Eulalia SKAWIŃSKA
Poznań University of Technology
Faculty of Engineering Management
Department of Economic Science

Romuald I. ZALEWSKI
Poznań University of Economics
Faculty of Commodity Science
Department of Natural Methods in Quality Management

STATUS AND PROSPECTS FOR DEVELOPMENT OF INFRASTRUCTURE FOR TECHNOLOOGY TRANSFER IN GREAT POLAND

Summary. This paper deals with the assessment of performance of technology transfer units' infrastructure through the implementation of the statutory goals, the impact on the development of innovativeness of companies located in parks and the anticipated development barriers and challenges faced by these units. The aim of this study is to examine the role of entities of technology transfer infrastructure in developing innovativeness. The study was performed among units belonging to TTUs in Greater Poland.

Based on the data analysis the following conclusions have been formulated.

1. There is a strong relationship between the importance of the goals defined in the statutes of TTUs and the degree (importance) of their execution.
2. More important in the realization, however, are the goals that constitute the first stage of creating the potential for innovation. They are associated with raising the quality of human capital, development of cooperation, entrepreneurship and creating environment for conducting business activities. The transfer of innovation goes to the second plan according to the obtained replies.

On the basis of the referred studies it can be generally concluded that the state of development of infrastructure technologies in Poland today and in the future (which is a manifestation of the innovation capacity of enterprises and a measure of testing - signaling the level of cooperation between companies of different sectors with the sphere of science and R & D) is weak and remains endangered.

Keywords: Technology transfer institutions, innovation gap, statutory objectives, barriers, challenges

STAN I PERSPEKTYWY ROZWOJU JEDNOSTEK INFRASTRUKTURY TRANSFERU TECHNOLOGII W WIELKOPOLSCE

Streszczenie. W pracy podjęto problem oceny funkcjonowania jednostek infrastruktury transferu technologii poprzez realizację celów statutowych, wpływ na rozwój innowacyjności firm ulokowanych w parkach oraz przewidywane bariery rozwojowe i wyzwania stojące przed tymi jednostkami. Celem pracy jest zbadanie roli podmiotów infrastruktury transferu technologii w rozwoju innowacyjności. Badania wykonano wśród jednostek należących do JTT w Wielkopolsce.

Na podstawie analizy danych sformułowano następujące wnioski.

1. Istnieje duży związek między wagą celów określanych w statutach JTT i stopniem (wagą) ich wykonania.
2. Większe jednak znaczenie w realizacji mają cele stanowiące pierwszy etap tworzenia potencjału innowacyjności. Są one związane z podnoszeniem jakości kapitału ludzkiego, rozwoju współpracy, przedsiębiorczości i stwarzaniem warunków prowadzenia działalności gospodarczej. Transfer innowacyjności schodzi , w świetle wypowiedzi respondentów , na drugi plan.

Na podstawie referowanych badań można w sposób uogólniony sformułować wniosek, że stan rozwoju jednostek infrastruktury technologii w Polsce, obecnie i w przyszłości, będący pewną formą przejawiania się zdolności innowacyjnej przedsiębiorstw i miarą testującą, sygnalizującą poziom współpracy między firmami różnych sektorów ze sferą nauki i B&R jest niewielki i zagrożony.

Słowa kluczowe: Instytucje transferu technologii, luka innowacyjności, cele statutowe, bariery, wyzwania

1. Introduction

The infrastructure of technology transfer includes the social infrastructre of knowledge co-creation and technical infrastructure increasing access to information and its transparency.

Generally it can be concluded that its formation involves the development of knowledge environment (Prahalad, Ramaswamy 2005, ch. 10,11). It is impossible without the co-operation of entities from this environment.

The notion of non-cooperation of enterprises and scientific institutions and research and development in Poland does not require justification, because it is sufficiently documented in the literature (Skawińska 2010). This fact explains to some extent the existing gap between Polish innovativeness compared to many EU member states. Therefore, attempts are being made to revive and intensify this cooperation from the side of formal institutions such as internships for scientists, construction of scientific-industrial consortia, joint implementation of projects, etc. The activity of technology transfer infrastructure units (TTUs) remains a little-known area which constitutes an important opportunity in this respect. These include centers of excellence, business incubators, science parks, technology parks, etc. There has been an attempt to raise the problem of their performance through the implementation of the structure of the statutory objectives, the impact on the development of innovative companies located in the parks, planned development barriers and challenges faced by these units (Kowalak 2010). It has been assumed that the state of functioning and development of TTUs in Poland constitutes a pointer ahead piloting innovative changes in the economy (Ośrodki 2011, Rekomendacje 2011).

