

MANAGEMENT OF SCIENCE AND TECHNOLOGY PARKS IN TERMS OF INNOVATIVE ASPECTS

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ABSTRACT

The aim of the herein paper is to present the processes of managing science and technology parks by means of indicating their essence, types and domains of activities. Moreover, the attributes of these parks were emphasized in the context of the innovative processes. Pilot research was conducted which concentrated on the institutionalization and functionality of the science and technology parks which facilitated the formulation of conclusions relating to the cooperation between enterprises, science and technology parks and the sphere of science in terms of innovativeness.

KEYWORDS

Management, science and technology parks, innovativeness, cooperation.

Introduction

The subject matter of the management of science and technology parks should be enumerated among the relatively new concepts undertaken in Polish literary sources to a small degree. The reasons for this state of affairs may include the short period of functioning of the science and technology parks in Poland, whereby between the 20th and 21st centuries there were calls for this type of organization to come into existence. As opposed to the developed market economy, in which science and technology parks became the accelerators and creators of innovativeness, the dynamics of these parks in Poland is still not high. Science and technology parks strengthen their position in society and in the economy by undertaking cooperation with institutions representing science and enterprises as entities of the sphere of business. This cooperation is a connector in itself, or a platform for the exchange of new technologies generated in the fields of science and business. These entities integrate activities that facilitate the growth of innovativeness as the identified market demand for new and innovative products and services.

On the one hand, market analysis provides information referring to demand, while on the other hand it has an impact on the supply of innovative goods and services. The market decisions of consumers and producers determine the directions of management in science and technology parks and in enterprises representing the side of market supply. In this context, the model of the functioning of science and technology parks was indicated in the sphere of providing support for innovative policy. The optimal model solutions lead to the fact that science and technology parks are acknowledged in scientific environments. The heterogeneous effects achieved as a result of the cooperation between science and technology parks and enterprises are first and foremost the result of the efficient management of the afore-mentioned organizations. The circumstances of the cooperation of science and technology parks in terms of SMEs has an impact on the research theme.

In the herein paper, the theme was accepted that the assumption was accepted that a dependency exists between the magnitude of enterprises and the science and technology parks cooperating with them in the sphere of innovativeness.

Essence, types and domains of science and technology parks

A market that matches the demand of consumers informs about the particular demand for the results of innovative activity. A significant role in the innovative processes is played by the science and technology parks by means of stimulating and implementing undertakings, which result in the supply of new or enhanced goods and services [1]. The acceptance by the clients of the innovative products and services leads to the increase in their supply, albeit usually at a higher price [2]. As a consequence, the processes of further growth in supply occur until the moment in which another new product or service appears as a result of the dynamic innovative activities, which are executed in among other areas, the science and technology parks. In order to achieve the assumed goals, this activity requires the appropriate management of the science and technology parks, which illustrate significant differentiation in terms of the name and nature of activities [3].

In terms of the definition of the science and technology parks, it is important to refer to the three basic types of entities. These are technological parks, industrial parks and scientific parks. In the definition of the technological park, in accordance with the bill on supporting investments of a financial nature, it is assumed that its essence is ... “a group of separate properties, together with the technical infrastructure, which is created with the aim of the flow of knowledge and technologies between scientific units and entrepreneurs” [4]. This definition first and foremost illustrates the potential of technology and infrastructure that is designated for enterprises [5].

In another definition a technology park is ... “an organized group of higher level colleges, research centres, enterprises representing advanced technologies ... and varied service firms ..., which are units spatially concentrated with the aim of creating favourable conditions for the development of a broad perception of innovative activities” [6]. By way of continuing deliberations in the sphere of identifying the aforesaid entity, it is assumed that ... “a technology park is a specific entity for the promotion of innovation executed as a symbiosis of scientific research and laboratory research of an advisory and productive nature” [6]. The second type of organization is an industrial park [7]. This park is defined as a set of “... separate properties, which consists of at least real estate where technical infrastructure may be found following restructuring or liquidation of an entrepreneur’s business operations” [4]. A park of this type refers to the basis of the civil-legislative agreement entered into by a self-governing territori-

