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FORMING OF SCIENCE AND TECHNOLOGY PARK AS AN ASPECT OF CIVIL ENGINEERING

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Abstract. *Forming of science and technology parks is followed by the establishment of the appropriate building infrastructure that will form the park basis, as well as accompanying infrastructure facilities in which the professional staff would live and spend their time, and thus create the environment to live and work in. The science and technology park is the term which is used to describe various attempts to encourage the development of entrepreneurship through the establishment of knowledge-based small and medium-sized enterprises. The main goal of science and technology parks is joining the economic and intellectual resources in the region in which the park is established in one unit, in order to improve and enhance the existing companies' business conditions and to concentrate knowledge in one place. For this type of organization it is necessary to choose the area where the park will be built and determine the function of the complex of buildings to ensure the work of the scientists and research workers. In this paper the general conditions, which are required so that the management of the organization that founds the park would achieve the successful results, will be shown. It will present the conditions which are concerned with the necessary human, technological and infrastructural resources for the establishment of science and technology park on one territory, appropriate examples in the world and the beginning of the process of forming the science and technology park in Nis.*

Key words: *Science and technology park, civil engineering, human resources*

1. INTRODUCTION

In most cases, the science and technology parks are founded by transformation of the former research and development institutes. Sometimes they are the product of creative initiative of individuals or groups of creative people such as the ones from research departments or project teams that are dissociated from the larger organizations (the state

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companies, large private companies or research institutes). They continue their activities as non-profit companies, i.e. companies that aren't aimed at gaining profit. Sometimes, they continue their development by using offices, equipment, production space, laboratories, and instruments of their mother institutions and companies. This type of organization is also the natural selection of the most successful managers who will later administer the park in the best possible manner.

As the currently most cost-effective business model that is based on knowledge and exchange of information, there are more and more science and technology parks being open everywhere in the world. Relatively small investments can be returned through the creation of healthy and favorable investment climate, which can spread very quickly to the entire region and even the entire country where the park is located. A lot of countries that had traditional commercial products for many years slowly establish scientific and technology parks on their territories in order to rely more on the economy based on knowledge research.

In our country the formation of science and technology parks in different parts of the country has been discussed for a few recent years, which would, according to foreign experience, start up the economy and attract foreign investments following this type of business. Consequently, that will not only increase the economy in the region in which parks would be established, but also improve the education by quite rapid adjustment to the latest world's technical and technological achievements. Development of education, especially vocational and academic education, and involvement in economic mainstream, would lead to the economic growth and better life not only for the qualified staff directly related to the park, but also for the other branches of economy that have parallel development along with the progress of the park. Inclusion of economy in the scientific and research processes will result in the selection of the quality staff who will administer the park. The staff will connect economy and science and make significant economic progress of the region in which science and technology park will be established.

2. GOALS OF ESTABLISHING SCIENCE AND TECHNOLOGY PARKS

The main goal of establishing science and technology parks is integration of economic and intellectual resources in the region in which the park will be established into one unit, in order to improve and enhance the existing companies' business conditions and concentrate knowledge in one place [1].

There are a number of objectives for establishing of science and technology parks. They depend on the region and state in which the parks is founded. Goals that are common for everyone and naturally create the essential reasons for establishing science and technology parks are:

- cooperation of the existing companies in the field of information and communication technology (ICT) on the realization of major projects that companies would not be able to carry out all by themselves,
- development of the necessary telecommunication infrastructure for easier operations of companies,
- attracting large foreign companies from the field of technical sciences in the region in which scientific and technology park will be founded,

- development of technical faculties belonging to the University in the region,
- employment of larger number of young professionals who will be motivated to stay in the region,
- encouraging innovation and creating a favorable economic environment,
- stimulating the establishing and financing of new companies,
- establishing the economy based on knowledge and innovation.

3. World Experiences in Establishing Science and Technology Parks

The first science and technology park in the world was founded in 1950. It announced the establishing of the Silicon Valley which is now well-known. In Europe, the first park was founded in 1960 under the name of Sophia Antipolis scientific park.

