

Levi-Jakšić, Maja; Jovanović, Milica; Petković, Jasna

Article

Technology Entrepreneurship in the Changing Business Environment – A Triple Helix Performance Model

Amfiteatru Economic Journal

Provided in Cooperation with:

The Bucharest University of Economic Studies

Suggested Citation: Levi-Jakšić, Maja; Jovanović, Milica; Petković, Jasna (2015) : Technology Entrepreneurship in the Changing Business Environment – A Triple Helix Performance Model, Amfiteatru Economic Journal, ISSN 2247-9104, The Bucharest University of Economic Studies, Bucharest, Vol. 17, Iss. 38, pp. 422-440

This Version is available at:

<https://hdl.handle.net/10419/168925>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<http://creativecommons.org/licenses/by/4.0/>

**TECHNOLOGY ENTREPRENEURSHIP IN THE CHANGING BUSINESS
ENVIRONMENT – A TRIPLE HELIX PERFORMANCE MODEL****Maja Levi Jaksić¹, Milica Jovanović^{2*} and Jasna Petković³**¹⁾²⁾³⁾ *University of Belgrade, Faculty of Organizational Sciences, Belgrade, Serbia***Please cite this article as:**

Levi Jaksić, M.L., Jovanović, M. and Petković, J., 2015. Technology Entrepreneurship in the Changing Business Environment – A Triple Helix Performance Model. *Amfiteatru Economic*, 17(38), pp. 422-440

Abstract

In this paper the contribution of technology management and entrepreneurship to sustainable development is emphasized and the Triple Helix (TH) model is used to analyse the performance of different actors in accomplishing the activities of Technology Innovation Management and Entrepreneurship (TIME). By analysing TH model (Government – University – Industry) in relation to accomplishing TIME main functions: Planning, Organizing and Control (POC), we created a general model which measures TIME effectiveness related to the key elements of the TH model. The general model – TMD-TH (Technology Management and Development – Triple Helix) represents the framework for further more specific research into the relations of the observed dimensions. From the general model, three sub-models are excluded: TMD-G (Government), TMD-U (University) and TMD-I (Industry), and each of TH dimensions is observed by a set of indicators classified from the perspective of the specific function (POC) of TIME. This provides better categorization of TIME indicators and linkage with the actors in the TH model. The applicability of the suggested general model was tested by a set of indicators at the example of Serbia, Austria and Finland and comparison of these countries was made from a perspective of innovativeness and sustainable development. Since technology, innovation and entrepreneurship are considered as the main forces leading to sustainable development at different levels of the economy and society, it is of paramount importance to develop our capacities to better monitor, analyse and develop these forces. A model is developed with a set of indicators that enables the systematic analysis in concrete situations in practice. In this paper, the model is applied at the level of the national economy, the results obtained point to the most critical activities of the actors in the TH model in accomplishing TIME. The performance model represents a base for developing policies and strategy better tuned to the urgent needs of the economy and society in developing TIME directly related to accomplishing a higher level of sustainable development.

Keywords: Changing Business Environment, Entrepreneurship, Technology and Innovation management and entrepreneurship (TIME), Triple-Helix (TH) concept, Sustainability, General model, Performance Indicators

JEL Classification: I23, O32, Q01

* Corresponding author, **Milica Jovanovic** – milica.jovanovic@fon.bg.ac.rs

Introduction

Today's global business environment is characterized by exponential and unceasing technological development and growth. Thus, reaching competitiveness at the global level (whether of an enterprise or a country) is highly correlated with successful management of innovation, technology and change. Innovation and technology became one of the main components of every developed strategy whether we talk about firm, industry or national economy. Its importance was examined by (White and Bruton, 2007), who stated that technology management and entrepreneurship are crucial because of: (a) the rapidness of technological changes which demands cross-discipline approach; (b) the rapidness of technological development and increasing consumers sophistication, which have shortened life cycles of products; (c) the necessity to cut time for developing product and create more flexibility within organizations; (d) the need to maximize competitiveness by using new technologies in effective manner because of increased international competition; (e) the necessity to change management tools caused by rapid technology changes. All of these dimensions of TIME importance are highly correlated with the concept of entrepreneurship. Therefore, in order to have a competitive force which will lead to sustainable development it is not only technology that matters, but also Technology Innovation Management and Entrepreneurship (TIME). Capacities for measuring and observing performance are crucial for successful TIME, but it is not a simple requirement since the activities of TIME are interconnected, delay related to effects of research and development (R&D) investments, etc. Theory and practice both showed that, since sustainable new technologies and innovation are fundamental for economic, societal and technological growth, TIME is becoming a key component for reaching sustainable development. Also, it is managing technology, per se, is becoming at least equally significant (or even more significant) as the technology capacity. Because of that, determination of the future TIME priorities relies on measuring indicators at the level of national economy, economy sectors and companies. By tracking these values it is possible to set and accomplish TIME efficiency and effectiveness at different perspectives and levels. Classification of indicators by the Triple Helix concept (Etzkowitz and Leydesdorff, 1995) is suitable for sustainable development and entrepreneurship because this perspective obliges a comprehensive, complete approach. The TH is based on the concept of the Entrepreneurial University, and it comprises the hybridization of three dimensions/elements: University, Industry and Government in order to generate new institutional and social formats for the production, transfer and application of knowledge (The Triple Helix Concept, 2013). The TH is based on the concept of the Entrepreneurial University, and it comprises the hybridization of three dimensions/elements: University, Industry and Government in order to generate new institutional and social formats for the production, transfer and application of knowledge (The Triple Helix Concept, 2013). Thus far, indicators related to R&D activities, level of innovation implementation and technology changes intensity were mostly used measures of TIME development, but the practice and theory (Mirchev and Dicheva, 2013; Pearce, Grafman, Colledge and Legg, 2008) showed the necessity for an overall methodological approach. Therefore, in this paper, we suggest the general TIME model, a model of sustainable technology and innovation management and entrepreneurship, which systematizes TIME indicators according to the Triple Helix (TH) actors classified by basic management functions of planning, organizing and control (POC).

This research is based on following hypothesis and assumptions:

General hypothesis:

1. TIME is as significant as technology development, per se, for achieving sustainable development, and

Special hypothesis and assumptions:

1. The triple Helix concept is a basic sustainability model and indicators of TIME are set up according to the dimensions of TH (University, Industry, Government),

2. Functions of TIME (Planning, Organizing, Control), classified according to TH dimensions, provide the creating of the comprehensive, general model,

3. The general model with feedback relations is valid for application in making effective decisions in strategic management in the state, university and industry areas.

4. It is possible to have a more effective strategic analysis, creation and implementation of strategies and policies with concrete tasks for government, industry and university (TH) related to the functions of planning, organizing and control (TIME), by applying the model with classified indicators in practice.

