm. According to them, there is a clear need of an appropriate combination of internal and external assets, so absorptive capacity gets the highest rate of results and firm performance.

Ardèvol and Masllorens (2011) state that organizational factors affect the tendency to cooperate and identified three categories of them:

- structural factors, such as firm size or industry;
- external factors, such as the access and use of institutional support for innovation or the existence of market turbulences; and
- internal factors, such as the knowledge embedded in a firm's staff (identified as human capital) or its continuous engagement in R&D activities.

Authors also excluded three main motivations to cooperate:

- lack of internal resources,
- risk sharing, and
- search of complementarities.

In the theoretical approach these factors can be considered indicators of the determinants of science based cooperation. Ardèvol and Masllorens (2011) tried to validate it through the empirical application. It was logical regression used to model the propensity of firms to engage the science-based cooperation. The results show the key role played by absorptive capacity as a determinant of science-based cooperation activities among small and micro firms. Authors Ardèvol and Masllorens (2011) found two different sources of absorptive capacity: a set of internal factors and a set of external factors. The core internal factor is labor qualification (educational degree of employees); meanwhile the crucial element of external factor is institutional support as it can help these firms to strengthen their organizational knowledge and to give access to networks configured by more diverse members.

According to Pisano (2010), science-based businesses confront three fundamental challenges: (i) the need to encourage and reward profound risk-taking over long time horizons ("the risk management problem"), (ii) the need to integrate knowledge across highly diverse disciplinary bodies ("the integration problem"), and (iii) the need for cumulative learning ("the learning problem"). After the analysis, the fundamental lesson was defined, that while technological progress creates potential for economic growth, that potential can only be realized with complementary innovation in organizations, institutions, and management. After the analysis of technological and innovational progress, it was noticed that the science bases of medicine, agriculture, advanced materials and energy has a huge potential in the foreseeable future. In short, Pisano (2010) states, that we are once again confronted by a serious need to invent new organizational forms and new institutional arrangements to deal with a new set of economic problems.

5. The impact of spillovers on R&D efforts

During the analysis of S&T based company interaction with industry area environment, the strategic management problem appeared then incentives of firms to invest in research and development was analyzed. Vandekerckhove and Bondt (2007, 2008) took into account this problem and analyzed it through the sequential moves of companies. According to authors, there may be spillovers between leaders and between followers and also between these two groups of players. Critical spillover values are identified that drive the effects of cooperation in R&D as is the case in simpler settings. These S&T company strategic moves could be considered both as a feature of such kind of company and as a result when company is operating in S&T based environment. The nature of strategic investments is to maintain sustainable competitive advantage. According to different authors and empirical studies, this type of investment could have many forms starting from business and technological knowledge accumulation, product modification, production process or internal governance policies, etc. The important thing is that those investments could change the parameters of the market rivalry outcomes, could hurt or benefit competitors and forms may have an incentive to temper or exaggerate efforts for strategic reasons. According to Barney (2002), it is

well known that some players may attempt to be technological leaders to exploit so called first-mover advantages. Others may use a second mover approach and rely on their ability to quickly adopt what other firms demonstrate as valuable. That was the reason of Vandekerckhove and Bondt (2008) analyses, when authors tried to capture these related heterogeneities and looked at the industry with leaders and followers, with strategic R&D investments. There was d'Aspremont and Jacquemin (1988) model used in stage setting with sequential investment decisions followed by sequential output decisions, given symmetric or asymmetric spillovers (four group of spillovers were looked at: leader specific spillover, follower specific spillover, spillover from leaders to followers and spillover from followers to leaders). Authors found, that the symmetric spillover is usually having a negative impact on cooperative investments of leaders and followers, which is due to, respectively, the spillover from the leaders to the followers and the spillover from the followers to the leaders. With asymmetric spillovers, tendencies are, however, the same as in the two-stage models and help us to understand tendencies with symmetric spillovers. The second issue defined after the comparison of both symmetric and asymmetric spillovers, was that with symmetric spillovers, the leaders invest more than the followers, meanwhile with asymmetric spillovers, the spillover from leader to followers play a crucial role in the comparison of leaders' and followers' investments. Moreover, after the performance comparison of R&D cooperation and R&D competition, the results showed, that with symmetric spillovers, investments of leaders with R&D cooperation are higher than with R&D competition; meanwhile with asymmetric spillovers, critical leader-specific (follower-specific) spillovers determine whether the R&D cooperation enhances R&D investments compared with R&D cooperation. The most important role of this research, was that it is possible to analyze when followers tend to invest more than leaders and the results of cooperation among first and second movers.