Senator Pierre Laffitte, the founder of the first science and technology park in Europe, had a theory according to which creativity is born from the exchange of knowledge among industry, science, philosophy and art. Thus the application of this concept in France created Sophia Antipolis scientific park.

Today this park has over 1,260 companies that employ about 25,911 people. Around 1,326 new jobs and approximately 30 new companies is opened only in the period between July 2001 and January 2003. [2].

On the basis of [3] if we look at the number of scientific parks in the West and East European countries, it can be concluded that the richest countries and countries with developed education have the largest number of science and technology parks. Thus Finland, France, Germany, Sweden and the United Kingdom have 68% of the total number of science and technology parks on their territory, i.e. 159 out of 234 parks in Europe.

While parks in the world may vary in different shapes and sizes from parks in the middle of urban areas to parks built in suburbs or rural areas; the typical American science and technology park is located in the suburbs with less than 500,000 inhabitants. Parks are usually administered by universities or nonprofit organizational units that are part of universities. In North America there totally 37 parks of which 27 are in the United States of America and 6 of them are in Canada [4].

Over 300,000 people work in North America in the science and technology parks and according to AURP-BATTELLI Technology Practice report [5], each working place in the science and technology parks generates 2.57 jobs in the other fields of the economy, which in addition creates more than 750,000 jobs related to the science and technology parks.

In the past few years the science and technology parks extended to the Middle East, from Egypt, Morocco and Tunisia in the north, to Kuwait, Oman and Qatar in the east. For example, the Persian Gulf states which are rich in oil are searching for the ways to incorporate diversity in their economies preparing themselves for the time after the termination of the use of oil. For countries that are not rich in oil, such as Egypt and Jordan, the science and technology park is a way to escape from poverty, with potentially large profit from the science and technology parks gained without the need for excessive investing in them. According to [6], in the Middle East countries there are about 30 science and technology parks, which are based on information and communication technologies. That is a very large number of new parks founded for a short period of time.

4. NECESSARY CONDITIONS FOR ESTABLISHING SCIENCE AND TECHNOLOGY PARKS

Regis Cabral, a physicist and historian of science and technology, a specialist in the area of international and regional knowledge transfer, became renown for Cabral-Dahab Science Park management paradigm [7], which is used for the evaluation of science and technology parks, business incubators and similar organizations. He also participated in the evaluation of more science and technology parks in the world. Cabral is currently one of the grader and judges for Stockholm City award, named "The Global Challenge Prize". In the world of information technology and information society, this award can be compared with the Nobel Prize in other areas.

Cabral in [7] gives the following ten points that are essential for the management of science and technology parks around the world in order to develop the science and technology park Cabral:

1. Access to qualified professionals for research and development in the area of knowledge which the park deals with.
2. Ability to sell the main products and services.
3. Capacity of the park which provides expertise in the area of marketing and management skills of the companies in the park, especially small and medium-sized companies which lack such resources.
4. Good social and legal basis that enables the protection of business secrets through patents, the security of the environment or in some other way.
5. Possibility of choosing the companies that can enter or cannot enter the park. It is expected that the business plan of the company should be in compliance with the identity of science and technology park.
6. Possession of the clear identity that can be expressed symbolically through the name of the park, its logo or the appointment of the management.
7. The park should have the management with recognized experience in finance and organization of work. The management need to present the long-term economic development plans.
8. The park should have strong, dynamic and stable economic factors, such as fund raising agencies, political and state institutions or local universities.
9. The park should include active individuals who have the vision, the ability to make decisions and clear personality profile in the management of the park. They are seen in the relevant social circles, which will represent the interface between science and industry, long-term plans and good short-term management.
10. The park should include a great deal of consulting firms available on the market and companies that deal with maintenance in technical area, including laboratories and companies for quality control.

5. SCIENTIFIC AND TECHNOLOGICAL PARK FOR THE REGION OF THE CITY OF NIS

Science and technology park which is located in Serbia on the territory of the city of Nis, would be a natural hub to all the integration processes in the region of Southeast Europe. That park would have enormous potential not only to improve the economic climate in the region, but also to contribute to the stability and integration of the whole region.