In this paper, a new model is created for measuring sustainability of technology and innovation management in relation to entrepreneurship. The model is general cross-functional model TMD-TH, based on two concepts: (1) Triple Helix concept of three dimensions: Government, University and Industry; (2) management and entrepreneurship concept of three fundamental functions – planning, organizing and control. The authors point out the interrelatedness between TIME, and basic TH actors and develop such a model that enables monitoring, analysis and strategy leading to higher overall entrepreneurial performance and sustainability.

1. Literature review

Creating knowledge-based economy and social club in the traditional sense is not sufficient for significant economic and social growth and progress. In literature and practically it has been identified that, although investment without any doubt has the main role in new economic and knowledge progress, linkage of economic progress, global competitiveness and new employment opportunities is missing (Levi Jakšić, Marinković and Petković, 2011a). As stated in (Kriščiūnas and Greblikaitė, 2007) knowledge-based economy is highly entrepreneurial, and absence of knowledge about new inventions and new technology means the absence of entrepreneurs in society because knowledge initiate entrepreneurial behaviour, and thus entrepreneurship is one of the most important factors of knowledge-based economy. Entrepreneurship in knowledge-based economy is becoming a scientific problem, because of the mutual impact of modern entrepreneurship and economic sustainability (Kriščiūnas and Greblikaitė, 2007). By United Nations (2012) enterprises which focus their activities of the application of Research and Development, are a pillar of knowledge-based economy. They claim that “the uninterrupted cycle of innovation and successful commercialization of its results is largely determined by the intensive collaboration of major stakeholders, that is institutions of applied research, private innovative companies and government agencies establishing framework conditions for this process”. Also, in this document, the main problem of the innovation process is identified to be a lack of communication between industry and science. As a consequence, it causes

restrains of private investment in R&D which leads to insufficient number of inventions by universities and other research institutions.

In 1950s a new phenomenon was detected: increase of physical capital investments with simultaneous decrease of productivity indicators. This, so-called “productivity paradox” (Bailey and Chakrabarti, 1988) and the fact that intangible elements were neglected showed the necessity for a new perspective. In 1960s, these “soft” elements, previously developed in Japan, were pouring into European countries (Sweden, Germany), and in the 1970s continued toward the United States and refocused towards intangible assets. It was found that productivity decreased because ideas, knowledge and creativity were neglected while physical investments were increasing. This was evidence of inevitability of technology components and knowledge in models of economic progress (Levi Jakšić, 2011). Researchers quickly pointed the common success denominator: shifting from physical capital toward the capital of knowledge: technology, science, ideas and creativity (Acs, Audretsch and Strom, 2009). Since, knowledge alone was not enough for creating competitive advantage, technology emerged as the integrative concept since it consists of both tangible (physical) and intangible elements. This afforded a novel position for understanding the competitiveness forces in the detailed analysis of the factors relevant to technological development. As already mentioned, in Europe – “as measured by the most common benchmarks of knowledge investments, such as R&D, university research, patents, human capital, education, creativity and culture, Sweden has ranked consistently among world leaders. However, following more than a decade a stagnant growth and rising unemployment, concerned policymakers in Sweden started to worry about what they termed as “the Swedish paradox” (Acs, Audretsch and Strom, 2009). Besides this term, one another emerged, “the European Paradox” determining the stagnation of economic growth regardless of the high level of knowledge investments (Acs, Audretsch and Strom, 2009). New methodology approaches include not only focus on soft elements in the form of intangible elements, but also entrepreneurship, leadership, principles and practices of management and appearance of the technological dimensions (rather than technical) in terms of achieving a high level of competitiveness (Levi Jakšić, 2011). According to (Mirchev and Dicheva, 2013) “technology entrepreneurship is uniting the efforts of science and business in the discovery of new technologies or the improvement of existing ones in industrial enterprises with the purpose to enhance the quality of life of people and the satisfaction of newly originated needs”.

Encouraging linkage of science and industry fosters innovation-based entrepreneurship and this could be performed by open innovation projects, which develop cooperation in R&D and ensure more effective commercialization of entrepreneurship. From another perspective, universities also need feedback on their performance, and since rankings are shown to be unreliable (Jovanović, Jeremić, Savić, Bulajić and Martić, 2012), education institutions have to rely on industry to provide them with guidelines for new development directions. In order to encourage collaboration of industry and scientific community it is necessary to foster technology transfer from universities to the private business sector. Also, to achieve this cooperation, scientific institutions should include entrepreneurship in their curricula, and, on the other side, business subjects should be more actively included in creating those curricula by including market requests and their experiential knowledge. Also, cooperation between these two sectors could be fostered through the mobility of employees from both sectors and another possibility is to induce academic entrepreneurship by spin-offs (United Nations, 2012).

Examining the situation in Serbia, one of the most serious problems in science, by (Government of Serbia, 2010), is the poor investments distribution, where the majority of investment (mainly from one fund) are invested in fundamental research, for which 50.2% of budget of the Ministry of Science and Technological development was allocated, and technological development projects (39.2% of the Ministry funds) but very small amount is invested in applied research. Although there were 501 fundamental research projects, 129 innovation projects and 471 projects related to technology development, the number of patent applications from R&D has been extremely low, 54, which placed Serbia in the last position among European countries. The same difficulties were detected in Europe also: “*The Europe 2020 strategy clearly signalled the importance of industrial competitiveness for growth and jobs as well as for Europe’s ability to address grand societal challenges in the coming years. Mastering and deploying Key Enabling Technologies (KETs) in the European Union is central to strengthening Europe’s capacity for industrial innovation and the development of new products and services needed to deliver smart, sustainable and inclusive European growth*” (European Commission, 2011).

The situation of difficult translation of newly created knowledge into merchantable product The High-level expert group (HLG) recognized as “valley of death” issue. This gap affects interruptions of value chains impacting in that way the overall sustainability of strategic sections in Europe. Lack of regulations, insufficient R&D and political support and absence of large investments are causing this problem. There are three possible strategies for crossing the valley (European Commission, 2011):

1. *Technological research* – focused on transforming concepts which are the results of fundamental research into technological solutions competitive at the global level.
2. *Product demonstration* – focused on use of KETs in order to make European prototypes of products and processes more competitive at the global level.
3. *Competitive manufacturing* – focusing on advanced manufacturing of product prototypes developed in the previous stage in order to make economic environment more attractive based on industries that are competitive at the global level.

The HLG detected that the biggest issue in European R&D is the valley and the step between basic research ideas and competitive production of KETs, although this sector has a significant number of new KETs. This indicates that the both EU and its Member States are too focused on basic research, and that they neglected enabling innovation in the EU. Appliance of these innovation chain stages, proposed by the HLG, can generate a virtuous cycle starting with the creation of knowledge to market flow, which provides the feedback for supporting the creation of knowledge, thus strengthening European economic development.