al unit as one of the parties to the agreement that creates the base for undertaking business activities, which is usually with a small or medium-sized entrepreneur. The science park as a further type of organization is defined as ... “an institution of management by specialists, whose principal aim is to advocate innovative culture, while also the competitiveness of the science and research institutes and associated firms in the park” [4]. In the science park, the processes of management in the sphere of the flow of knowledge and technologies are conducted between organizations of the nature of colleges, science and research institutes, while also enterprises. In terms of the functions fulfilled, the science park illustrates great convergence with a technology park. The difference comes down to the implementation of prototype production in the scientific park. In accordance with the definition of UKSPA (British organization of science parks) the science park is an initiative based on ownership which has formal and operational connections with the university or research centre. Furthermore, the task of a science park is to encourage the creation and development of firms based on knowledge, combined with cooperation with other organizations located at a small distance from the park [8]. Science and technology parks display a large range in the science-technology-economy chain as it constitutes a significant element in combining and processing the innovative concepts in technological undertakings at a high level of modernity, which is to be found in manufacturing enterprises [9].

A science and technology park can be also described as a cluster of independent firms and supporting organizations, which is based on knowledge and tries to take advantage of a certain competitive advantage in a specified field of technology [10]. Science and technology parks “facilitate the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities” [11]. On the basis of the three types of definitions of science and technology parks distinguished, it is possible to adopt your own definition of these organizations for further deliberation, namely, science and technology parks are organizations that are concentrated entities of science and business in the area of innovative activities that in turn ensures an increase in the competitiveness of the cooperating enterprises. The processes of management in the sphere of the flow of knowledge and innovative technologies are conducted in these parks between organizations, which are usually co-financed within the framework of projects that facilitate a high level of modernity of the enterprises involved [12].

In subject-based literature, the differentiation of the definitions of science and technology parks is emphasized, albeit it is possible to indicate three characteristically common features as follows [13]:

- concentration on high-tech industry and a specialization of services in parks,
- selection of a technological university or institution with whom enterprises cooperate on the basis of formal agreements,
- promotion of knowledge transfer.

It is assumed that the aim of science and technology parks is to advocate regional development via the mechanisms of supporting entrepreneurship, innovations, technology transfer for the increased competitiveness of SMEs [4].

The fundamental elements of science and technology parks are as follows: surface area, universities, together with R&D institutions, as well as SMEs.

Analysis conducted on the definitions of science, industrial and science and technology parks determines the basis for the definition of the specifics of the afore-mentioned organizations. The following features that distinguish science and technology parks may be acknowledged [9]:

- the aim, which is identified as the generation of innovativeness on the basis of the development of knowledge in the chain of science – technology – the economy for the enhancement of the level of competitiveness,
- the form of activity that is aimed at the execution of science and technology projects,
- the organizational structure of a decentralized nature that is created by an entity of the science and technology parks in cooperation with organizations (universities, R&D institutions, enterprises, other parks),
- resources characterizing the high level of modernity in order to ensure the execution of innovative undertakings,
- acquiring funds from the EU programs of economic development of technological potential,
- promotion of pro-consumer approach in the area of a modern product and service offer, while also the acquisition of supply gaps on the market,
- adjusting the offer of cooperation to the magnitude of enterprises, financial standing, staff resources and strategies,
- priorities in cooperation with SMEs,
- location nearby scientific centres,
- provision of services for enterprises in the area of innovativeness,
- revitalization of regions.

Taking account of the afore-mentioned specifics, the emphasis of the differences between the science and technology parks and economic entities is

justified. The basic difference is the result of the aims of these organizations. Science and technology parks are created for the generation of innovativeness, whereas the aim of enterprises is to achieve profit as a result of the business activities conducted. The prevalent form of activity for parks is that of projects, while enterprises conduct business activities on the basis of plans, in which the implementation of projects indicates less significance. The projects in science and technology parks ensure the increase in the level of competitiveness on the market by means of innovative solutions. The role of innovations, particularly in SMEs is miniscule, however economic organizations have motivational systems that stimulate the launching of innovative products and services. The implementation processes are executed by personnel of the required qualifications, while simultaneously, an important function is fulfilled by the leaders of the innovation.

In science and technology parks, the fundamental obligations of the personnel are associated with the preparation and execution of projects by competent leaders and teams of employees. Employees dealing with projects in science and technology parks must display competences that are guided by inspiration for innovative concepts.

