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POTENTIAL IMPACT OF THE SCIENCE - TECHNOLOGY PARK ON THE REGIONAL DEVELOPMENT

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Abstract

The impact of the Science and Technology Park (STP) on the development of one region can be considered through many reasons for establishment of STPs. STP represent useful instrument which creates conditions for promoting innovations, entrepreneurship, growth of knowledge-based companies, while the output results are reflected in economic growth of the region. Due to declining demographic trends in region of eastern Serbia, especially considering young population and phenomenon of "brain drain", the goal of STP is to provide conditions for intellectual companionship at the highest level, to create chances to exchange knowledge and ideas, to improve potential of the community and to increase knowledge and achieve suitable bilateral cooperation with similar entities in the world. This paper provides review of possible benefits of establishing STP in city of Bor, based on scientific-research potential of Eastern Serbia region.

Keywords: science and technology park, regional development, technology park, potential, growth, Eastern Serbia

1. INTRODUCTION

The impact of the Science and Technology Park (STP) on the development of one region can be considered through reasons for establishment of STPs. Among those reasons can be stated achieving cooperation between companies in fields of information and communication technologies, realization of projects that companies are not able to implement themselves, development of necessary telecommunication infrastructure for easier business operations, attraction of large foreign companies in the field of technical sciences to the region where the STP will be established, development of technical faculties belonging to the university in the region, the employment of a large number of young professionals who will be motivated

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to stay in the region, encourage innovation and create an economically positive environment, stimulate the founding and financing of new companies and establish a knowledge-based economy and innovation (Stanković et al., 2009). Universities as main providers of "contemporary knowledge, state-of-the-art for science and technology", and the STP as the main entity that stands behind the commercialization of knowledge and technology, are having the central role in development of one region. They should be highly interconnected in order to determine the targeted economic growth of a region, as well as the country itself (Kang, 2016).

Among different definitions of STPs, there is an official definition Adopted by International Association of Science Parks (IASP) in February 2002. According to it the following characteristic features of scientific parks can be stated:

- Science park is an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions.

- Science park stimulates and manages the flow of knowledge and technology among universities, R&D institutions, companies and markets.

- Science park facilitates the creation and growth of innovation-based companies through incubation and spin-off processes.

- Science park provides other value-added services together with high quality space and facilities (www.unesco.org, 2017).

Considering the properties of scientific parks, two basic properties can be distinguished. The first property is derived from the operation of the STPs as a catalyst for regional economic development. Another is the simplification of the creation and development of new technology-based companies and the transfer of knowledge from universities to companies (Vilà & Pagès, 2008).

STP represent useful instrument which creates conditions for promotion of innovations, entrepreneurship, growth of knowledge-based companies, while the output results are reflected in economic growth of the region (Felsenstainer, 1994; Zeng et al., 2010). It may be said that science parks serve many entities with different interests and different expectations. Thus, universities expect science parks to enable them commercialization of their research ideas and to secure funding for further research, entrepreneurs and other smaller companies expect a close association with the university, other similar businesses on site and the managerial services provided by the park staff while large multinational businesses see STPs as providers of flexibility for short-term projects and proximity to already established cooperation partners at universities (Hansson et al., 2005). This paper provides a review of possible benefits of establishing STP in city of Bor. Thereby, these benefits are derived from a detailed consideration of the potential of the Eastern Serbia region by means of suitable methods and techniques.

2. LITERATURE REVIEW

The history of science parks goes back to the 1950s, when the first science park was established at the Stanford University in the USA. This was followed by establishment of the Cambridge Science Park in Great Britain and the Sophia Antipolis Science Park in France, created over a decade later, as the

STPs have spread around the world in various dynamics. The concept of science parks gained new value first in highly-developed European countries in the 1970s and later in the dynamically growing Asian economies in the late eighties and early nineties of the twentieth century (Brčić & Brodar, 2008; Sobkowicz, 2013). Incorporation of science parks by India, Iran, Egypt, Morocco, Tunisia, and many more has resulted in fostering regional innovation and economic development, which subsequently created several thousand new jobs, R&D opportunities, entrepreneurship, and emergence of small and medium enterprise (SME) with increased role of information and communication technologies (ICT), (Wasim, 2014). With this growing establishment of STPs over the world, they have become more diverse in aim and practice. As an example, the diversity in aim and practice between STPs can be stated concerning the type of target firms, the set of services provided and the stakeholders involved (van Geenhuizen, 2016).

Nauwelaers et.al. (2014) cite the benefits arising from the activity of STPs, such as:

-Increased place visibility and attractiveness, conferring a high-tech image to the region where STPs are located. This improved image can play an important role for attracting talent and investors, and for creating good conditions for accessing a pool of high-skilled talents;

-Provision of adequate infrastructure (incl. information and communication technologies) for research- and technology-intensive businesses, which can be shared with public research organizations and universities located in the STP;

-Provision of a range of tailored business support services targeting specific categories of firms and high-tech businesses. Theme-oriented STPs (on ICT, life science, etc.) may have more opportunities for developing specialized services (IPR, management support, technology brokering, etc.) and for attracting a critical mass of professionals specialized in these areas. Díez-Vial & Fernández-Olmos (2017) state that STPs can provide benefits regarding proximity to universities or other higher education institutions. Those benefits are reflecting in implementation of certain techniques developed in the university, solving specific problems experienced by the firms, and, among other things, recruiting personnel from the university. Also STP management can provide help in establishing relationships with other firms and institutions from inside or outside STPs. The location of STP itself is of great importance, bearing in mind that if the STP is located close to important customers, suppliers, researchers and other business organizations, there is a possibility to build a network that will support the development of STP (Gursel, 2014).

3. REGION POTENTIAL

The potential of this region can be viewed through four dimensions, which would be the scientific-research potential, infrastructure, economy and local government.