Innovation, as opportunity for creating new business, is at the core of entrepreneurial efforts and therefore all the relevant actors in the business environment are analysed according to their support to innovation and innovativeness. It is noted that the institutions play a critical role in the promotion of innovation. The concept of national innovation systems is developed with the goal to identify the relevant actors in the business environment and their contribution to the overall innovation processes. Universities are cited as critical institutional actors in national innovation systems (Mitra, 2011). The focus is on changing university environment for business academic education, especially developing and introducing technology innovation management and entrepreneurship knowledge and skills in high education study programs. Emphasizing the new,

contemporary roles of universities, the Triple Helix concept was created as the general framework which highlights the grid of institutions in the entrepreneurship and innovations (Levi Jakšić, Marinković, Petković and Kojić, 2012). By this concept, manufacturing is not the post-industrial driving force of economic development, and the generation and distribution of socially organized knowledge have the main role in generating an economy's competitive advantages. Further, organizations that create knowledge progressively have a more important role in the grid of relations among the crucial actors: Government, University, and Industry (Etzkowitz, 2007). Knowledge-based system can be viewed as a result of collaboration between various social coordination mechanisms, such as market, knowledge production and governance at interfaces (both public and private). On the other hand, the TH concept, based on the relations of its actors, produces a heuristic for examining these complex dynamics referring to developments in the institutional networks among the carriers (Leydesdorff and Meyer, 2006). Those components should create new social and institutional forms which should influence creation, transfer and application of knowledge. As identified by Ivanova and Leyersdorff (2012), activities and elements of these three entities are overlapping progressively, and in some parts of intersections, the actors can even substitute each other partially. In Figure no. 1 are presented relations between TH elements which are identified to be bilateral (when two sectors are overlapping, and there is no overlapping between all three of the sectors) and trilateral (when we have overlapping between each two sectors and also **all three** of the sectors).

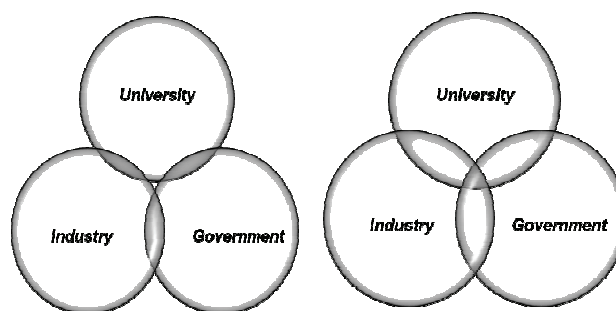


Figure no. 1: Bilateral and trilateral overlapping in a Triple Helix configuration

Source: Leydesdorff, 2012.

In both situations, although they have mutual activities, the relationships are in transition because each actor also develops its own mission. Because of that, a balance of activities can be created as integration or differentiation, and there could be examined and potentially shaped some forms of synergies (Leydesdorff, 2012). TH does not use each component separately: it can combine economic forces, regulations and research inventions and observes the dynamics two (bilateral) or even all three components (trilateral).

The most explored topic related to the TH concept is the role universities have in contemporary changing business environment and knowledge-based system. It is explored from different perspectives, at the level of: sectors, regions, countries, etc. (Godin and Gingras, 2000; Shinn, 2002). Some research studies (Levi Jakšić, Marinković and Kojić, 2012; Čudanov, Săvoiu and Jaško, 2012), confirmed the thesis of the existence of a continual necessity to examine the role of the universities in society. There is a special

emphasis on the role universities have in practice and compliance of study programs at different educational levels and practical knowledge requests of the market. TH is based on the concept of Entrepreneurial University, which states that “it takes a pro-active stance in putting knowledge to use and in creating new knowledge” (H-STAR, 2013). TH concept assigned the leading role to universities because it assumes that the knowledge they produce and transmit is useful enough to be widely shared and applied. Also, the appliance of the knowledge created at universities should lead to national development. In brief, we can say that every TH component has its role from a perspective of entrepreneurship: Industry is the place of production; Government is the public entrepreneur which creates contractual relations and assures stable interactions and exchange, and, the University is the creator of knowledge and technology, the generative principle of knowledge-based economies (Triple Helix Conference, 2011). We saw in Figure no. 1, that the boundaries between these institutional elements are blurred because, by producing applicable knowledge and sharing it to all key players in socio-economic system, University accept its entrepreneurial role. On the other hand, in order to assure the prosperity, the role of Industry is also to produce new knowledge and not only apply the one generated by universities. Finally, by creating a framework of regulations, the Government has the task to enable effortless interactions of University and Industry for their successful cooperation. Some studies (Saad and Zawdie, 2011) also claim that developing countries have the challenging request to realize the TH concept in practice, and in that way create a base for sustainable system and reduce poverty. Thus, it is essential to measure the performance within each TH component in a country, and further to define indicators and quantitative measures for each of the three. In this paper, we develop an overall model which that examines all of the three components, then focuses on each component separately, and tested it in practice by measuring the performance of three countries.

2. Methodology

Technology and Innovation management is a process of planning, organizing, leading, directing, organizing, coordinating and control all activities related to technology and has the goal to provide continuous success. It involves both strategic and operational activities: strategic – management of innovation, R&D activities, technology transfer; operational: management of *specific* technology system, processes and operations within implemented technology (Jakšić, Marinković and Petković, 2011b). TIME is a crucial success factor for enterprises, sectors, economies and regions because it emphasizes a set of competencies in the competency based competitiveness approach.

Taking into consideration the importance of TIME, and the overall approach of the TH concept, a cross-functional TIME model was created (Figure 2). This model has two basic dimensions: the TH dimension with three clusters/elements of the TH concept (Government, University and Industry) and TIME dimension in which we use its basic functions (Planning, Organizing, Control – POC). Within each TH cluster we examine the POC functions of TIME and measure its performance. In this way, in every cluster can be observed its current state, flaws, advantages and there could be set priority areas and activities a system (state) should perform in order to achieve sustainability. Established in this way, the feedback from this model can also be used as a tool for making effective strategic decisions within the observed system.