In carrying out a description of the characteristics of a park, it is necessary to emphasize its cooperation with universities, research institutes, as well as other institutions.

Colleges and enterprises are worthy of recognition, which within the framework of joint projects prepare new technologies that create innovativeness. A significant role is played by knowledge and the inter-organizational relations on the basis of which the processes of management for organizations are conducted [14]. In these processes, the boundaries of an organization need to be ensured. It is worth underlining the fact that within the boundaries of an organization there is a mechanism of feedback that renders the appropriate exchange of information possible, together with the improvement of the management of an organization [15]. The management system is geared towards the preparation and execution of research and innovative projects within the framework of the cooperation between the science and technology parks and enterprises that create new market potential for business [16]. The expansion of the domain of the functioning of the science and technology parks is essential for the aim of the further development of innovativeness.

In the activities of these organizations, decision-making processes are required that are concentrated on enterprises, particularly SMEs, which search for systems of support for their own development. Like-

wise, support for the activities of economic regions is also required.

There is also an inverse relation as science and technology parks may avail of support from government and local self-government organizations. This support is usually associated with the attractiveness of the parks for the enterprises of the region at hand that become dynamic in terms of the development of innovativeness. As a result of the development processes, significant effects are achieved.

Technology transfer is determined by first and foremost the magnitude of the enterprises. Large enterprises that have significant capital resources at their disposal attain greater profits than small and medium-sized enterprises that have a chance to increase innovativeness with the appropriate location.

The execution of aims is possible when transparent mechanisms are defined in organizations for the determination and assignment of tasks for managers and employee teams. The organizational schemes require the implementation and functioning of the appropriate motivational systems that integrate the tasks of the managers of the science and technology parks with the activities executed by the personnel of the enterprises.

The results of the project cooperation in the science and technology parks may be listed in two groups. One group is the “economic results (including sales, exports, cost, profits, employment, internal R&D or productivity)” [17]. In the second group, we may find “intangible results (including the increased ability to formulate strategies, enhanced human resources and better management of information and relationships)” [17].

The aforesaid results are attained as the consequence of cooperation in the sphere of R&D, while also government and local self-government organizations. The integrative nature of the cooperation among the aforesaid organizations has an impact on the dimension of the economic effects in the partic-

ular entities by means of the common execution of goals, particularly in the case of SMEs. The most important aims may be acknowledged to be the presentation of a modern product-services offer on the market by means of concentrating on the supply gap, while also enhancing the innovativeness as a result of the EU projects executed, which are aimed at the increase in the level of competitiveness.

Undertaking the evaluation of innovativeness would seem to be justified in the context of the magnitude of enterprises. Indicating the cooperation of enterprises with science and technology parks encompasses areas of resources. Their magnitude is the result of the potential of the business entities and the personnel of the entities involved. These may include work in the sphere of creating cooperation, while also preparing motivational systems and procedures of action for the personnel of the organizations involved. The distinction of small and medium-sized enterprises is relevant here. The magnitude of enterprises has an impact on the innovative processes. Hence, it is important to establish the tasks undertaken in the organizations cooperating on behalf of innovativeness.

Decision making process in technology and science parks in terms of the aspect of innovative goals

Conducting comprehensive analysis of the management of the science and technology parks requires the inclusion of multiple aspects in the area of deliberation [18]. Due to the vast area of research, the creation and execution of the innovative aims in the science and technology parks that cooperate with their environs were deemed to be justified [19].

With the aim of presenting the functioning of the science and technology parks, it is justifiable to refer to their attributes (Table 1).

Table 1
Attributes of functioning of science and technology parks.

Basic attribute	Particular attribute	Characteristics
Aims and tasks designated in the activities of science and technology parks	Preparation and execution of innovations	Preparation of conditions for innovative activity.
Innovative- conditions of creating networking of science and business	Execution of innovative projects	Accumulation of knowledge and its utilization in projects of an innovative nature. Analysis of crisis-based factors in innovative activities.
	Management processes, particularly knowledge management	
	Creating value for stakeholders	
	Supply offer for new or enhanced products and services	
Infrastructure as the conditioning of the innovative processes of production	Scientific-research potential that facilitates the preparation and implementation of innovative projects.	Ensuring constant development of infrastructure in terms of tangible and financial aspects.
IT systems	Having modern IT technologies at your disposal	Implementation of modern IT networks.
Environment: state administration, entrepreneurs	Financial support from EU funds and institutional and financial aid	Motivating and legislative regulation of innovative projects

Source: [20].