The scientific-research potential of eastern Serbia region is reflected through the leading scientific-research institution in the region - the Technical Faculty in Bor, within the University of Belgrade with about 80 researchers, among which a dozen scientific workers are known outside the borders of our country according to the number of published works with an impact factor, a

number of citations, visiting professors at numerous universities in the world and realization of numerous international projects. The Technical Faculty in Bor is publishing four scientific journals - one M22, one M24 (with IF on SCImago Q-3) one M51 and one M52. Two international journals that publishes the Faculty are *"Journal of Mining and Metallurgy"*, with sections *"A-Mining"* (now classified under category M51) and *"B-Metalurgy"* (the section B is on Science Citation Index Ehpanded list, classified under category M22) and *"Serbian Journal of Management"* which is being published from the year of 2006. and it is classified under M24 category. The Department of Recycling Technologies and Sustainable Development has started publishing the journal "Recycling and Sustainable Development" in 2007. This journal is classified under category M52.

It also organizes 5 international scientific conferences, one of which is in the EBSCO database. At the same time, membership within the large family of the University of Belgrade (among the top 300 in the world) offers the possibility of engaging experts from the remaining 30 faculties and 11 scientific institutes through the Technical Faculty for the needs of STP in Bor.

The Institute for Mining and Metallurgy has been existed for 55 years as a part of RTB Bor, and exists for the last ten years as an independent institute with about 200 employees, of which about 50% are researchers and around a dozen of them have a scientific title. The Institute publishes three scientific journals, one of which is category M24 and two categories M52. The Institute has a lot of experience in the implementation of numerous practical projects for the economy in the country and abroad.

In Zaječar there is a private Faculty of Management with about twenty scientists who develop their research career. Also, in Zaječar there is an Institute of Agriculture with twenty researchers, out of which a dozen with a scientific title that produce notable results, primarily for the needs of this region. Significant equipment, for the needs of scientific research, in the laboratories of the Technical Faculty in Bor and the Institute for Mining and Metallurgy in the amount of over $ 50,000,000 is owned by the state and is available to researchers at STP in Bor. In the Bor and Zaječar district there are about 3300 people with a high professional education, but the degree of their exploitation is relatively small. Annually at the Technical Faculty in Bor graduates about 130 people, a master studies completes about 30 students and about 5 students defends their doctoral dissertation, which represents a significant potential for the development of innovative activities and knowledge-based economy.

Regarding the *infrastructure*, for the needs of the STP, in Bor exists a spacious state-owned complex of the buildings of the former Copper Institute Computer Center, with about 7,000 square meters of space. In the first phases, only the first two floors can be used with the necessary infrastructure of approx. 2,500 m2 with a small infrastructure investment. The whole complex presents a separate whole, with parking for about hundred vehicles. Near by this building there is a sports center, with a significant potential of the best in Serbia, and the Institute for Mining and Metallurgy with significant research infrastructure.

The economic resources of this region include the following main institutions: RTB Bor, Djerdap Hydroelectric Complex, Cables, Gorenje, Milk Processing,

Agricultural Complex; touristic destinations: Djerdap National Park, Stara Mountain Nature Park, Romuliana, Vratna, the Canyon of the Zlot river and Zlot cave. All these economic institutions are far from developing in real terms (for example, RTB Bor has only a cathode in its product range, which is a range of finished products from 1936). The development of new products, the improvement of existing products in defining additional value, the improvement of the existing and the development of new tourist services with stakeholders from Romania and Bulgaria are overwhelming for the economy of this region that the STP can provide. The announced selection of professional management in RTB Bor, which is in progress, provides realistic opportunities for interaction between STP and the company in order to continuously improve the quality of key production and management processes with the development of innovative products and services with added value.

Local government, primarily in the city of Zaječar and the municipality of Bor, has the potential to support the realization of the idea of creating STP with modest financial resources, professional and organizational potential that has evolved over the years in these local governments. The interests of these local governments are that they create opportunities for improving the quality of life with young and ambitious people from the country and abroad who should attract the STP in Bor. Local government is a key stakeholder for STP development in Bor as a key instrument for regional development and the creation of long lasting partnerships with the University of Belgrade and other universities from the country and abroad in order to change the present gloomy image of this region.

By integrating innovative scientific research results created in the STP in the interaction with the obvious needs of the industry of this region, it leads to the creation of new values in the products of existing companies, which increases the profit and standard of employees in them.

3.1. Demographic data

Due to declining demographic trends in region of eastern Serbia, especially considering young population and phenomenon of "brain drain", the goal of STP is to provide conditions for intellectual companionship at the highest level, to create chances to exchange knowledge and ideas, to improve potential of the community and to increase knowledge and achieve suitable bilateral cooperation with similar entities in the world (Janković et al., 2017).

The review of demographic trends of the eastern Serbia population represent the starting point of consideration of the need to develop the region in terms of providing jobs for the young and educated people and modernization of many processes, which can be accomplished by establishing an STP in Bor. Table 1. presents data of Bor and

Table 1. Population of Bor and Zaječar districts according to results of censuses conducted on 1991, 2002 and 2011 year

District	Census year		
	1991	2002	2011
Bor	160939	147223	123848
Zaječar	153660	138625	118295

(Source: Penev & Marinković, 2012)

Table 2. Growth/Decrease in the number of inhabitants of the Bor and Zaječar districts according to results of censuses conducted on 1991, 2002 and 2011 year.

District	Growth/Decrease		
	1991	2002	2011
Bor	-13716	-23375	-37091
Zaječar	-15035	-20330	-35365

(Source: Penev & Marinković, 2012)

Zaječar districts according to results of censuses conducted on 1991, 2002 and 2011. year.

The Table 2. indicates the recorded growth and decrease in the number of inhabitants of the Bor and Zaječar districts in the observed periods.