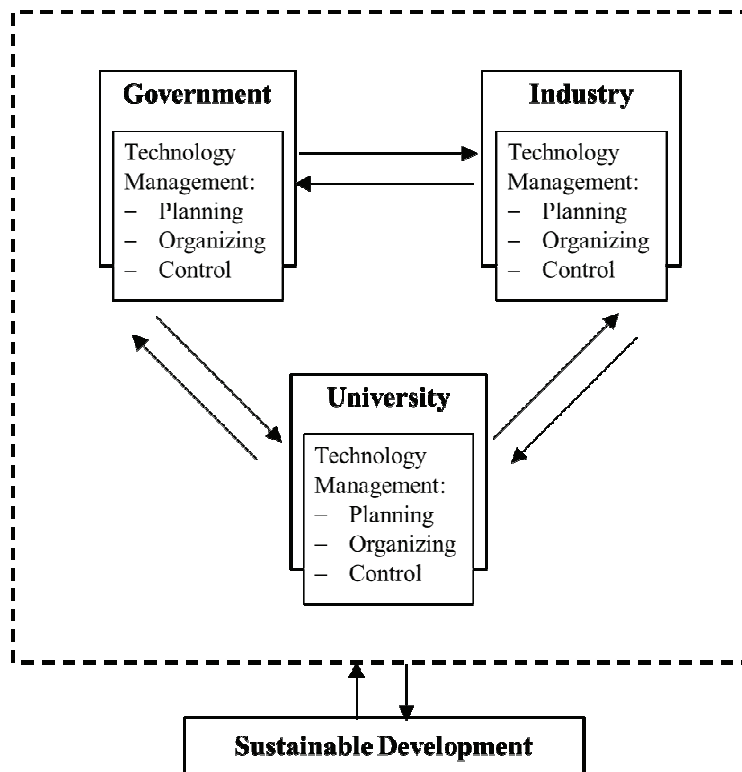


Figure no. 2: Cross-functional TIME model

Source: authors

For better understanding of the proposed model, we created a closer look at the model based on system approach shown at Figure no. 3. Within every TH cluster we measure the performance of POC functions by the presented model. Planning is observed as input activity. In this section, we measure investments and infrastructure related to TH component in which we perform measuring. Organizing is considered as process activity which transforms inputs into outputs of the observed TH component. Control is the output activity where the results of transformation of inputs are measured. Finally, as every system requires a feedback, in this case it is crucial for making decisions for further planning and investments, which is a key step in the process of achieving/enhancing sustainability. The most challenging step in the appliance of this model is the separation of measures and indicators of TH clusters, since, as already mentioned in the previous section, there are progressive overlapping and so-called “grey zones” of the cluster’s influence on indicators. In this case, it will be inevitable to repeat indicators within each cluster they have influence on, but determining the weights of the indicators within each cluster.

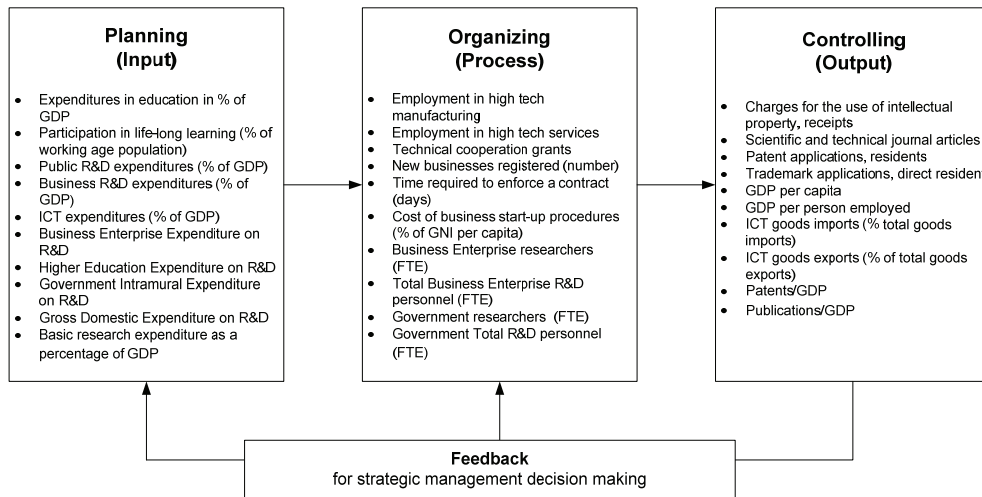


Figure no. 3: Technology Innovation Management and Entrepreneurship Model (Indicators taken from World Bank,2014; European Commission, 2009; Eurostat, 2014b; OECD,2014)

Source: authors

Further, in Figure no. 4 we decomposed suggested model for each TH component, and every sub-model consists of its own TIME performance indicators.

If we examine the benefits of the model defined in a presented way, it not only classifies and systematizes the indicators, but also examines the relations and mutual influence of these groups of indicators. This model enables measuring performance of TIME at the state level, the level of national economy. Also, indicators of the developed model are applicable in most cases, with some differences depending on the characteristics of the environment. On the other hand, this model has certain drawbacks. Firstly, we mentioned the problem of explicit separation of indicators within each TH cluster, which may be difficult when the indicator has an impact on more than one component. Also, indicators used in this model should be relevant, quantitative, measurable and with available data. In model suggested on Figure no. 3 there were no explicit definition of indicators, the list was not closed and in the model presented in Figure no. 4 the explicit classification was not performed. Further research will be focused on solving these two problems: identification of indicators for each TH cluster, by each POC function, relying on indicators measured by Eurostat, European Innovation Scoreboard (EIS) World Bank, OECD and similar organizations.