The aim of this study is to examine the role of actors in technology transfer in infrastructure development and innovation using the interview method. The study was performed among units belonging to TTUs in Great Poland. The analysis of the results of this research is essential to improve the management of innovation of Polish economy.

2. Characteristics of the studied population

In 2011 an interview was conducted directly among the representatives of the units belonging to the infrastructure for technology transfer (TTU) in Great Poland. From 59 active units only 15 agreed to participate in the interview. The sample include: a science-technology park (1), a center of excellence (1), incubators (3), a technology incubators (2) and 8 other entities, including foundations, NOT association, clubs of rationalization techniques, regional development agencies, chambers of industry and commerce. The interviews were conducted against prepared questionnaire. The first group of questions deals with the statutory and realized goals and was followed by self-evaluation. The next package of questions was linked to barriers, which may occur in future. The last body of question deals with expected

challenges in future. The results of the study, which was conducted in June 2011, are presented below.

Among the studied TTU populations only five revealed the number of their companies, while two reported only the total number of firms (12 and 50). The other three were composed of 4 and subsequently 3 high-tech companies. Average number of medium technology companies differed greatly and were set at 16, 1 and 7. Overall, those TTUs which disclosed the details of companies revealed 20, 18 and 10 companies in operation. The questionnaire consisted of three substantive parts in addition to specifications, i.e. characteristics of the statutory objectives and the structure of their implementation (1) and the evaluation of results, namely the effects of actions (2). The third part concerned the ex ante evaluation of barriers to development and the most pressing development challenges.

Taking into account the period of operation of the entities we can find significant differences in time. In general, these are businesses which have been in existence from a few to several years which allows their activities to be associated with a subjective-structural and economic stability. This is indicated by the structure of their funding in 2011. 56% of these are own funds, and in the three entities they amount to 100%. The EU funds constitute the second place (26%), while the third is occupied by university funds (6.675%). In light of the respondents' replies the state budget funding forms only 4.27%. The representatives of TTUs also pointed to other sources of funding for these units at 7%.

On this basis it is possible to draw conclusions about high activity and effectiveness of external funding in the financing of the objectives pursued by TTUs. EU funds occurred in 10 of the surveyed enterprises as a source of financing.

2. Statutory objectives and their implementation in TTUs

Therefore, it is important to analyze the structure of these objectives and the degree of their implementation. Tab. 1 presents the main statutory objectives and the structure of the surveyed units' responses indicating their rank. Respondents had a possibility to underscore multiple targets among the 22 listed in the questionnaire. For that reason some objectives get identical ranks.

Table 1

Ranking of statutory purposes (S) and realized (R) activities of TTUs
Ranking celów statutowych (S) i realizowanych (R) działalności JTT

No.	Objectives of activity	S	R
1	technology transfer and commercialization,	8	8
2	providing favorable conditions for the development of innovative companies	4	5
3	creating business opportunities	3	4
4	provision of technical infrastructure	9	10
5	provision of office infrastructure	8	8
6	creation of new jobs	6	7
7	development and commercialization of new products	11	13
8	focus on the common area of production (creating clusters)	12	10
9	assistance in the protection of intellectual, industrial, patent property	9	9
10	advice on business development	2	1
11	technical and scientific advice	10	11
12	assistance in access to specialized laboratories	11	12
13	technological audit	8	7
14	assistance in the research of market trends	11	11
15	facilitating access to patent databases	9	9
16	training, conferences	1	2
17	search for any income-generating activity.	10	10
18	taking part in competitions for grants	5	3
19	deepening of the cooperation: business-science and R & D - environment	5	5
20	stimulation of economic development in the region	4	6
21	facilitating contacts with financial institutions	7	8
22	strengthening of a company's image	11	7
23	other	13	13

Source: results of direct interviews conducted in 2011.

From the data contained therein it is possible to conclude that training and conferences (93.3%) occupy the first place among these goals. Advisory services in business development ranked second (86.7%), and the third place was reserved for creating business opportunities (73.3%). The fourth position in this ranking was taken by two goals - 66% each:

- providing favorable conditions for the development of innovative companies and
- stimulation of economic development in the region.

The fifth place on the list deals with such goals as cooperation with the business environment and entrepreneurship. 9 units pointed to them. It refers to competing for EU grants tied with

the deepening intermediation in cooperation of business with R & D and scientific institutions.