From the provided information, it can be said that with each subsequent census, there is an increasing number of population reduction. In both districts, negative numbers indicate a devastating trend of decreasing population. In many domains of demographic development of Serbia devastating trends, which were present in past, continue. Depopulation, intensive aging of population, negative migration balance, with low fertility and high mortality, are just some of the most important demographic characteristics of Serbia in the period between two censuses from 2002. to 2011.

4. MISSION, VISION AND STRATEGIC GOALS OF STP

Mission. The purpose of the STP Bor is to encourage young, smart, educated and ambitious people to work, to help them realize their ideas on the market and to be a bridge between science and the economy. It is a place where smart, ambitious and creative people who, through the exchange of ideas in the infrastructure of the Scientific and Technology Park and expert help from people in it, create conditions for the development of creative ideas for creating new products and conquering new markets around the world.

Vision. STP in Bor in the future should be recognizable in the world as a place where dozens of recognizable companies in the world operate, which contemporary ideas are shaped into products sold to the whole world. It should be a regional center where young people from all over Serbia and neighboring countries (Bulgaria and Romania) realize their ideas on the market.

Strategic goals. The creation of the Scientific and Technological Park in Bor requires the following strategic goals to be achieved:

-First strategic goal would be creation of an appropriate climate so that young, smart, ambitious and creative people from this region do not leave Serbia but realize their ideas here by starting their own business based on the ideas of high technologies and their realization on the market.

-Second, to give a chance for young, smart, ambitious and creative people to stay in the region of Eastern Serbia, to build their knowledge-based potential for creating jobs for themselves and thus helping the development of their families and environment.

-Third, to transform a mono-structured economy based on natural resources in Eastern Serbia into a semi-structure where knowledge will be the main resource for the development of the economy.

-Fourth, by developing modern

technologies and deeper entry into the University of Belgrade, through its part of the Technical Faculty in Bor, a knowledge-based development is in line with contemporary trends in science in the world.

-Fifth, following the development and application of new technologies, new materials and new products, this Science Park, as a benchmarking partner, will take the experience of the best scientific parks in the United States and certainly the experience of the Scientific Park in Zvezdara Forest in Belgrade, and will strive to overcome their results over time.

-Sixth, to be an inherent incubator for new companies with cutting-edge technologies, which develop and grow in it, and that after getting to be independent become its best partners.

-And finally, seventh strategic goal is to become recognizable and desirable for young and ambitious people from all over the world, to gain part of their practical education in it, and, also, to make some of them to stay.

5. SWOT ANALYSIS

SWOT actually represents an acronym composed of the first letters of words Strengths, Weaknesses, Opportunities and Threats. It is a commonly used tool for analyzing internal and external organizational environment in order to attain a systematic approach and support for decision making process (Ghazinoory et al., 2007). The results of the SWOT analysis represent the starting point for the formulation and selection of appropriate strategies (Dyson, 2004; Živković & Nikolić, 2016). The importance of applying this method in this paper is reflected in highlighting of Bor and Zaječar district main strengths, weaknesses, opportunities and threats, among which strengths and opportunities represent certain predispositions for establishment of STP in Bor, while weaknesses and threats can be considered as the main reasons for establishment of such institution for the purpose of regional development. In the following section authors have tried to highlight the most relevant regional features and rank them among the strengths, weaknesses, opportunities and threats, with an objective approach to analysis.

5.1. Strengths of Bor and Zaječar district

Idea of an STP is not new, it successfully functions around the world, and also functions in Serbia for about ten years by now. According to that, one of the strengths could be that our country already has necessary experiences for establishing STP. The knowledge concentration within the University of Belgrade, which is among the top 300 in the world, makes a great strength that can generate a large number of ideas for young and ambitious people. There is a real possibility in Bor for realization of idea of an STP. After Belgrade, Bor is a convenient place due to the significant scientific and research infrastructure at the Technical Faculty in Bor of the University of Belgrade and the Institute for Mining and Metallurgy. The company RTB Bor is of national significance, and it should be interested in establishment of such a park because of the condition in which it operates currently. Its potentials and infrastructure can be a good polygon for the realization of scientific ideas in practice which can come through this park from around the world. The infrastructure

and space in which Scientific and Technology Park in Bor will function already exists with an ideal position and does not require investments for construction, but only insignificant funds for reconstruction (the building of the Institute for Mining and Metallurgy, which has its own parking place). Also, in addition to the listed strengths, it is important to mention that Bor owns an airport to which planes of all sizes can land. Hotels of higher categories also represent strength (Hotel Albo with 3 star, Hotel Jezero on Bor Lake with 4 star and Hotel Lux 3 star, near Zaječar). The advantage of this region is also an excellent road network that connects Bor with major cities such as Belgrade and Nis, as well as World Heritage facilities like Romuliana near Zaječar. The great strength of this region is the availability of tourist sites that are of great importance, so the region has attractions such as Romuliana near Zajecar, which is under the protection of UNESCO, as well as Lake Bor, Brestovac spa and Gamzigrad spa. The Bor region also has significant sports and recreational facilities, such as sports halls, football fields, tennis courts, outdoor and indoor swimming pools. The wide rage of education options exists in this region. There are Mechanical - Electrical Engineering School in Bor, Technical School in Bor and Zaječar, School of Economics and Trade in Bor and Zaječar and Medical School in Zaječar, as well as Technical Faculty in Bor, and therefore there is the possibility of retraining and further qualification of profiles.