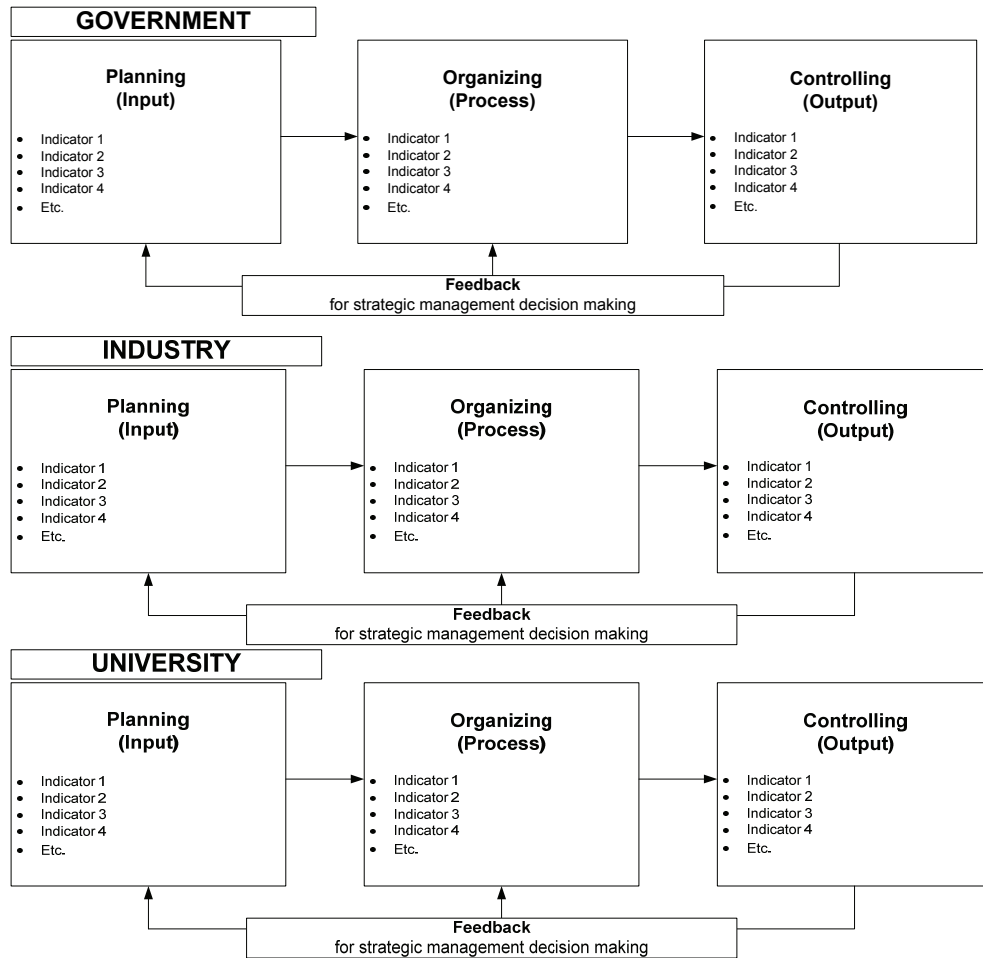


Figure no. 4: Sub-models of TIME model for each TH cluster
 Source: authors

3. Results and discussion

In order to test the proposed model, we selected a set of indicators from every TH component, and classified them according to TIME model. In Table no. 1 we have the list of selected indicators with corresponding TIME function. As a feedback, we took the official indicator of a country’s competitiveness of World Bank – Global Competitiveness Index (GCI) (World Economic Forum, 2012a). This indicator provides information about both macroeconomic and microeconomic aspects of each economy, since it is compounded by over 100 indicators that are measuring key parts of these aspects. In order to get the whole image of a country’s competitiveness and sustainability in the global market, it is very important to include each of these aspects, because they both have great influence on its position and ranking among other countries. This indicator “contributes to an understanding of the key factors that determine economic growth, helps to explain why

some countries are more successful than others in raising income levels and providing opportunities for their respective populations, and offers policymakers and business leaders an important tool for formulating improved economic policies and institutional reforms” (World Economic Forum, 2012b).

Table no. 1: Selected indicators for testing cross-functional TIME model

Planning	Organizing	Control
Expenditure per student, tertiary (% of GDP per capita)	Researchers in R&D (per million people)	Charges for the use of intellectual property, receipts (BoP, current US\$)
R&D expenditure (% of GDP per capita)	Personnel in R&D by sector	ICT goods exports (% of total goods exports)
R&D Expenditures by science field (% of total R&D expenditures)	Cost of business start-up procedures	ICT service exports (% of service exports, BoP)
R&D Expenditures by sector (% of total R&D expenditures)	Time required to start a business (days)	Patent applications, residents
	Start-up procedures to register a business (number)	Number of publications per researcher
	Teaching staff in total tertiary per 1000 people	Number of new business registered
		New density
GCI		

Source: authors

In order to have more relevant test, we conducted data for three countries: Serbia, Austria and Finland, and analysed achieved scores. Serbia, since the authors are familiar with the characteristics of the environment, and Austria and Finland because these two countries were ranked in top 20 countries, according to The Global Entrepreneurship & Development Index (GEDI) (Global Entrepreneurship & Development Institute, 2014). The results were observed for the year 2011, since this was the most recent year with the complete data for all of the indicators.

Considering input data or planning indicators, we have the results on Figure no. 5. Results of planning indicators show that, among three countries, Serbia has the highest percent of investments in tertiary education, but the lowest score on expenditures in R&D, in which Finland has the highest score. If we examine the structure of R&D expenditures, it can be seen that in Serbia, most expenditures are in basic research, and the least amount is in experimental and applied research while in the other two countries the situation is completely different, where the priority is in experimental research, then applied research, and the lowest priority has the basic research. Considering sectors in R&D expenditures, Serbia again has a completely different structure than Austria and Finland. In Serbia, R&D expenditures mainly come from Higher education, and the least amount is from Business sector (less than 10%), while in Austria and Finland, R&D expenditures are primarily from Business sector, with about 70% of total R&D expenditures in both countries.

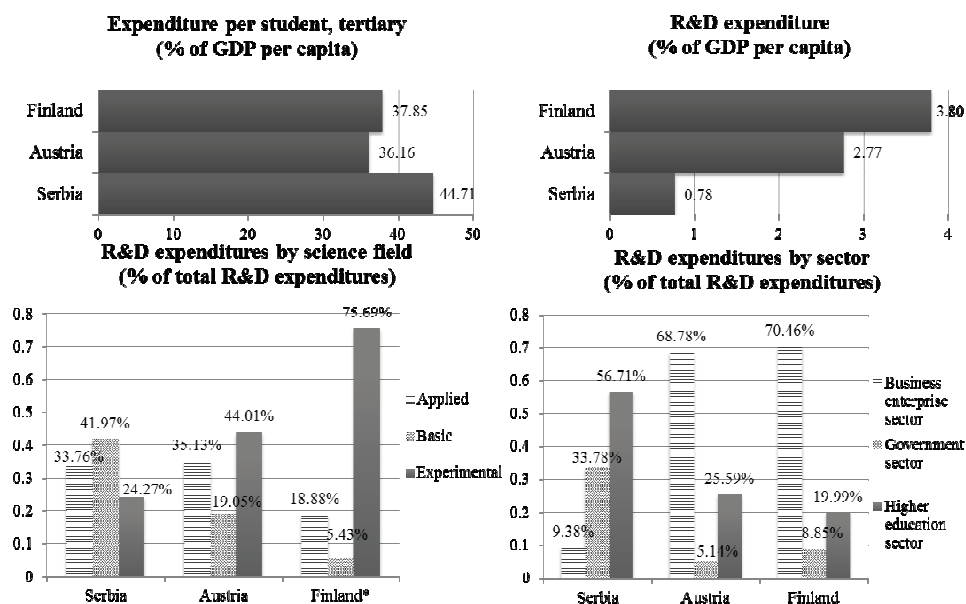


Figure no. 5: Results of planning (input) indicators

Source: World Bank, 2014; Eurostat, 2014c.