6. S&T company identification and economic/financial assessment ratios

This part of the paper proposes a list of indicators presented in Table 2, what could be used for S&T based company identification. These ratios were created in accordance of S&T based company features and environment indicators in Table 1. Also it must be emphasized, that all ratios could be easily calculated in terms of data availability.

Table 2. STI Indicators

Indicator	Meaning/importance
R&D spending / Net sales	Amount of net sales, which equals to R&D spending. Basically is useful to measure the impact of R&D expenditure to net sales.
R&D spending / EBITDA	The efficiency of R&D products.
R&D spending / Employees	Amount of R&D spending for one company's employee.
Net sales / S&E degree holder	Amount of net sales for one science and engineer degree holder.
Net sales / PhD's	Amount of net sales for one PhD degree holder
Education spending / Spending	The level of education spending in comparison of all spending.
Innovation revenues / Revenues	The level of innovational revenues in comparison of all revenues.

Usually indicators could be divided twofold as quantitative and qualitative. In this instance, the quantitative ratios were presented; meanwhile qualitative ratios are difficult to measure. Thus the first constraint of this research is the impact of qualitative indicators. Such information as R&D department or even institutional support is very important (universities, suppliers, science parks, etc.). Also number of patents and international co-authoring should be evaluated. However, intensive communication with universities could determine no need of R&D department and conversely. In general, qualitative ratios could be used as a description in separate investigations. The second constraint of these ratios is the amount and/or value of quantitative ratios, e.g. less spending in comparison with net sales doesn't necessarily mean that company is less science and technology based. To conclude, these ratios are necessary but not compulsory conditions for science and technology based company and could be practically implicated by describing and identifying S&T based company.

7. Discussion

Research, development, innovations empower company to increase productivity by creating new products, improving quality of them or reducing existing costs. Even more, the STI affects society and its development level by growing GDP, creating and/or optimizing new jobs, increasing countries image in comparison with other countries and create a relevant environment for other businesses, which starts the circle again. Moreover, research, development and innovation could produce positive spillover effects in other companies, sectors, countries, which could be very significant in countries economy development. Technological innovation is a result of interaction of R&D and entrepreneurial dimensions, executed in the networks of knowledge creating organizations. Thus that shows the growing importance of timing, marketing, quality management, investments and etc. Because of this, it is very important to identify such kind of companies and environment issues, which are required to keep and maintain S&T and R&D activities. It is necessary to examine, identify and develop companies unique set of resources and capacities, to assimilate opportunities provided by the environment and avoid restrictions imposed by companies' internal assets.

After the brief overview of S&T companies in Lithuania, it was defined, that the importance of such kind of companies is growing. Thus the researches are faced to a problem how to identify and evaluate S&T based company. Regarding this situation, overview of STI system was done. It was noticed, that most important key issues were analyzed by Hall & Jaffe (2012). However, these indicators are used to analyze more S&T environment than S&T based company. In order to understand, how company is science and technology based, academic literature were overviewed and features of such kind of company were identified.

Theoretical propositions involves S&T based company features such as determinants of science based cooperation and the absorptive capacity as one of the most important conceptual constructs that have emerged in the research on organization in the last decades. Structural, external and internal factors defined, which affect the tendency to cooperate. Later the impact of spillovers on R&D efforts overviewed. However, these thesis are based on conceptual models and in reality we could face to different results that is way knowledge based science analysis, methods, indicators must be kept up to date. Even because of different country/sector/company or technology according to Chandlerian lessons 3 core problems must be solved – management, integration and learning. It could be stated, that all these facts and researches affects not only companies, but the environment these companies are operating in as well.

Finally, there were S&T based company identification and economic/financial assessment ratios defined (see Table 2). These ratios were created in accordance of S&T based company features, R&D environment and other key issues, which are important in research of such company. Also data availability condition was taken in consideration, thus all quantitative ratios are easily computed.

Finally, knowledge based development should not only be discussed in science literature or other writings, but even could be forecasted in different social settings have in influence in different economics and/or political issues. Moreover, it is important to evaluate the returns of investment in R&D, even to understand investment timing and technological and/or economic fluctuations, which could impact the performance of S&T companies. These challenges shall be analyzed in further research.

References

Barney, J. B. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management* 17 (1): 99–120.

Barney, J. B. (2002). Gaining and Sustaining Competitive Advantage. *Upper Saddle River: Prentice Hall.*

Brehm, S. & Lundin, N. (2012). University–industry linkages and absorptive capacity: an empirical analysis of China's manufacturing industry. *Economics of Innovation and New Technology,* 21:8, 837-852. doi:10.1080/10438599.2012.687503

Bronwyn, H. H. & Jaffe, A. B. (2012). Measuring Science, Technology, and Innovation: A Review. *University of California at Berkeley and University of Maastricht*.