5.2. Weaknesses of Bor and Zaječar district

The new idea and the creation of something as progressive as STP in Bor itself provokes fear that creates resistance to project realization. Insufficient regional development is considered as a weakness, as well as the presence of environmental pollutants, especially in district of Bor (primarily because of the RTB Bor). Another significant weakness of the region is that renewable energy sources such as solar energy, wind energy, water energy are unused in this region. Waste is being disposed uncontrolled, not categorized or recycled, which is another weakness of the region. Regarding some economic factors, the privatization of individual companies is often unsuccessful and takes too long, also often comes to shut down of some companies. This is conditional on lack of financial resources and a poor economic situation, as well as insufficient investment in economic development. A common phenomenon within this region is the brain drain, where most of the young, educated and competent people go to bigger cities or other countries. Although there is a good and developed road network, investments in the transport infrastructure are rare and small. Unemployment in the region is 23.7%, which is 6% higher than elsewhere in Serbia. One of the weaknesses is also the depopulation of the region. The number of people has been decreasing since the 1960s.

5.3. Opportunities of Bor and Zaječar district

The chance for people with knowledge to realize their ideas in Serbia in the Scientific and Technological Park in Bor is that they can stay in their country and try to realize their ideas with much less risk and with full logistics within the Park. STP establishment would bring to increase of high tech companies, which would decrease the brain

drain phenomenon in this region. In spite of the fact that this area is known for copper and its exploitation, so it can freely be said that is its main feature, so the Science Park, in addition to its other tasks, would pay great attention to more efficient use of mineral resources. A major step towards this is the introduction of new technologies and the attraction of young and highly educated people. One of the important external factors, i.e. chances, represents Serbia's approach to joining the EU and new legal regulations that are in line with regulations in the European Union, which will enable a better economic situation in the country and the region, better ecological regulations based on clean environment, industry development and employment growth. This step offers a great opportunity for possible connection with specialized institutions as well as participation in European Union projects, which will result in an increase in the economic power of the region. This creates space for attracting foreign investments, which would have a large share of the capital stock. Also, regular taxes payment by foreign investors would create a positive influence on budget of the Republic of Serbia. New investments are linked with an increase in the number of jobs, the opening of which gives young people the opportunity for success and progress. They will create a place for work and establish normal living conditions, which will give young educated people the opportunity to stay in their own country instead of going abroad in search of a better life and achieving goals. Potential opportunity is, also, formation of regional and international connections, especially because of the proximity of European Union border. This kind of connections would have a direct positive impact on demographic trends, which have been in drastic decline in recent years. This step would open opportunities for regional and international cooperation of scientific institutions especially with Institutes and Universities across the country. One of the opportunities are UNESCO sites, such as Gamzigrad and Romuliana. Using their capacities would certainly contribute to the success of the Science Park. The positive side of the geographical position of this region is also that it is located near the borders with EU member states, such as Bulgaria and Romania. Due to the proximity of the border areas, Vidin (Bulgaria) and Turn Severin (Romania), there is the possibility of using EU funds as well as the chance that in this park young and ambitious people from Bulgaria and Romania can realize their ideas by creating international teams and companies.

5.4. Threats to Bor and Zaječar district

At the center of observation is the region that the inhabitants themselves describe as "blind hose", so the term indicates that it has a handful of endangering factors that could influence the realization of an innovative project in this environment. In that sense, it could be pointed out that one of the most influential threats is the lack of understanding of the ruling majority that provides resistance to change in this environment. The next threat that has become a feature of this environment in recent years is directed at unfavorable demographic trends. The census statistics in this environment represent devastating results as a higher rate of mortality than birth rates is recorded. The decrease in the number of inhabitants is drastic in the last two censuses that took place in 2002 and 2011.

The average age of inhabitants in the Zaječar and Bor districts is around 40-50 years. This data indicates to lack of young population. That could be explained by "brain drain" from this region. Young people go to faculties in some of the more populated cities and tend to stay there after completion of the studies considering that in these cities there are more opportunities for employment and better conditions for establishing a family, and some, as many describe, "a better life". And those young people who gain their degree on one of two faculties in Bor and Zaječar tend to find a job in some other place, and a great majority of them chooses going abroad with the opinion that it is better to live and work in an environment where knowledge is appreciated and adequately rewarded. In addition, the unstable economic situation in the country greatly prevents entrepreneurial ventures, as well as in this region. This is followed by a lack of regulations in the state concerned with the protection of the environment, an increase in unemployment, which further leads to an increase in poverty in the country. Public institutions are not sufficiently transparent, and in some areas there is insufficient public awareness. Especially with regard to subventions that the population could use for self-employment and starting of a private business. Of the many companies that existed in Bor and Zaječar, those who have "survived" are using obsolete technologies, machines that are minimum 30 years old. It is necessary to replace them with new technologies, which also implies adequate training for workers that should handle new machines. However, there is an obstacle in the form of an old employee structure. Middle-aged employers are not interested in learning and improving the work process, most people just want to get a monthly salary. Industry in the country is largely based on the use of old technologies, and there is a significant need for innovation, which further conditions the necessity of having a number of institutes and research centers.

One of the threats for realization of this kind of project would be lack of understanding by institutions which would be vital in supporting the project. Based on mentioned situation analysis of Bor and

STENGTHS	WEAKNESSES
◆ Highly educated experts in the region ◆ The existence of a realistic possibility of realizing NTP in Bor ◆ The availability of secondary and higher education ◆ Possibilities of retraining and additional qualification ◆ Sport and recreational facilities (sports hall, sports grounds, swimming pools) ◆ Close to the airport	◆ Lack of financial resources ◆ Insufficient investment in economic development ◆ High percentage of brain drain ◆ Insufficient regional development ◆ Slow privatization and extinguishing of certain economic entities ◆ Low investments in the transport infrastructure ◆ Non-use of renewable energy sources
OPPORTUNITIES	**THREATS**
◆ New workplaces ◆ Market realization of the ideas of young people ◆ Increase in the number of new high-tech companies ◆ Improving demographic trends ◆ Possibility of more efficient exploitation of mineral resources ◆ Participation in EU projects ◆ Approaching Serbia to joining the EU	◆ "Brain drain" ◆ Increase in unemployment ◆ Society's resistance to change ◆ Poor demographic trends ◆ Using obsolete technologies in almost all industries ◆ Unstable economic situation

Figure 1. SWOT matrix for the potential of the Bor and Zaječar district

Zaječar districts, Figure 1. shows SWOT matrix that generates key sub-factors within each SWOT factor (strengths, weaknesses, opportunities, threats).