Within the framework of these attributes, both the basic and detailed ones have been distinguished. The basic attributes have been acknowledged to be the aims, infrastructure, IT systems, while also the environs. Each basic attribute has been defined in detail. From the viewpoint of the subject matter of deliberations, it is necessary to distinguish the potential for the creation of values as a result of innovative projects. The problem of designating the boundaries of organizations cooperating in the science and technology parks is of significant importance. Likewise, it is important to flag threats that may lead to a crisis.

Science and technology parks conduct activities in a multitude of areas, while also in specified circumstances. The aim and system of management is significant in the sphere of cooperation between the science and technology parks and other entities and institutions. Within the framework of cooperation, integration of the aims of the science and technology parks and the aims represented by the other stakeholders takes place. The fundamental integrative element may be accepted as that of innovativeness which is created by the science and technology parks, together with science and enterprises, which are first and foremost executed in the form of EU projects.

Hence, the evaluation of the science and technology parks is a significant issue.

The parameters for the evaluation of the science and technology parks in accordance with the European Commission are those of the data in the following spheres [21]:

- the area of the park,
- the number of firms located in the park, together with the number of employees, while highlighting the employment structure with regard to qualifications,
- the offer of lease and type of general services provided, broadband connections, possibility of conference calls, conference rooms, administrative support, list of free services,
- range of professional services: accountancy, risk funds, advertising with breakdown into ones that are free and those that require additional fees,
- investment projects executed within cooperation with other organizations.

In the analysis of the functioning of the science and technology parks, the problem of the activity and entrepreneurship of business entities in the context of mutual relations is undertaken. Relations of this type relate to two basic areas [22]. One of these relates to the tangible resources and cooperation in this case involves the possibility of availing of laboratories and the acquisition of financial resources for innovative activity [23]. The second area is determined

by intangible resources [24]. The basic relations of the science and technology parks are shaped on the basis of technical support and consultation, while also information and knowledge in the sphere of new technologies [25]. Furthermore, a significant role is played by the joint projects, together with business partnership, while also informal contacts of employees that coordinate the utilization of resources [26].

The processes of management in the science and technology parks have been referred to the employees of these organizations. The identification of three groups of employees and their tasks has been conducted. The first group took the determinants of the decision-making preparation into account, while the second one concentrated on the reactions and the third one dealt with the execution of the allocated tasks. On this basis, several sub-models were developed with differentiated characteristics for each group. It is assumed that the most important role in the management of the science and technology parks is played by the determinants of innovativeness. The critical state of the evolution of the processes of management illustrates the necessity to strengthen the position of the government, industry, while also the scientific and research field, which these entities display as the priorities for the development of the country. In the afore-mentioned relations, the entities may be expected to achieve positive results of cooperation [27].

One of the interesting approaches is the indication of the model of the functioning of the science and technology parks in the area supporting market policies for the theory of management "... the development of business models and their constant innovation – driver evolution has gained more" [28]. This distinguished the tasks of managers that execute the aims of the science and technology parks and create innovativeness in the processes of management. The level of knowledge management in enterprises is also important [29].

The science and technology parks are organizations that execute innovative policies, while the geographical location is particularly significant. It is assumed that close proximity is important for the implementation of innovation as smaller geographical distances facilitate direct contact and knowledge transfer. Local circumstances also have an impact on the aim of parks in the sphere of supporting the environment, strengthening the networking of enterprises. The favorable location of the science and technology parks ensures the achievement of external effects by the enterprises within the framework of cooperation with colleges. Strategic contexts are also taken into consideration.