Results of organizing cluster (Figure no. 6) show that in Serbia, there are the highest costs of business start-up procedures, 7.8% of GNI per capita, while Finland has the lowest costs of 1% of GNI per capita. In Austria it takes 25 days to start a business, while Serbia has the shortest period of time for starting a business since its average duration is 13 days. Austria also has the highest number of start-up procedures 8, while Finland has, in average, 3 procedures to register a business. Considering personnel included in science and research, Finland has the highest number of researchers per million people, 7,422.9, while in Serbia there are 1,221.15 researchers in R&D per million people. The structure of those researchers is similar in Austria and Finland, where most researchers come from Business enterprise sector, more than 50%, and in Serbia there is a situation that it has less than 5% (2,6%) from Business enterprise sector, and the highest percent of 66% in High education sector. Also, in tertiary education, Serbia has the highest number of teaching staff per million people, 6,773.75, while Austria has the lowest number with 1,767.27 teachers per million people.

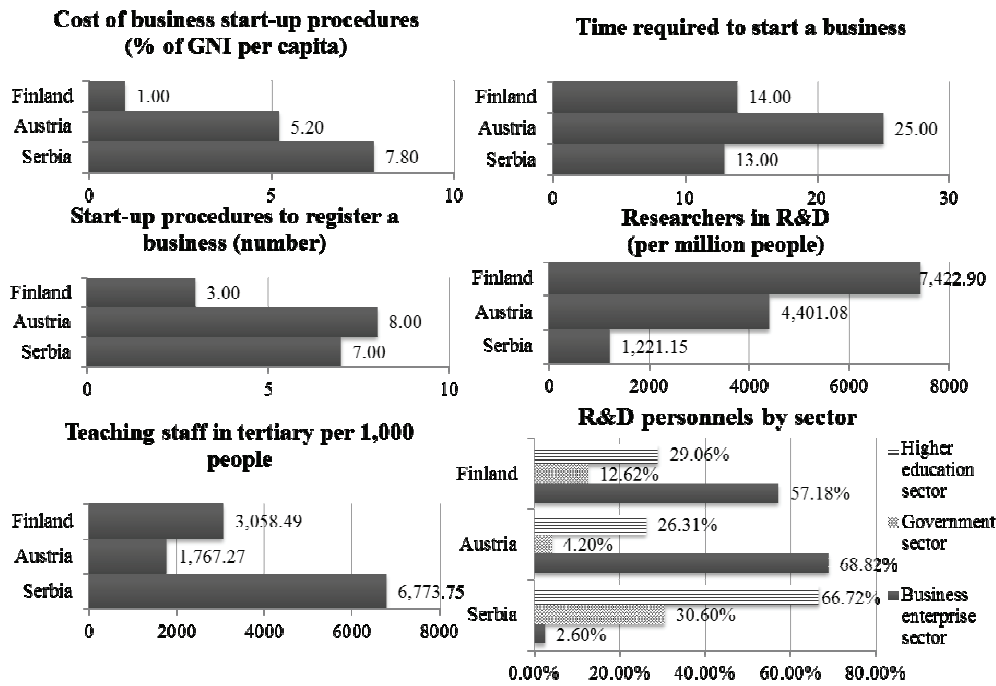


Figure no. 6: Results of organizing (process) indicators
Source: World Bank, 2014; Eurostat, 2014c; Eurostat, 2014a.

To have a complete picture, an analysis of control indicators is made, and the results are shown in Figure no. 7. As we said in the methodology section, in this part we have the indicators which should be the results of planning and organizing activities. Finland has the highest charges for the use of intellectual property, 3,187.72 million of US\$, and Serbia has a far lower amount of 56.90 million of US\$. Finland also has the highest percent of ICT goods export with 4.92% of total export, while Serbia again has the lowest score with 1.42%. When it comes to ICT service exports, the situation is slightly different, and the lowest score has Austria, with 28.58% of total service exports, while Finland again has the highest score of 42.63% of total export. Patent applications of residents are the highest in Austria, 2,154, while Serbia again has very low score, compared to the other two countries with only 180 patent applications. But, when it comes to the number of publications per researcher, Serbia has the highest score of 0.482 publications per researcher, and Finland had the worst score of 0.33. According to new density (the number of newly registered companies with limited liability per 1,000 working-age people), Finland again has the highest score of 2.62, and Austria had the lowest of 0.58.

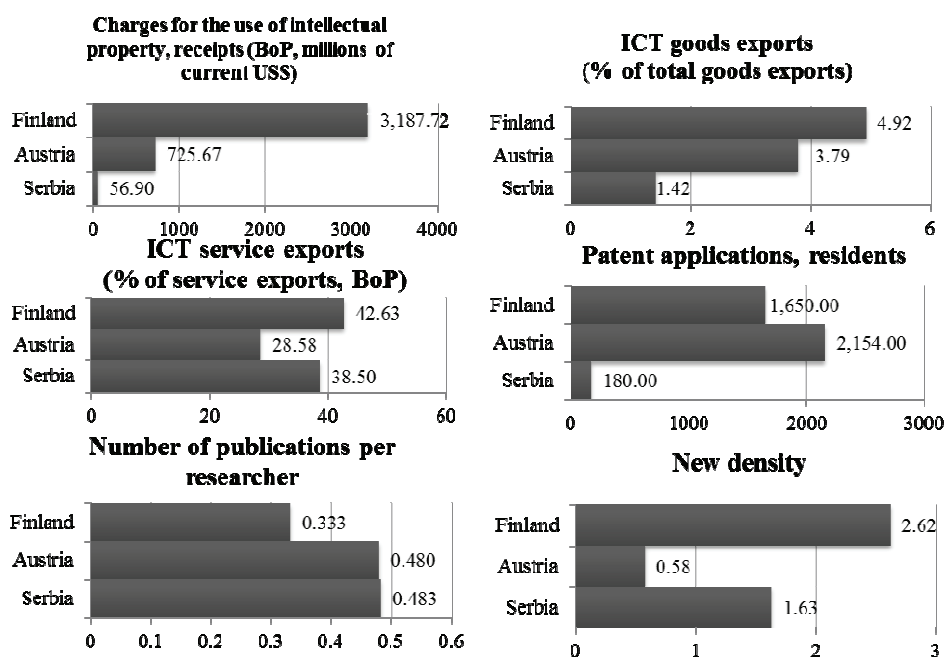


Figure no. 7: Results of control (output) indicators

Source: Eurostat, 2014c; World Bank, 2014; Doing Business - World Bank, 2013.