Bronwyn, H. H., Mairesse, J. & Mohnen, P. (2010). Measuring the Returns to R&D. *Série Scientifique, Scientific Series, Montréal, Janvier*.

Chandler, A. D. Jr. (1992). Organizational capabilities and the economic history of the industrial enterprise. *Journal of Economic Perspectives,* 6(3), 79–100.

Clarke, T. (2001). The knowledge economy. *Education + Training*, Vol. 43.

Colyvas, J., Crow, M., Gelijns, A., Mazzoleni, R., Nelson, R. R., Rosenberg, N. & Sampat, B. N. (2002). How Do University Inventions Get into Pratice? *Management Science* 48 (1): 61–72.

Erken, H. & Kleijn, M. (2010). Location factors of international R&D activities: An econometric approach. *Economics of Innovation and New Technology* 19: 203–32.

European Commission (2004). *Research and Innovation Union scoreboard*.

Fernández-Ardèvol, M. & Masllorens, J. L. (2011). Determinants of Science-Based Cooperation: Evidence in a Sample of Small and Micro Firms. *Managing Global Transitions 9 (4):* 319–333.

Haq, S. M. K. (2012). Knowledge-based Development and Its Relation to Economic Prosperity in Developing Countries. *Asian Social Science;* Vol. 8, No. 12. doi:10.5539/ass.v8n12p36

Hülsbeck, M. & Lehmann, E. E. (2012). Academic entrepreneurship and board formation in science-based firms. *Economics of Innovation and New Technology,* 21:5-6, 547-565. doi:10.1080/10438599.2012.656525

Jakšić, M. L. & Jakšić, M. (2012). Entrepreneurship in the knowledge based economy – The case of Serbia. *Megatrend Review.* Vol. 9 Issue 1, p35.

Kayhan, T. (2010). Effect of customer orientation and entrepreneurial orientation on innovativeness: Evidence from the hotel industry in Switzerland. *Tourism Management,* Vol. 31 pp. 221–231.

Kriaucioniene, M. (2009). The Features of Science and Technology Knowledge Based Entrepreneurship in Lithuania. *Social Sciences* (1392-0758), Vol. 63 Issue 1, p28.

Landvall, B. A. (2000). The Learning Economy: Some Imlication for the Knowledge Base of Health and Education System. *In knowledge Management in Learning Society, OECD Press*.

Lane, P. L., Koka, B. & Pathak, S. (2002). A Thematic Analysis and Critical Assessment of Absorptive Capacity Research. *Academy of Management Proceedings* 1:1–7.

Leichteris, E. (2008). Analysis of activities of science and technology parks and proposals to improve their effectiveness. *Lithuanian Ministry of Economy*.

Leydesdorff, L. (2002). Indicators of Innovation in a Knowledge – based Economy. *International Journal of Scientometrics, Informetrics and Bibliometrics* Vol. 5.

Lithuanian Department of Statistics. Retrieved from: <http://www.stat.gov.lt>.

Malecki, E. J. (1991). Technology and Economic Development: The Dynamics of Local, Regional and National Change. *London: Longman*.

Mortazavi, S. H. & Bahrami, M. (2012). Integrated Approach to Entrepreneurship – Knowledge based Economy: A Conceptual Model. *Procedia - Social and Behavioral Sciences* 41, 281 – 287.

Özdemirci, A. (2011). Corporate Entrepreneurship and Strategy Process: A Performance Based Research on Istanbul Market. *Procedia Social and Behavioral Sciences* 24 (2011) 611–626. doi:10.1016/j.sbspro.2011.09.068

Pisano, G. P. (2010) The evolution of science-based business: innovating how we innovate. *Industrial and Corporate Change.* Volume 19, Number 2, pp. 465–482.

Shane, S. (2002). Selling university technology. *Management Science,* 48, 61–72.

Srivastava, A. & Lee, H. (2005). Predicting order and timing of new product moves: the role of top management in corporate entrepreneurship. *Journal of Business Venturing.* 20, p.461.

Vandekerckhove, J. & Bondt, D. R. (2007). Asymmetric spillovers and sequential strategic investments. *MSI Research report 07.05, Leuven, Department of Managerial Economics, Strategy and Innovation, Catholic University of Leuven*.

Vandekerckhove, J. & Bondt, R. D. (2008). Asymmetric spillovers and investment research and development of leaders and followers. *Economics of Innovation and New Technology,* 17:5, 417-433. doi:10.1080/10438590701356041

Wright, M., Mosey, S., Noke H. (2012). Forthcoming. Academic entrepreneurship and economic competitiveness: Rethinking the role of entrepreneurship. *Economics of Innovation and New Technology.* doi:10.1080/10438599.2012.656528