The role of science and technology parks in Nis would be to enable the region of Nis to reaches a leading role in the development of Serbia as an innovative knowledge-based society in 2013 [8]. Nis, as geographical, cultural, scientific and business center of this part of Europe, will achieve this leadership position through the open, dynamic and natural co-operation with a number of different factors, such as:

- Large concentration of companies in the field of information technology,
- Local community which is effective, transparent and cozy to live in,
- University of Nis, which has excellent reputation. In the University and/or its faculties and research institutes, there are individuals or groups of researchers who are the most recognized world authorities in a certain scientific discipline. The majority of students are students beyond the borders of Serbia, and they pay high fees. There are several world-recognized centers for distance learning. Students find employment in the most notable companies after graduation. Students can very easily open their companies on the basis of knowledge acquired at the University. A few students are founders of companies which achieved world-noticed success.
- Social environment with the high degree of use of modern information and communication technologies.

Currently there are two initiatives for the formation of science and technology parks in Nis, which are seemingly related, but essentially the opposite ones.

The first is the establishing science and technology park "Tesla" on the location behind technical faculties and the industrial zone, on the location of military barracks, for which urban plans and feasibility studies are already developed. The second initiative was launched in September 2008, it is up-to-date and it presumes the recovery and transformation of the former Electronic industry into the scientific and technological park "TEHNIS".

These initiatives are not only different due to the choice of location on which the science and technology park in Nis will be realized, but they differ in the technological profile of the park. Profile of the science and technology park in the first initiative [9] implies the following basic activities of the park:

- information and communication technology,
- software development,
- hardware development and design,
- integration system,
- informatics systems for biological, chemical and medical applications,
- Internet technology and applications and
- robotics and mechatronics.

The second initiative presents the science and technology park "TEHNIS" in the following areas:

- electrotechnics and telecommunications,
- mechanical engineering and
- information technology.

It can be seen that the profile of the park in this initiative is in discrepancy with international standards on the formation of science and technology parks, such as point 6 of Cabral-Dahab's paradigm, which is about the clear identity of the science and technology park. Areas that are not directly related are indicated here, so that the park iself doesn’t have a clear profile which is necessary for the proper development.

Both initiatives are not well promoted in the scientific and entrepreneurial community, which is required in the formation of science and technology parks. In addition to that, Vojin Senk talked at the international conference "Icest 2005" which included panel discussion named "Innovation System and Science & Technology Parks: Present and Future", where he said: " The idea of a science and technology parks should have much more aggressive approach to the public." [8]

A new initiative emerged in October 2008, coming from the General Association for Information Technology Nis [9], Faculty of Electronic Engineering and the Faculty of Occupational Safety, which should complete the shortcomings of the first and the second proposal [1]. The project proposes the establishment of the Center for development and investment in the field of information technology for the region of Nis district within the Ministry of economy and regional development. According to this initiative, the Center would be primarily focused on human resources and engaged in promotion, organization and gathering of scientific, technical and economic resources required for the formation ofthe science and technology park in Nis, regardless of the location on which it would be situated. This way of forming the park is the basis and the right way for the formation of science and technology parks, which can be seen from numerous experiences in the world. According to the project [1], the work of the Center would be based on the strategy of development of information society in the Republic of Serbia, with special emphasis on the point 10, „The development of the business sector of information and communication technology", as well as t point 5, „Establishment of industrial and technological parks and industrial zones to encourage identified industrial sectors", of the concept for industrial development of the Republic of Serbia, which is the basis on which this type of body can achieve noticeable results.

The first step in any initiative that involves the formation of science and technology park in the area of Nis region should be the formation of high-quality staff committed to creating experts who would join such an initiative, as well as animation of the existing economic potentials in the realm of future activities of science and technology park. It is possible to predict success and conception of such a park in our area only with the experts who respected international experience and standards.

Strategy of establishing science and technology parks in the world is well known but apparently it is either not applied in our country, or has a poor application. Therefore, it is primarily necessary to establish the management similar to foreign experience that would deal with all the problems following the formation of institutions, such as the science and technology park.