The aspect of the location of the science and technology parks requires an evaluation of the choice of these organizations by the enterprises [30]. The appropriate structure of an organization has an impact on the results of the activities of the parks in question. These parks indicate differentiated economic effects with regard to the fact that the cooperating enterprises significantly vary in terms of the efficiency of operations, while moreover their results are influenced by the development of the region where they are located. Great responsibility for the economic performance lies with the managerial staff [31]. The management of these parks over a short term of functioning that involves financial problems, while also the shortage of specialized knowledge leads to the case whereby the managerial staff is forced to undertake intricate decisions in order to ensure the execution of the assumed goals. It is emphasized that in this situation, the science and technology parks support the cooperating enterprises in terms of financial and marketing aspects, thus creating a safer basis for the strategies of their development [32]. Simultaneously, it is indicated that the managerial staff of the parks should strengthen the function of support for business and restrict the function of managing the science and technology parks. An important problem is the transformation of scientific accomplishments into final innovations, namely, whether universities and enterprises can illustrate commercial competences in the area of cooperation with these parks or not. The managerial staff is faced with challenges in terms of transforming knowledge into a commercial outcome [15].

To sum up the literary analysis, it is possible to state that science and technology parks are significant organizations that create innovativeness in enterprises located in these parks. Their activities are determined by their domains and capital at their disposal. Moreover, the relations between enterprises and science and technology parks is worth emphasizing [32].

These relations reflect cooperation that is aimed at creating knowledge and innovativeness in science and technology parks [33], which are identified as key organizations of economic and social growth.

Problematic issue of managing science and technology parks from a historical perspective, as well as the prevailing circumstances in the European Union

Conducting an analysis of science and technology parks justifies a reference to a historical outline of their emergence.

The first two science and technology parks were established in the 1960s in the USA (Stanford Research Park and the Research Triangle Park), while subsequently in the 1970s in the UK (Research Park Heriot – Watt) [34]. The significant dynamics behind creating science and technology parks were characteristic of the 1980s, 1990s and the beginning of the 21st century. In this period alone, 30, 48 and 18 science and technology parks were established respectively [9].

After establishing the first science and technology parks in the USA, there was a fast increase in their numbers all over the world. The general evaluation of science and technology parks reveals that these organizations indicate great differentiation in terms of the assumed goals, conditions and efficiency of activities [35].

By taking the afore-mentioned circumstances into consideration, it may be stated that the aim of science and technology parks in the EU is to support regional development, while also commercialize scientific research that has an impact on the innovativeness of the economy. It is estimated that approximately 500 science and technology parks function in the EU. The greatest number of parks are to be found in: Spain, France, Great Britain, Italy, Finland and Germany [9].

In the EU, over the last 15 years the number of science and technology parks has doubled [21]. These parks are first and foremost availed of by small and medium-sized enterprises (approximately 90%), while also enterprises located close to these parks (approximately 84%) [13].

For instance, in the financial perspective of 2014–2020, investments were planned that were designated for R&D work, innovations, informatization for SMEs at the level of 160 billion euro [13].

An outline of the problematic issue of the functioning of science and technology parks in the EU presented justifies the reference to the experience of the chosen countries in this area, albeit only in the form of the highlighted problem. The justification of the accepted assumption is illustrated by vast literary sources related to the problem in the area of the functioning of the science and technology parks. In the period 1986–2016, 56 literary works in this sphere were published, which indicates great interest among theorists and practitioners in the problematic issue of the management of the science and technology parks [35]. In this paper, only the experiences of the UK, Finland, Spain and Poland have been illustrated.

The first science parks in Great Britain were opened at the beginning of the 1970s. The development of the parks was decided by reforms of the activities of universities, which were accused of mak-

ing a small contribution in terms of creating innovativeness in British industry. The financial offer for universities in exchange for a significant contribution in the development of the economy turned out to be the stimulator of change in universities and in the economy.

The afore-mentioned motivational systems caused the occurrence of a second intensive period of the formation of science parks in Great Britain. The precursors of initiatives in these entities are deemed to be the universities of Aston, Birmingham, Manchester and Warwick. The 1980s brought with it the dynamic growth of universities first and foremost as a result of the cooperation with science and technology parks, whose number rose to over 100 [9].

A very significant role in the economy of Finland is played by the science and technology parks. "The pioneer of the Finnish Science and Technology Parks was the Oulu Technology Park, which was established in 1982. The Finnish Science Park Association has 29 members" [34]. The most recognizable innovative program executed by the science and technology parks were the projects of cooperation in the Finnish telecommunications company Nokia [34]. The science and technology parks in Finland were geared towards the development of the innovative systems in the country by means of cooperation between universities and enterprises.