It is important to note that TTUs in Poland operate according to the paradigm of sustainable development similar to manufacturing companies, service, etc. Therefore, not only economic but also social and environmental goals are important (The Constitution of The Republic of Poland 1997 pos. 1/art. 5). Therefore, job creation is on the sixth place among the other statutory goals of research units. It is complementary to the next goal: to facilitate business contacts with financial institutions.

If all of the statutory objectives get generally divided into the hard ones (technical - administrative) and soft ones, cover analytical advice, assistance and facilities, it should be noted that the latter ones dominate in terms of quantity and are associated with the transfer of technology. One can for example mention the transfer and commercialization of technology, the help in protecting intellectual, industrial and patent property, assistance in access to specialized laboratories and facilitating access to patent databases. However, they are positioned farther in the ranking structure of goals (8^{th}, 9^{th}, 11^{th} place).

In addition, only two companies indicated the goal of creating a technological cluster, 3 companies pointed to the development and commercialization of new products and assistance in market research. These are the objectives related to small and medium sized companies as many others mentioned above, but directly related to increasing their competitiveness through the operation on the market according to market orientation and due to reduction in transaction costs.

Let us look, therefore, at the achievement of these goals. Which of them plays a major role in the functioning of TTUs? The first place in the ranking is occupied by consulting in the development of entrepreneurship. At this point it is necessary to recall the opinion of JA Schumpeter (1934) who believed that the concept of entrepreneurship is wider than innovation. In this aspect it is necessary to positively assess the fact that this goal is being achieved in connection with the need to increase creativity and skills to implement innovations, including any activities that increase the competitiveness of companies.

Training and conferences ranked second, while taking part in competitions for grants ranked third, and the fourth was the creation of business opportunities. The fifth position is occupied by the goal of deepening the cooperation of enterprises with science and R & D institutions and to provide favorable conditions for the development of innovative companies. So some "soft" goals have gained priority in the implementation over "hard" goals occupying the 8^{th} and 10^{th} place in the subjective assessment of respondents.

The goals directly related to innovation, among the 22 analyzed ones, occupy farther ranking positions in this assessment (e.g. question 1 - pos. 8, question 9 pos. 9, question 12 pos. 12, question 15 pos. 9). Goals indirectly related to innovation ranked higher (e.g., goal 2 and 19 pos. 5). Based on this analysis the following conclusions have been formulated below.

1. There is a strong relationship between the importance of the goals defined in the statutes of TTUs and the degree (importance) of their execution.
2. More important in the realization, however, are the goals that constitute the first stage of creating the potential for innovation. They are associated with raising the quality of human capital, development of cooperation, entrepreneurship and creating environment for conducting business activities. The transfer of innovation moves to the second plan according to the replies obtained.

The next block of questions the respondents were asked regarded the self-assessment of the TTU they represented. In terms of the effects of the units surveyed on companies there were 7 questions directly related to innovativeness (questions 3-7) and two of a socio-economic character (questions 1 and 2). The data presented in Tab. 2 confirms the results of the goal assessment included in the table. 1. It turns out that only half of the participants responded positively to these questions. Thus, the following conclusion arises. Infrastructure units of technology transfer focus more on the purposes of their own operation (raising funds, providing potential) than the effective activation of the region through innovative growth of companies using their services. Perhaps this is related to the need to overcome the currently existing developmental barriers of these institutions and those anticipated in the near future.

Table 2

Evaluation of the results of TTU's activity for companies
Ocena rezultatów działalności JTT na rzecz firm

No.	Description	YES	NO
1	Have companies operating in parks developed employment?	6	1
2	Have companies operating in parks developed production?	6	1
3	Have the companies inside the parks increased the number of new products?	7	0
4	Have the companies inside the parks received patents, trademarks, etc.?	5	2
5	Do companies inside the parks effectively adapt new technologies?	6	1
6	Do companies inside the parks purchase licenses?	4	3
7	Do companies inside the parks participate in international and national research projects?	3	4

Source: own study based on direct interviews in 2011.

3. Future development barriers and challenges for TTUs in the eyes of their representatives

Traditionally, in accordance with the methodology of management sciences, barriers to development are divided into endogenous and exogenous. Similarly, in this analysis Table 3 lists ten most significant barriers that were identified by respondents. Five areas can be distinguished among them. These are: financial barriers as external determinants (question 2), and internal determinants of entrepreneurship and pro-innovation cooperation (questions 1, 5, 6, 8), human capital skills (questions 3, 4, 9, 10, 11, 12, 13, 14, 15, 16) and the efficiency of implementation by the units (7). The largest number of respondents (11) sees difficulty in obtaining funds for development. Only two respondents see difficulty in inadequate housing conditions and technological basis for the conduct of major innovative projects. This means that it has already been developed at an optimal level. However, it is interesting that access to specialists dealing with the protection of intellectual and industrial property will not constitute a barrier.