6. TOWS MATRIX AND GENERATION OF STRATEGIES

The TOWS Matrix, or situation analysis, has been introduces by Weihrich (Weihrich, 1982) with the explanation that the set of variables used in the matrix is not new (threats, opportunities, weaknesses and strengths), but the systematic way in which they are matched is. As the author further states, the primary concern regarding the TOWS matrix is generation of strategies, but this analysis could also be applied to the development of tactics necessary to implement the strategies, and to more specific actions supportive of tactics. Wyns & Khatchadourian (2016) state that the analytical engine of TOWS is the construction of four scenarios through the combination of the identified internal strengths and weaknesses with the external threats and opportunities. This leads to four combinations: SO, WO, ST, WT, where WT strategy aims at diminishing both the internal weaknesses and external threats, WO strategy seeks to minimize the internal weaknesses and maximize the available external opportunities, ST strategy looks at the internal current strengths, which are capable of dealing with external threats and thereby focus on advancing the former and SO strategy seeks to maximize gains from external opportunities. Describing the SWOT-TOWS methodology authors Ravanavar & Charantimath (2012) state that SWOT analysis becomes a useless exercise if it is not extended to TOWS where the strengths are used to take advantage of opportunities while countering threats, and the opportunities are used for minimizing the weaknesses and, in some way, avoiding threats. It can be said that because the TOWS

	STRENGHTS – S ◆ Highly educated experts in the region ◆ The existence of a realistic possibility of realizing NTP in Bor ◆ The availability of secondary and higher education ◆ Possibilities of retraining and additional qualification ◆ Sport and recreational facilities (sports hall, sports grounds, swimming pools) ◆ Close to the airport	**WEAKNESSES – W** ◆ Lack of financial resources ◆ Insufficient investment in economic development ◆ High percentage of brain drain ◆ Insufficient regional development ◆ Slow privatization and extinguishing of certain economic entities ◆ Low investments in the transport infrastructure ◆ Non-use of renewable energy sources
OPPORTUNITIES – O ◆ New workplaces ◆ Market realization of the ideas of young people ◆ Increase in the number of new high-tech companies ◆ Improving demographic trends ◆ Possibility of more efficient exploitation of mineral resources ◆ Participation in EU projects ◆ Approaching Serbia to join the EU	**SO STRATEGIES** SO1 - Integration of interests of the University, Economy and Local Government (STP). SO2 - International connection of regions research potential with research potential in Turn Severin (Romania) and Vidin (Bulgaria).	**WO STRATEGIES** WO1 - Promotion and encouragement of the most successful innovation ideas and the most successful highly educated people in the region.
THREATS – T ◆ "Brain drain" ◆ Increase in unemployment ◆ Society's resistance to change ◆ Poor demographic trends ◆ Using obsolete technologies in almost all industries ◆ Unstable economic situation	**ST STRATEGIES** ST1 - Development of state regulation for the promotion of the development of a knowledge-based economy.	**WT STRATEGIES** WT1 - Stimulating development of private entrepreneurship and spin off companies.

Figure 2. TOWS matrix for generating strategies

methodology places emphasis on studying the external environment should enhance situation awareness (Wyns & Khatchadourian, 2016). In order to generate powerful strategies for the realization of the idea of creating an STP in Bor, based on the previously formed SWOT matrix, a TOWS matrix is composed, by comparing the key sub-factors of the defined factors for the realization of the proposed idea, as presented on Figure 2. Conducting the research in this way gives us a comprehensive view of the situation and the STP establishment issue, thus providing responses and solutions through generated strategies.

The multi - criteria model of the selection of the best strategy and the definition of the order of application of the generated strategies for achieving the goal consists of three phases: Identification of criteria and sub-criterion; Determining the significance of criteria and sub-criterion using the AHP method; Evaluation of alternative strategies and prioritization using AHP. First of the three phases conducted while implementing AHP method is defining a hierarchical model, as illustrated in Figure 3.

Second phase refers to determining the significance of criterion and sub-criterion using the AHP methodology, carried out by an expert team made up of a large number of experts, which leads to group decision-making. By group decision, the experts evaluated criterion or and sub-criterion while taking the mean value for each, then on the basis of the final ranking decision is made. Based on the comparison of pairs of criteria and sub-criterion, their significance was evaluated, and the results obtained by the AHP calculation for the significance of the criterion and sub-criterion, as well as the degree of consistency for each group, are shown in Table 3.

In this way, normalized results were obtained indicating the dominant influence of the following sub-criterion:

-Positive sub-criteria: S1 - Highly educated experts in the region (0.213); O1 - New workplaces (0.050).

-Negative sub-criteria - W1 - Lack of financial resources (0.056); T1 - "Brain drain" (0.023).