In the mid-1990s, the first science and technology parks appeared in Spain within the framework of "... a strategy of regional development without any formal link with universities or the central government" [21]. At present, in Spain there are 57 science and technology parks in operation in 16 out of 17 regions [32].

The activation of the activities of the science and technology parks in Spain occurred in 1999 with regard to the expansion of the initiatives for R&D, particularly as a result of the execution of EU projects. These projects concentrate on the development of the regions, while each region has its own science and technology park, which supports the development of SMEs.

The initiative of establishing the first science and technology parks in Poland emerged at the end of the 1980s. The first entity of this type is deemed to be Poznański Park Naukowo – Technologiczny (Poznań Science and Technology Park) [9]. Currently, there are 73 science and technology parks in operation in Poland. This number includes parks that are defined to be industrial, technological, industrial/technological, innovations, science, park centers.

It is emphasized that the attractiveness of the locations of the science and technology parks is the

result of the assumptions of regional development, while also the perspectives of the activation of SMEs. The principal segment of the science and technology parks is acknowledged to be small and medium-sized enterprises that avail of the offers of these parks in the area of innovations.

In subject-related literature, there are concepts of the new generation of science and technology parks that will require increasingly comprehensive views on innovations. New parks should activate broader eco-systems of innovations within the framework of cooperation in knowledge transfer.

The changing circumstances require the execution of empirical research, which has been presented in the subsequent sections of this paper.

Analysis and evaluation of cooperation of science and technology parks with enterprises in the context of empirical research

On the basis of pilot research results, it is possible to underline that with the aim of improving the activities executed, enterprises undertake cooperation with the science and technology parks. This pilot research was conducted on a sample of 167 enterprises of varying magnitude. The principal aim of the research was that of activities undertaken on behalf of the development of the innovativeness of the afore-said enterprises. There is a prevalence of cooperation with universities of a direct nature (51 enterprises), or executed as an indirect form of cooperation by means of utilizing the science and technology parks (65 enterprises). Enterprises that do not conduct this type of cooperation hold a significant position (31 enterprises). Employees who do not have knowledge on the issue of cooperation are representative of 20 enterprises. By way of conclusion, it is possible to state that the vast majority of the analysed enterprises cooperate with the sphere of science and research by executing innovative undertakings by means of the science and technology parks.

Further research reveals that enterprises that undertake cooperation with science and technology parks execute their specified goals. These include the following: presenting a modern product-service offer, enhancement of the competitive position, as well as the acquisition of EU projects in order to increase the level of innovativeness, while also to acquire a market niche for the products of the enterprise. On the basis of the structure of the responses, it is possible to state that the ranking of the aims is comparable to the particular groups of enterprises.

Furthermore, the responses of the respondents indicate that in spite of undertaking cooperation with the science and technology parks, a small percentage of enterprises (approximately 10% do not indicate interest in this form of cooperation). The group of enterprises in which there is a very low level of involvement in terms of cooperation with the science and technology parks amounts to approximately 20%. It would seem to be justified to connect groups of enterprises of medium and high levels of involvement in cooperation with the science and technology parks. However, enterprises that are characterized by a very high degree of involvement in terms of cooperation with the science and technology parks are worth emphasizing. On average, these constitute approximately 20% of the total number of enterprises analysed. Moreover, a group of respondents gave the response that they do not have information about this issue. Percentage-wise, this group amounts to approximately 10%. Relations occurring between enterprises and organizations of the sphere of science and research are confirmed by the ranking of the processes of management, which are directed towards relations involving a multitude of important goals. Management of the afore-mentioned relations first and foremost facilitates an improvement in the level

of innovativeness and competitiveness of enterprises (Table 2).

Within the framework of the evaluation of the level of involvement of enterprises in terms of the execution of the aims of cooperation with the science and technology parks, the average evaluation was also calculated by means of the following equation:

$$\bar{n} = \frac{n_1 + n_2 + n_3 + \dots + n_m}{m}, \quad (1)$$

whereby n_1, n_2, \dots, n_m are the consecutive numbers on a 5-degree scale of assessment encrypted as follows: 1 – lack of involvement; 2 – very little involvement; 3 – medium-level of involvement; 4 – high level of involvement; 5 – very high level of involvement.