Table 3

Barriers to development of technology transfer units predicted by respondents
Przewidywane przez respondentów bariery rozwoju jednostek transferu technologii

No.	Description	L *
1	low efficiency in attracting high-technology companies	6
2	problems with financing the growth (EU structural funds, public funds, etc.)	11
3	insufficient level of pro-innovation attitudes and behavior among enterprises	9
4	insufficient level of pro-innovation attitudes and behaviors among the representatives of science and R & D sectors	8
5	distrust regarding the cooperative activities and to organize joint business ventures	9
6	distrust between the representatives of science and business	8
7	small number of technological implementations by research institutes and research units	10
8	insufficient infrastructure base for conducting large innovative projects	2
9	insufficient technological base for conducting large innovative projects	2
10	lack of one's own study and research facilities	4
11	too low level of social capital of employees	4
12	the lack of business core (strategic investor) the character who could concentrate	6
13	activities of other enterprises around its own	2
14	the lack of specialists who could perform a professional market analysis of inventions	5
15	the lack of specialists to evaluate the market value of innovation	6
16	the lack of specialists to build a marketing strategy	3
17	the lack of specialists for the protection of intellectual, industrial property etc.	1
18	Other	2

* Number of responses to individual questions.
Source: as in Table 1

Let us remember that the nature of activity of analyzed entities requires entrepreneurial management. However, their results also depend on the environment. The identified areas of risk are therefore puzzling, since they deal, in addition to financial aspects, with the attributes of human and social capital of companies and thus the internal innovation potential of TTUs. These are the pro-innovative attitudes and behaviors of companies and science sector and R & D sector, the lack of trust - so necessary in co-operation, the lack of leadership - entrepreneurial business to focus on and support SME activity, lack of skills (professionals to analyze the market inventions, innovations and valuation of intellectual property protection). Therefore, it is further necessary to intensify the implementation of statutory tasks of TTUs in this field.

The last issue examined in this study is related to challenges. In the light of the obtained responses it can be concluded that it is perceived most individually by respondents. The participants were presented with 6 anticipated challenges to the development of TTUs by the investigator and were asked to rank them from 1 - most important to 8 least important. Due to a large dispersion of ratings their interpretation involved a combined scale assuming a total assessment of 1 and 2 as very important (*VI*), 3 and 4 as a important (*I*), 5 and 6 as sufficiently important (*SI*) and 7 and 8 as not important (*NI)*.

Table 4

Characteristics of the level of importance regarding developmental challenges of TTUs
Charakterystyka stopnia ważności wyzwań rozwojowych JTT

Description of the challenges	**Number of answers**				
	1 (VI)	***2 (I)***	***3 (SI)***	***4 (NI)***	**Lack**
effectively organized funds for further development of statutory activity	5	1	1	3	5
developing ways to attract a potential technological leader	3	2	3	1	6
improvement of co-operation with the scientific community in the implementation activity	2	4	5	2	2
7. stimulation of innovative needs among entrepreneurs	2	2	5	1	5
paradigm shift in state policy regarding the long-term development strategy	1	4	2	3	5
guarantees of funding the innovation policy by EU funds	3	2	2	1	7
6. involvement of municipalities in attracting strategic investors whose location in parks would allow the organization of innovative development centers	3	0	2	3	7

Source: as in Table 1.

Based on the data contained in table 4 it can be stated that the challenges pointed by five respondents correspond with the results of assessments related to the barriers (the financial

one was the most important). It regards an effective organization of funds for further development of statutory activity. Also the guarantees of the financing of innovation policy by EU funds are significantly important as a challenge according to three respondents and important for two more. The development of ways to attract potential technological leader was also indicated by five entities at the level of "very important" and "important", and by 3 entities at the level of "sufficiently important". But as many as 11 indications were obtained for the challenges of improving cooperation with the scientific community in terms of implementation activity, although the ranks at the level of "important" and "sufficiently important" were dominant. It is still worth paying attention to the challenge regarding the stimulation of innovative needs of entrepreneurs. 9 indications occurred here, among those surveyed, at the assessment level from 1 to 6. Approximately half of the respondents said that state policy is a major challenge and should be changed in the long term development strategy of innovation-driven economy. But only 5 entities pointed to the involvement of local governments in attracting strategic investors as a challenge to the development of innovation. This may suggest that local governments are partners in local communities in terms of the development of innovation.