In the next step of this analysis, by assessing the weighting effects of the SWOT

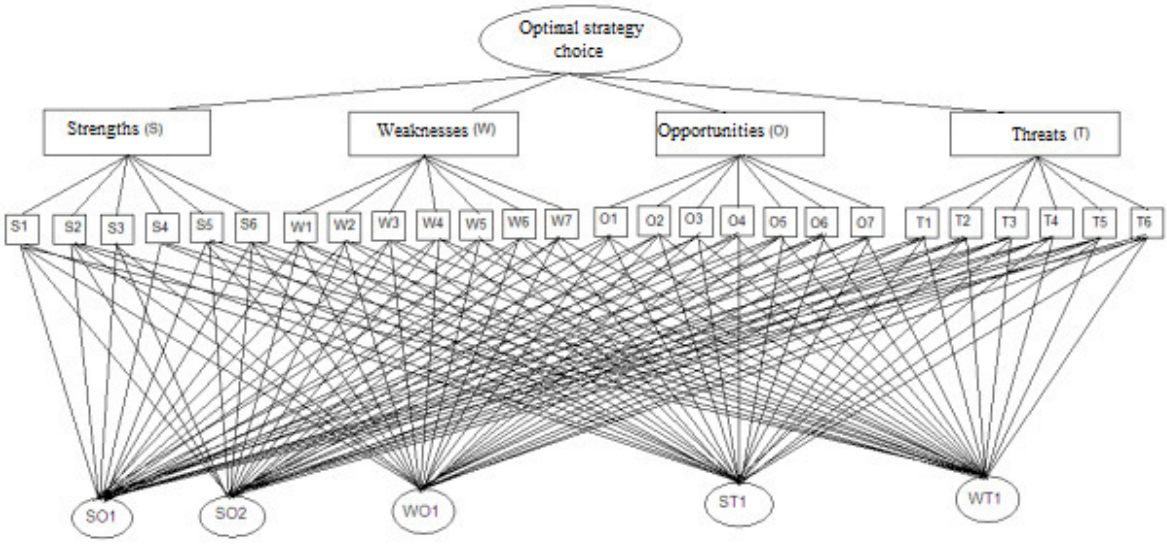

Figure 3. Structure of hierarchical model for prioritization of strategies based on TOWS matrix

Table 3. Significance of criteria and sub-criteria of SWOT analysis, determined by AHP methodology.

SWOT groups - criteria	Significance of SWOT factors	SWOT sub-criteria	Local significance of SWOT sub-criteria	Global significance of SWOT sub-criteria
Strengths (S)	0.596	S1	0.356	0.213
		S2	0.273	0.163
		S3	0.186	0.111
		S4	0.095	0.056
		S5	0.061	0.036
		S6	0.030	0.018
Weaknesses (W)	0.203	W1	0.277	0.056
		W2	0.258	0.052
		W3	0.191	0.039
		W4	0.123	0.025
		W5	0.080	0.016
		W6	0.048	0.010
		W7	0.023	0.005
Opportunities (O)	0.149	O1	0.334	0.050
		O2	0.245	0.036
		O3	0.179	0.027
		O4	0.092	0.014
		O5	0.077	0.012
		O6	0.048	0.007
		O7	0.024	0.004
Threats (T)	0.052	T1	0.441	0.023
		T2	0.209	0.011
		T3	0.173	0.009
		T4	0.092	0.005
		T5	0.055	0.003
		T6	0.030	0.002

sub-criterion on alternative strategies defined in the TOWS matrix, the finalization of proposed alternative strategies is determined in the framework of all individual SWOT criteria, including different strategic alternatives within all individual SWOT relationships. The results of the obtained weight parameters of the SWOT criteria and sub-criterion, which were shown in Table 3. can also be shown graphically. This visualization is a situation analysis of SWOT results and allows the decision maker to clearly see the impact, as an example, the weight value of each SWOT criterion or sub-criterion in the considered multi - criteria model. The weight of the SWOT criterion is plotted on the graph by the corresponding position of the points on X and Y axis. Positions of weighting significance of internal SWOT criteria: strengths and weaknesses are also in the opposite directions to the X axis. Within four quadrants, which form the previously defined axes of the SWOT criterion, it is designed the positions of weight values of the SWOT product at an angle of 45% for each group, with the length of each projection for a given sub-criterion representing its global significance in the model. The obtained results indicate the influence of the SWOT criterion in the decreasing sequence of series S → W → O

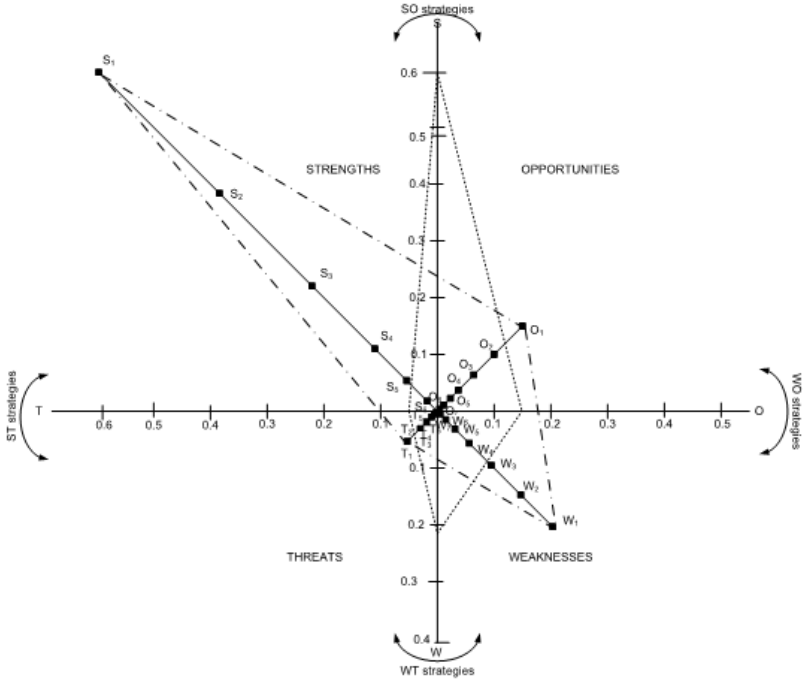

Figure 4. Schematic representation of situation SWOT analysis for STP in Bor

→ T (Živković & Nikolić, 2016). The values of the overall significance of the SWOT sub-criterion with the greatest significance within a single factor are also in the declining series S1 → O1 → W1 → T1.