The results have been presented in Table 3.

Analysis of the average evaluation attained indicates that the most important aim that is associated with the highest level of involvement of firms in cooperation with the science and technology parks is the modern product-service offer. In turn, the least enthusiastic firms become involved in cooperation with the aim of enhancing their competitive position. All the average assessment scores simultaneously indicate that the level of this involvement is medium at most.

Table 2
List of aims of cooperation between enterprises and science and technology parks.

Evaluation of level of cooperation with scientific-technological parks:	Aims of cooperation of enterprises with scientific parks			
	Modern product-service offer	Enhancement of competitive position	Acquisition of EU projects for improvement of innovativeness	Searching for supply gaps on the market
1. Lack of involvement	11	9	13	10
2. Very little involvement	31	31	33	37
3. Medium level of involvement	34	31	32	33
4. Large involvement	41	39	41	40
5. Very large involvement	32	38	33	28
6. I do not have any information	18	19	15	19
Total number of enterprises analysed	167	167	167	167

Source: Self-analysis on the basis of research

Table 3
Average evaluation of level of involvement in execution of aims of cooperation between enterprises and science and technology parks.

Aims of cooperation between enterprises and scientific parks	Modern product-service offer	Enhancement of competitive position	Acquisition of EU Project for improvement of innovativeness	Searching for supply gaps on the market
Average evaluation	3.35	2.83	3.11	3.26

Source: Self-analysis on the basis of research

The reason for this state of affairs is to be found in the relations with the magnitude of the entity in question. With this aim in mind, analysis of the statistical dependencies between the magnitude of the entity and the level of involvement in terms of the particular aims of cooperation was conducted. With the aim of assessing the statistical significance for the particular pairs of variables, a calculator of the level of significance was availed of. At first, the dependency between the magnitude of the entity and the average assessment of involvement in terms of the execution of the particular aims of the non-parametric test of chi-square of the equation expressed was analysed as follows

$$x^2 = \sum_r^{i=1} \frac{(y_i - np_i)^2}{np_i} \quad (2)$$

whereby y_i – the number of values observed from the particular section, np_i – the number of which should be found in the particular section.

A high level of significance and the chi-square coefficient have been stipulated in Table 4.

Statistically significant dependencies between the magnitude of the enterprises and the aims of cooperation with these parks have been listed. Micro-sized and small entities undertake cooperation with the aim of enhancing their competitive position, while also with the aim of acquiring EU projects for improving innovativeness. All of these dependencies are characterized by a medium level of impact. A significant statistical dependency for all aims was only

listed in terms of relations with medium-sized enterprises, which signifies the fact that the entities which cooperate with the science and technology parks in order to vary their offer have become more competitive and innovative, while also gain new business partners. All these relations have a medium level of impact. There is one statistical dependency that exists between the large firms and the aims of cooperation with the parks. Large firms, which are simultaneously the most sovereign and independent, only gain from the cooperation with the parks with regard to the expansion of their product and services offer. Hence, a clear trend is observed in which the larger firms are willing to conduct cooperation with external entities in order to gain specific benefits for themselves. This may also result from the availability of EU programs for the development of primarily the sector of SMEs.

The desire to cooperate with the environment is only one of the dimensions of the development of the innovative activities of firms. Apart from this, they also conduct internal activities which most frequently encompass the designation of the leaders of innovativeness (53 responses), while also combining the various modern solutions in accordance with the stipulated strategic aims of the enterprise (45 responses). With the aim of checking the significant dependencies between the magnitude of the entity and the activities conducted within the firm, the statistical test with the use of the non-parametric chi-square test was once again applied. The results have been presented in Table 5.

Table 4
Testing dependencies between magnitude of firm and aims of cooperation with science and technology parks.

Specification		Modern product-service offer	Enhancement of competitive position	Acquisition of EU projects for improvement of innovativeness	Searching for supply gaps on the market
Micro-sized firms	Bi	0.841	0.031	0.023	0.432
	Pc	0.329	0.342	0.432	0.123
Small firms	Bi	0.043	0.012	0.006	0.213
	Pc	0.313	0.421	0.442	0.321
Medium-sized firms	Bi	0.043	0.001	0.018	0.048
	Pc	0.513	0.476	0.401	0.365
Large firms	Bi	0.029	0.054	0.432	0.053
	Pc	0.512	0.387	0.383	0.376

Source: Self-analysis on the basis of research.