At the end, as a feedback, we give achieved score of the countries from World Competitiveness Report, according to World Competitiveness index, as a measure of achieved sustainability and innovativeness which is given in Table no. 2. Finland had the highest rank in 2011, as the 3rd country, according to WCR 2012-2013, Austria was ranked 16th, and was the second among the three selected country, and Serbia had the lowest score, as 95th country. With the provided classification of indicators we can examine what lead to these rankings. Although Serbia had higher amount of expenditures in tertiary education, it had a much lower amount of R&D expenditures of total GDP in comparison to Austria and Finland. Also, the structure of those expenditures is completely different, so the most expenditure were made in Higher Education, and not in Business Enterprise sector, as it was the case in Austria and Finland.

Table no. 2: GCI score

	GCI 2011
Finland	3
Austria	16
Serbia	95

Source: World Economic Forum, 2012b.

From another perspective of R&D expenditure structure, Serbia has the most investments in basic research (as had also been stated in The Ministry of Serbia Report (Government of Serbia, 2010) while Austria and Finland primarily focused on experimental research.

Considering process cluster, it is identified that although Serbia has the highest number of tertiary teachers, it has a low number of researchers in R&D, also, the most of these researchers are again in Higher education sectors, while in the two countries with better competitiveness score the most researchers are in Business enterprise sector. On the other hand, in Serbia there are no issues when registering a new business, considering the amount of time and procedures, but the costs are higher than in other two countries.

To summarize, in order to achieve a higher level of innovativeness, Serbia has to focus primarily on its inputs cluster. It has to redirect R&D funds from basic to experimental and applied research, and increases its R&D activities in Business Enterprise sector and increases the total amount of R&D investments. In process cluster it had no significant issues, except again, the structure of R&D researchers which are focused on Higher Education sector. These poor R&D activities lead to the low amount of charges for the use of intellectual property and patent application.

In the above, we tested the general proposed model by identifying a set of indicators that are the key for TIME. Indicators were from all the three components of TH model, and were not classified separately by Government, University and Industry sectors. If done so, the analysis would be more accurate and precise and problems of sustainability of an economy should be better identified. Further research will focus on deeper analysis with classification by the TH components.

Considering the provided research, the model is further to be decomposed for each TH component, which will consist of its own indicators of TIME performance as shown in Figure no. 4.

Conclusions

Changing global business environment developed perpetual and progressive technological growth and development, and technology is the one that gives competitive advantage, which makes it essential in developing strategies at every level. Thus, the need for technology management is non-arguable (White and Bruton, 2007). Jakšić, Marinković and Petković (2011b) claim that both theory and practice showed that management of technology and innovation and technological entrepreneurship are the missing component between technological development economic progress with new opportunities for employment.

Research and development is oriented at concrete results measured by innovation as the motor force of new value being constantly implemented in the economy and society enabling their dynamic competitiveness and welfare efforts at achieving the efficient transition of science into new technologies and new technology into new value are the main task of effective time. In this effort, the actors in the changing business environment have their special roles. The Triple Helix (TH) model is used in this paper to identify the main actors and to especially underline their innovative and entrepreneurial roles by developing a performance model to analyse their contribution. Also, the relations between the actors of the TH model are analysed as the three pillars of a knowledge-based economy: (1) the knowledge-producing sector (University), (2) the market (Industry), and (3) Governments (Cooke and Leydesdorff, 2006).

In this paper, we develop an overall cross-functional model which measures the performance of TIME at the level of national economy, emphasizing the roles of institutions of the TH concept. The model, applied with the relevant indicators, could be a basic for determining the level of TIME development at the national level. This model evaluates the basic functions of TIME and enables tracking of their performance together with the examination of the contribution of each TH component. The general model, without classification in TH components was tested on the examples of Serbia, Finland and Austria. The results showed that Serbia has major problems within input/planning section, with investments that are not distributed in a proper way, with main focus on fundamental/basic research, and poor knowledge application. The role of the business sector in R&D is neglected in Serbia, and it leads to a low level of innovativeness and sustainability. These results show how strongly poor management of technology and innovation lead to poor entrepreneurship development which impacts the overall sustainability of an economy. It also points out how important is the role of entrepreneurship, emphasizing the results of Serbia, where entrepreneurship is not developed enough. This country has significant funds in scientific research, but the economic effects of these investments are negligible (Levi Jakšić, Radovanović and Radojičić, 2013). The research also showed a discrepancy between basic and applied research, implying the necessity for establishing links between of Research, Development and Commercialization, which could be achieved through entrepreneurial cohesion. Linking the entrepreneurship with these phases could be introduced as Research-Entrepreneurship-Development-Entrepreneurship-Commercialization (Levi Jakšić, 2011). The shortcoming of the research is the missing classification by TH components which would lead to a better detection of problems within sectors of University, Government and Industry and it would be the subject of further research of the authors. In order to define sustainable goals, it is necessary to firstly develop the sub-models, and further to apply it in concrete, real world situations. Also, before the classification and sub-model definition, further research should define closed list of indicators, based on the data provided by official, relevant institutions (World Bank, OECD etc.), and after that perform classifications by the TH clusters. This would provide an overall tool which could determine the cause and effect relationships, and enable strategic decision making and sustainable TIME, with an ultimate goal of achieving sustainable development.

References

- Acs, Z.J., Audretsch, D.B. and Strom, R.J., 2009. *Entrepreneurship, Growth, and Public Policy*. New York: Cambridge University Press.
- Baily, M.N. and Chakrabarti, A.K., 1988. *Innovation and the Productivity Crisis*. Washington: Brookings Institution.
- Cooke, P. and Leydesdorff, L., 2006. Regional Development in the Knowledge-Based Economy: The Construction of Advantage. *The Journal of Technology Transfer*, 31(1), pp.5-15.
- Čudanov, M., Săvoiu, G. and Jaško, O., 2012. Usage of technology enhanced learning tools and organizational change perception. *Computer Science and Information Systems*, 9(1), pp. 285-302.
- Doing Business - World Bank, 2013. *Entrepreneurship data 2004-2012*. [online] Available at: <[http://www.doingbusiness.org/data/exploretopics/entrepreneurship/~media/GIA](http://www.doingbusiness.org/data/exploretopics/entrepreneurship/~/media/GIA)>