The overall priority of the strategies under consideration is calculated in the last step and presented in the following way:

$$V_{alternative} = \begin{pmatrix} SO1 \\ SO2 \\ WO1 \\ ST1 \\ WT1 \end{pmatrix} = W_3 \times W_{SWOTsub-factors(global)} = \begin{pmatrix} 0.438 \\ 0.264 \\ 0.164 \\ 0.090 \\ 0.044 \end{pmatrix} \quad (1)$$

Prioritization of defined alternative strategies according to the size of normalized weight factors was determined: SO1 = 0.438; SO2 = 0.264; WO1 = 0.164; ST1 = 0.090; WT1 = 0.044. The dynamic role of the strategy implies that after achieving a certain result using the chosen strategy, it enters a new stage of growth and development of the organization, which requires the implementation of a new strategy. The obtained results define the prioritization of the listed alternative strategies in the following declining series: SO1, SO2, WO1, ST1, WT1.

According to the established model for determining the priorities of the proposed alternative strategies, the priority of implementation is on SO1 strategy which basically indicates the actions of the initiator of the initial discussion on determining the common interest, which would certainly be a working group that initiated the idea of creating an STP in Bor. Moderator of the discussion of key stakeholders: University - economy - local self-government and unavoidable moderator of defining the common interest are certainly the organs of the Republic of Serbia (Development

Agency of Serbia, Ministry of Education, Science and Technological Development, among others). When the undisputed interest gets clearly defined the proposed strategy comes to the point of the limiting results in achieving the defined goal which is the creation of an STP in Bor. After the completion of the networking of key stakeholders in the country using the SO1 strategy, due to the location of the Bor in the vicinity of the border with Romania and Bulgaria (EU members), it is necessary to start with the implementation of the SO2 strategy entitled the international linking of the scientific potential of the region (Bor and Zaječar District) with research potential in Turn Severin (Romania) and Vidin (Bulgaria). After linking with key stakeholders from the border environment, this strategy becomes the precondition for implementing the WO1 strategy, the promotion and encouragement of the most successful innovation ideas and the most successful highly educated people from the region (Bor and Zaječar District) in order to create a positive climate for the possibilities of STP in Bor and breaking the illusion that the STP is the place of employment over connections, instead to create a picture of a place of gathering the best and most creative staff from this region and wider environment. After achieving the limited values of the mentioned strategy, conditions for the implementation of the following ST1 strategy have been created. There begins the development of state regulation for the stimulation of the development of a knowledge-based economy. The announced adoption of the Law on Innovative Activity with the accompanying regulations creates legal frameworks for the realization of the basic idea of creating an STP in Bor. With this, the limit value of the implementation of the ST1 strategy is reached, and the conditions for applying the final WT1 strategy, which is incentives for the development of private entrepreneurship and spin off companies. In other words, the creation of incentives by the state and the use of international funds to encourage the

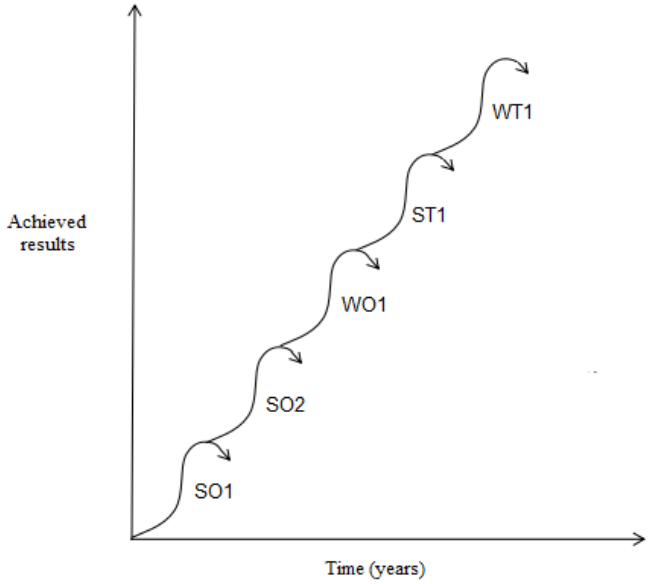

Figure 5. Curve of generated strategies implementation order based on calculated values of implementation priority

practical realization of the business idea arising in the STP in Bor.

Figure 5. shows a schematic representation of the successive application of generated strategies from the TOWS matrix in order to increase the probability of final realization of the STP investment idea in Bor on the basis of the strategy life cycle, because each strategy achieves its limited value in increasing the performance it delivers.

7. CONCLUSIONS

Results that emerged from this research and analysis of a large number of factors approve the great importance of the realization of the idea of establishing the Scientific - Technological Park (STP) in Bor. World experience in forming and financing STPs are positive, because STPs bring together smart, highly educated and ambitious people whose results change the image of the region in which they operate and create the conditions for continuous growth and development of all performances. Human potential of this region (Bor and Zaječar districts) encompasses the Technical Faculty in Bor within the University of Belgrade (the first 300 in the world) with about 80 researchers, the Institute for Mining and Metallurgy with over 100 proven researchers, the institute for Agriculture in Zaječar with about twenty researchers and the Faculty of the Management, with the possibility of involving of staff from Romania and Bulgaria, which provides a solid starting point for the start of the operation of STP in Bor. Establishing of the STP in this region would affect the return of personnel from abroad due to specificity of the region, because there is a large number of our people in different EU countries and the the building of solid infrastructure in the country gives a real chances of some of them to return. Technical Faculty in Bor, a part of the University of Belgrade, has been developing into a respectable scientific institution for 57 years now, and it enables the engagement of scientific staff from other Faculties and Scientific Institutes of the University of Belgrade, which dramatically increases the potential of human resource competencies for STP in Bor. The existing and immediate vicinity of the Sports Center makes the proposed establishment location one of the best in the wider area. The state-of-art infrastructure in equipment located in laboratories of the Faculty and the Institute of Mining and Metallurgy and owned by the state, provides a solid basis for the development of many branches of science, as evidenced by the existing publications of scientific workers from this region. The synergy of all positive factors and the common interest of key stakeholders make this idea very realistic and very useful for a change of the complete image of the entire Timočka krajina region (Bor and Zaječar districts).