Bi – Bilateral importance, Pc – Pearson coefficient.

Table 5

Testing dependencies between magnitude of firm and internal activities undertaken in the name of increased innovativeness.

Specification		Micro-sized firms	Small firms	Medium-sized firms	Large firms
Creating research teams	Bi	0.759	0.735	0.047	0.002
	Pc	0.321	0.452	0.254	0.422
Commissioning work of innovative nature to scientific-research units	Bi	0.143	0.099	0.045	0.030
	Pc	0.444	0.765	0.298	0.323
Conducting cooperation with colleges in the sphere of R&D	Bi	0.343	0.998	0.049	0.002
	Pc	0.514	0.865	0.300	0.353
Implementing stimulators of motivation for personnel	Bi	0.019	0.046	0.048	0.004
	Pc	0.513	0.345	0.283	0.374
Propagating innovative activities outside of the motivational systems	Bi	0.041	0.032	0.020	0.038
	Pc	0.372	0.377	0.351	0.382
Combining the afore-mentioned courses of innovative activities in the context of the strategic aims of enterprises	Bi	0.143	0.112	0.006	0.004
	Pc	0.642	0.754	0.402	0.321
Conducting analysis of solutions in crisis situations	Bi	0.073	0.048	0.042	0.035
	Pc	0.544	0.235	0.376	0.363
Creating leaders of innovation	Bi	0.121	0.053	0.132	0.022
	Pc	0.511	0.381	0.312	0.372

Source: Self-analysis on the basis of research.

Bi – Bilateral importance, Pc – Pearson coefficient.

It has been observed that the greater the enterprises, the more internal activities are conducted on behalf of the increase in the innovativeness of the entity in question. Micro-sized entities only stimulate their personnel by means of the systems of motivation and other activities. Small enterprises also add the analysis of new opportunities in crisis situations. Among the medium-sized enterprises, there was an additional combination of the various activities with strategic aims, creating cooperation with the scientific centers and commissioning tasks to them, while also creating research teams. A totally important statistical dependency exists between the large firms and internal activities, which signifies the fact that these entities are the most active in terms of the pursuit towards the development of innovativeness as the effect of the implementation of internal solutions and procedures.

Conclusions

The functioning of the science and technology parks in the market economy facilitates the achievement of a multitude of various positive effects. It is necessary to acknowledge the fundamental result as that of fulfilling the function of the creator of innovativeness for enterprises, as well as the organizer of the transfer of new technologies. The afore-mentioned courses of action are the result of the ability of divergent and convergent thinking. Divergent views are directed towards creative thinking, whose aim is first

and foremost innovativeness in the science and technology parks and other organizations. The convergent nature of the pro-innovative views creates the potential for the formulation of tasks with multiple variants for solutions within the framework of the cooperation with the science and technology parks undertaken with enterprises and the sphere of science. The results of pilot research reveal that the vast majority of the analysed enterprises conduct cooperation with the science and technology parks. Nevertheless, it is noticeable that a certain percentage of enterprises do not conduct such cooperation. The thorough research, which was adopted as an assumption involving the testing of the dependencies in the sphere of the magnitude of enterprises and the pro-innovative activities, it is possible to formulate the conclusion that the larger enterprises undertake more innovative undertakings by comparison with smaller entities.

The perspectives of the development of innovativeness in society and the economy would seem to be a flow of inspiration. The intensity of the scientific and technological processes has undergone constant acceleration and transgresses the boundaries of knowledge and organization with the aim of overcoming further challenges.

Limitations and further research

Received results should be interpreted in light of certain limitations. Functioning of the science and

technology parks are increasingly recognized as context of technology transfer, with their own unique characteristics, suggesting it would be useful, to investigate how the proposed framework operates in very innovative environments.

It is possible to state that the science and technology parks are important organizations which create many innovative initiatives in enterprises located in these parks. It is suggested for future studies focus on international technology and science parks, to draw comparative results and better understand how these entities operates in different settings.

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