Conclusion

Nowadays it is considered, regardless of the represented view on the processes of globalization, that technological innovations in the field of information and communication and organization (especially in the organization of production) is the dominant development factor of an irreversible character (Cyrson 2011, p. 46). Therefore, the awareness of the importance and type of innovation should be accompanied by effective management. This is especially important during the global crisis and the search for a new paradigm in economic theory (Wojtyna 2009, p. 43-47). Multidimensional competitive challenges in an international scale (taking into account multiculturalism) keep growing and this forces differentiated innovations. It poses greater demands for R & D sector and for technology transfer institutions regarding changing the functional ability. They should be able to perform multiple roles in the creation of value, they should be flexible in taking account of local diversity and efficient in building and using strategic capital (Prahalad, Ramaswamy, 2005, p. 148-152).

During the process of transformation of Polish economy many areas and causal factors of strategic capital development have been neglected. These include for example social capital and innovative entrepreneurship and education. The degree of innovativeness of enterprises is an indicator of "adaptation of industry to the new economic system and its opening to global

economy" (Stryjakiewicz, p. 121, 1999). In an era based on the paradigm of information and communications the sources of innovation keep changing. There are causal relationships between the sphere of communication of information about innovations and the level of innovativeness of the economy. On the basis of the referred studies it can be concluded that the state of development of infrastructure technologies today and in the future (which is a manifestation of the innovation capacity of enterprises and a measure of testing - signaling the level of cooperation between companies of different sectors with the sphere of science and R & D) is in danger. The problem is not just about money but also a strategic capital including social infrastructure. It is also worth noting that the degree of de-industrialization in Poland in favor of services in relation to developed countries is slow (CSO Statistical Yearbook 2011). Many authorities point to the traditional character of the industry (Lis, Klimczyk 2009; Grudzewski et al 2010). The expected softening of its structure known as *servicization* takes place very slowly. The results of the study indirectly confirm this view. The goals pursued by TTUs are little oriented towards marketing, organizational, logistical, innovations etc. This is because of a small demand for this kind of innovation on the part of the economy, including industry. Overall, the results obtained from TTU respondents are not optimistic for overcoming the innovation gap in our country especially taking into consideration the fact of the assumed economic slowdown. Reduced revenues of business entities will result in further reduction of incremental innovations. It can also be definitely concluded that the importance of infrastructure for technology transfer in the development of innovativeness in Poland is small and endangered in the near future.

Acknowledgements: The publication was financially supported by the National Centre for Research and Development (project NR11-0026-10).

References

1. Grudzewski W.M., Hejduk I.K., Sankowska A., Wańtuchowicz M. 2010. Sustainability w biznesie czyli przedsiębiorstw przyszłości, Poltext, Warszawa, p. 317.
2. The Constitution of the Republic of Poland 1997 pos. 1/art. 5.
3. Kowalak B., Benchmarking of technological parks in Poland. Report for 2010.
4. Lis S., Klimczyk P. (2009). Analiza zmian struktury produkcji przemysłowej w gospodarce polskiej w latach 1996- 2005 in: GOW. Wyzwanie dla Polski. Red. J. Kotowicz-Jawor, Warszawa, 445-462.
5. Ośrodki innowacji w Polsce . Katalog instytucji wsparcia innowacyjnego biznesu, PARP Warszawa 2011.
6. Prahalad C.K., Ramaswamy V., 2005. Przyszłość konkurencji, PWE Warszawa.

7. Rekomendacje zmian w polskim systemie transferu technologii i komercjalizacji wiedzy, red. K.B. Matusiak, J. Guliński, PARP Warszawa, 2011.
8. Schumpeter J.A. (1934). The Theory of Economic Development, Cambridge, MA, Harvard University Press, 1934.
9. Skawińska E. (2010). Instytucjonalne warunki współpracy między nauką i przemysłem dla wzrostu innowacyjności w Polsce, Marketing i Rynek, Grudzień, p. 56-60.
10. Skawińska E., Cyrson E., Zalewski R. (2011). Konkurencyjność przedsiębiorstw, Wyd. Politechnika Poznańska 2011.
11. Stryjakiewicz T. (1999). Adaptacja przestrzenna przemysłu w Polsce w warunkach transformacji, UAM Poznań 1999.
12. Wojtyna A. (2009). Współczesna ekonomia – kontynuacja czy poszukiwanie nowego paradygmatu in: Nauki ekonomiczne wobec wyzwań współczesności, red. B. Fiedor, Zb. Hockuba, PTE.