References

Brčić, R., & Brodar, K. (2008). Role of Science and Technology Parks in Enterpreneurship Development. The case of Varaždin County. International Scientific Publications: Journal Economy and Business, 1(2), 363-375.

Díez-Vial, I., & Fernández-Olmos, M. (2017). The effect of science and technology parks on firms' performance: How can firms benefit most under economic downturns?.

ПОТЕНЦИЈАЛНИ УТИЦАЈ НАУЧНО - ТЕХНОЛОШКОГ ПАРКА НА РЕГИОНАЛНИ РАЗВОЈ

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Извод

Утицај Научно-технолошког парка (НТП) на развој једног региона може се размотрити кроз многе разлоге за успостављање НТП. НТП представља користан инструмент који ствара услове за промовисање иновација, предузетништва, раст компанија заснованих на знању, док се излазни резултати одражавају на економски раст региона. Због опадања демографских кретања у региону источне Србије, нарочито узевши у обзир младу популацију и феномен "одлива мозгова", циљ НТП је да обезбеди услове за интелектуално удруживање на највишем нивоу, да створи шансе за размену знања и идеја, да побољша потенцијал заједнице и повећа знања и постигне одговарајућу билатералну сарадњу са сличним ентитетима у свету. Овај рад пружа преглед могућих користи од успостављања НТП у граду Бору, на основу научно-истраживачког потенцијала региона Источне Србије.

Кључне речи: научно-технолошки парк, регионални развој, технолошки парк, потенцијал, раст, Источна Србија

Technology Analysis & Strategic Management, 29(10), 1153-1166.

Dyson, R.G. (2004). Strategic development and SWOT analysis at the University of Warwick. European Journal of Operational Research, 152(3), 631-640.

Felsenstainer, D. (1994). University - related science parks "seedbeds" or "enclaves"of innovations. Technovation, 14(2), 93-110.

Ghazinoory, S., Esmail Zadeh, A., & Memariani, A. (2007). Fuzzy SWOT analysis. Journal of Intelligent & Fuzzy Systems, 18(1), 99-108.

Gursel, A. (2014). Science and Technology Parks and University Collaborations. Periodicals of Engineering and Natural Sciences (PEN), 2(2), 35-40.

Hansson, F., Husted, K., & Vestergaard, J. (2005). Second generation science parks from structural holes jockeys to social capital catalysts of the knowledge society. Technovation, 25, 1039-1049.

Janković, R., Dobrosavljević, A., Đorđević, M., Cvetković, V., & Kovačević, J. (2017). Science and Technology Park in Bor. Proceedings of International May Conference on Strategic Management – IMKSM, 745-753.

Kang, B. (2016). Governance Structures to Facilitate Collaboration of Higher Education Institutions (HEIs) and Science & Technology Parks. World Technopolis Association, 5(2), 108-118.

Nauwelaers, C., Kleibrink, A., & Stancova, K. (2014). The role of science parks in smart specialisation strategies. S3 Policy Brief Series No.08/2014, European Union.

Ravanavar, G.M., & Charantimath, P.M. (2012). Strategic formulation using tows matrix–A Case Study. International Journal of Research and Development, 1(1), 87-90.

Sobkowicz, P. (2013). The role of science

and technology parks in communication processes between research institutions and industry. Marketing of Scientific and Research Organisations, 10(4), 2-18.

Stanković, I., Gocić, M., & Trajković, S. (2009). Forming of Science and Technology Park as an aspect of Civil Engeenering. Facta universitatis, Architecture and Civil Engineering, 7(1), 57-64.

van Geenhuizen, M. (2016), Science parks' diversity and broadened roles: New concepts and grounds for evaluation. In Proceedings of XIV Triple Helix International Conference 2016. Triple Helix Association.

Vilà, P.C., & Pagès, J.L. (2008). Science and technology parks: creating new environments favourable to innovation. Paradigmes: Economia productiva i coneixement, 141–149.

Wasim, M.U. (2014). Factors of Science Park Planning. World Technopolis Association, 3, 97-108.

Weihrich, H. (1982). The TOWS matrix-A tool for situational analysis. Long range planning, 15(2), 54-66.

Wyns, T., & Khatchadourian, A. (2016). Situational analysis of EU renewable energy legislation. Climate Policy, 16(5), 568-585.

Zeng, S., Xie, X., & Chiming, T. (2010). Evaluating innovation capabilities for science parks: A system model.Technological and economic development of economy, Baltic Journal on Sustainability, 16(3), 397-413.

Živković, Ž., & Nikolić, Đ. (2016) The Basics of the Strategic Management School of Mathematics, University of Belgrade, Thechnical Faculty in Bor, Bor, (in Serbian).

Web references

Penev, G., & Marinković, I. (2012). First 2011 census results, Large Population Reduction, Demographic Review, Year XII, Number 43/2012, Belgrade. Retrieved from https://www.minrzs.gov.rs/files/doc/porodica/Demografski%20pregled/2012/43%20Prvi%20rezultati%20popisa%202011-Veliko%20smanjenje%20stanovnistva.pdf 2017 Oct 4.

Science and technology park governance, Concept and deffinition. Retrieved from http://www.unesco.org/new/en/natural-sciences/science-technology/university-industry-partnerships/science-and-technology-park-governance/concept-and-definition/ 2017 Oct 4.