- WB/Doing%20Business/Documents/Miscellaneous/Entrepreneurship-data-2004-2012.xlsx> [Accessed 4 August 2014].
- Etzkowitz, H., 2007. University-Industry-Government: The Triple Helix Model of Innovation. In: *51st EOQ Congress*, Prague, 22-23 May 2007.
- Etzkowitz, H. and Leydesdorff, L., 1995. The Triple Helix---University-Industry-Government: A Laboratory for Knowledge-Based Economic Development. *EASST Review*, 14, pp.14-19.
- European Commission, 2009. *EIS Indicators*. [pdf] Available at: <http://ec.europa.eu/enterprise/policies/innovation/files/proinno/eis-2009_en.pdf> [Accessed 10 April 2014].
- European Commission, 2011. *HLG group on KET report*. [pdf] Available at: <http://ec.europa.eu/enterprise/sectors/ict/files/kets/hlg_report_final_en.pdf> [Accessed 12 May 2014].
- Eurostat, 2014a. *Eurostat Education Indicators*. [online] Available at: <<http://databank.worldbank.org/Data/Views/VariableSelection/SelectVariables.aspx?source=Education-Statistics:-core-indicators>> [Accessed 5 August 2014].
- Eurostat, 2014b. *Eurostat Indicators*. [online] Available at: <http://epp.eurostat.ec.europa.eu/portal/page/portal/sdi/indicators/all_indicators> [Accessed 10 April 2014].
- Eurostat, 2014c. *Innovation indicators*. [online] Available at: <http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/database> [Accessed 2 August 2014].
- Global Entrepreneurship & Development Institute, 2014. *The Global Entrepreneurship & Development Index*. [Online] Available at: <<http://www.thegedi.org/research/gedi-index/>> [Accessed 4 August 2014].
- Godin, B. and Gingras, Y., 2000. The place of universities in the system of knowledge production. *Research Policy*, February, 29(2), pp.273-278.
- Government of Serbia, 2010. *Strategy on Science and Technological Development of the Republic of Serbia in period 2010-2015*. Belgrade: Government of Serbia.
- H-STAR, 2013. *The Triple Helix Concept*. [Online] Available at: <http://hstar.stanford.edu/3helix_concept> [Accessed 21 March 2014].
- Ivanova, I. and Leydesdorff, L., 2012. Rotational Symmetry and the Transformation of Innovation Systems in a Triple Helix of University-Industry-Government Relations. *Technological Forecasting and Social Change*, 86, pp.143–156.
- Jovanović, M., Jeremić, V., Savić, G., Bulajić, M. and Martić, M., 2012. How does the normalization of data affect the ARWU ranking?. *Scientometrics*, 93(2), pp.319-327.
- Kriščiūnas, K. and Greblkaitė, J., 2007. Entrepreneurship in Sustainable Development: SMEs Innovativeness in Lithuania. *Engineering Economics*, 4(54), pp.20-26.
- Levi Jakšić, M., 2011. Sustainable Tehcnology and Innovation Management. In: Y. Tsekouras and A. Damyanov eds., *Recent Economic Crisis and Future Development Tendencies, Proceedings of the 7th International Conference of ASECU*, Rostov-on-Don, Russia, pp.425-436.
- Levi Jakšić, M., Marinković, S. and Kojić, J., 2012. Technology and Innovation Management Education in Serbia. In: Faculty of Organizational Sciences, University

- of Belgrade, *Proceedings of SymOrg 2012, The 13th International Symposium, Innovative Management and Business Performance*. Zlatibor, Serbia, pp.1852-1860.
- Levi Jakšić, M., Marinković, S. and Petković, J., 2011a. From Knowledge Based to knowledge entrepreneurship economy and society – the Serbian paradox. In: Založba Moderna organizacija, *Proceedings of the 30th International Conference on Organizational Science Development, Future Organization*. Portorož, Slovenia, p.270.
- Levi Jakšić, M., Marinković, S. and Petković, J., 2011b. *Razvoj oblasti i kurikuluma menadžmenta tehnologije*. Beograd, Fakultet organizacionih nauka, pp.67-74.
- Levi Jakšić, M., Marinković, S., Petković, J., and Kojić, J., 2012. *Managing University Impacts on the Economy*. Portorož, Slovenia. 31st International Conference on Organizational Science Development Quality, Innovation, Future.
- Levi Jakšić, M., Radovanović, N. and Radojičić, Z., 2013. Absorptive capacity constituents in knowledge-intensive industries in Serbia. In: *Zbornik radova Ekonomskog fakulteta u Rijeci, časopis za ekonomsku teoriju i praksu - Proceedings of Rijeka Faculty of Economics, Journal of Economics and Business*, 31(2), pp.253-278.
- Leydesdorff, L., 2012. The Triple Helix of University-Industry-Government Relations. In: E. Carayannis and D. Campbell eds. *Encyclopedia of Creativity, Innovation, and Entrepreneurship*. New York: Springer.
- Leydesdorff, L. and Meyer, M., 2006. Triple Helix indicators of knowledge-based innovation systems: Introduction to the special issue. *Research Policy*, 35(10), pp.1441-1449.
- Mirchev, A. and Dicheva, V., 2013. Technological entrepreneurship of small and medium business in the Republic of Bulgaria as a factor for sustainable development. In: *Central Bohemia University, CBU International Conference on Integration And Innovation in Science And Education*. Prague, Czech Republic, , 7-14 April 2013.
- Mitra, J., 2011. *Entrepreneurship, Innovation and Regional Development*. New York: Routledge.
- OECD, 2014. *OECD Indicators*. [online] Available at: <http://www.oecd-ilibrary.org/economics/data/main-economic-indicators_mei-data-en> [Accessed 10 April 2014].
- Pearce, J.M., Grafman, L., Colledge, T. and Legg, R., 2008. Leveraging Information Technology, Social Entrepreneurship, and Global Collaboration for Just Sustainable Development. In: *Proceedings of the 12th Annual National Collegiate Inventors and Innovators Alliance Conference*, 20-22 March 2008, Dallas, USA, pp.201-210.
- Saad, M. and Zawdie, G. eds., 2011. *Theory and Practice of the Triple Helix Model in Developing Countries: Issues and Challenges*. New York: Taylor & Francis.
- Shinn, T., 2002. The Triple Helix and New Production of Knowledge: Prepackaged Thinking on Science and Technology. *Social Studies of Science*, August, 32, pp.599-614.
- Triple Helix Conference, 2011. *The Triple Helix Concept - Theoretical Framework*. [online] Available at: <www.triplehelixconference.org/th/9/the-triple-helix-concept.html> [Accessed 15 April 2014].

- United Nations, 2012. *Fostering innovative entrepreneurship: challenges and policy options/United Nations Economic Commission for Europe*. Geneva: New York and Geneva.
- White, M.A. and Bruton, G.D., 2007. *The management of technology and innovation: a strategic approach*. Mason, OH: Thomson South-Western.
- World Bank, 2014. *World Bank Indicators*. [online] Available at: <<http://data.worldbank.org/indicator/>> [Accessed 10 April 2014].
- World Economic Forum, 2012a. *Global Competitiveness Index*. [online] Available at: <<http://www.weforum.org/issues/competitiveness-0/gci2012-data-platform/>> [Accessed 25 July 2014].
- World Economic Forum, 2012b. *Global Competitiveness Report 2012-13*. [pdf] Available at: <http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf> [Accessed 21 July 2014].