The formation of a successful, modern and competitive science and technology park in Nis, according to the social situation in our country, would be possible only if the implementation of the project would include the broader scientific and professional public, businessmen, media, NGOs and consulting houses in the region. The involvment of wider social potentials enables to achieve goals on which grounds every science and technology park is formed, and which include the change of economic situation and investment climate.

6. VISION OF THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY PARKS

Science and technology parks are sources of entrepreneurship, talent and economic development of countries. They are key to the stimulation of economic progress in a country, as well as to the improvement of the global knowledge-based economy.

When the state administration, universities and private companies intersect in the same location, then the science and technology park creates the environment which promotes collaboration and innovation, and encourages development, transfer and commercialization of technology. As a result of that the number of jobs is increased and the standard of people living in the vicinity of science and technology park.improved

New, future model of science and technology park is a vision which is about to be achieved. The model presents strategic planning and expansion of the University Campus in which researchers employed in industry and researchers from the University can work side by side. This model is oriented towards the university and it is not only based on cooperation in the real estate business, but also on the inclusion of the university in broader activities of companies. The University will offer various services, such as access to researchers, specialized facilities and laboratories, as well as students, and, thus, it will be promoted as the new environment to live and work in.

7. CONCLUSIONS

The necessary base for establishing science and technology parks is a scientific and technical potential in the form of scientific and development research centers and institutions. Their human resources, material and technical infrastructure, computer science infrastructure, expertise in the methodology of scientific research and expertise in management are very powerful assets for the initial formation and development of science and technology parks. This way of establishing is the healthest form of founding technological parks.

The construction of residential and business infrastructure is an important link in the process of park formation. The construction is a phase of development of the park, and not a phase of its establishment. This phase creates better conditions for working and living in the park, it creates working environment that contributes to faster and advanced improvement of the staff employed and the park itself. In return, Universities get enough space for their laboratories and institutes, and they can achieve noticeable results in science and economy in cooperation with corporate entities situated in the park.

For all that, it is necessary to have regulated spatial plan on which the science and technology park will be built, with all the accompanying infrastructure required for the construction of scientific and research institutions. It is also necessary to build adequate business offices and provide life environment for young scientists and researchers who work in the park. The synergy of all that and having all under the same roof will produce results that have been known in the world for a long time and which can effectively change the situation in our area. New ideas which come from young and educated people, accompanied with international experience, realized by the management of the park, will guarantee success in the economy and the science here, as well as everywhere in the world.

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FORMIRANJE NAUČNO TEHNOLOŠKOG PARKA SA ASPEKTA GRAĐEVINSKOG INŽENJERSTVA

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Formiranje naučno tehnoloških parkova obavezno prati i formiranje odgovarajuće građevinske infrastrukture koja će činiti osnovu parka kao i pratećih infrastrukturnih objekata u kome će stručni kadar zapošljen u parku živeti i provoditi vreme stvarajući tako jednu životnu radnu sredinu. Naučno tehnološki park predstavlja pojam, koji se koristi da opiše raznovrsne pokušaje da se podstakne razvoj preduzetništva putem osnivanja na znanju zasnovanih malih i srednjih preduzeća. Osnovni cilj osnivanja naučno tehnoloških parkova je objedinjavanje privrednih i intelektualnih resursa u regionu u kome se osniva park u jednu celinu, kako bi se poboljšali i unapredili trenutni uslovi poslovanja kompanija i znanje skoncentrisalo na jednom mestu. Za ovakav vid organizovanja potrebno je odrediti prostor na kome će park biti izgrađen kao i funkcionalno opredeliti građevinske celine za nesmetan rad naučno istraživačkog kadra. U ovom radu biće prikazani opšti uslovi potrebni da bi menadžement organizacije koji osniva park imao uspešne rezultate. Prikazaćemo uslove koji govore o potrebnim ljudskim, tehnološkim i infrastrukturnim resursima za osnivanje naučno tehnološkog parka na nekoj teritoriji, adekvatne primere u svetu i početak procesa formiranja naučno tehnološkog parka u Nišu.

Ključne reči: *naučno tehnološki park, građevinsko inženjerstvo, ljudski resursi.*