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The impact of business support organizations on the innovative activity of Lubusz industrial enterprises

1. Introduction

Innovations play an increasingly important role in economic development. Especially in the last 20 years, the loss of importance of traditional factors of competitive advantage (work, land, capital) has been noted for the advancing globalization processes and the computer and telecommunications revolution (Audretsch 1998, p.19). They are replaced by knowledge and the ability to transform it into new products. However, implementing innovation is a difficult task. This is due to, among others, the imperfections of the innovation market, which are related to the treatment of knowledge as a public good, high financial risk of innovative projects and the gap related to their financing (Bukowski et al., 2012, p.4).

Proper identification and utilization of the innovative potential depends on the state of knowledge about the research and development sphere, a properly built institutional framework for the development of innovation and the use of the market potential (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz

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2012, p.1.). This is proved by international research, which indicates that the best conditions for the implementation of new solutions arise thanks to the implementation of innovations within the so-called triple helix, thus within the cooperation between enterprises, the sphere of science and the government sphere (Etzkowitz 2002, pp.2-5). The task of the governmental sphere is to create the right framework for implementing new solutions and establishing cooperation aimed at their creation. Therefore, what framework will be the best for Poland? In the economy of poorly developed countries, oriented to growth through efficiency, a prerequisite for further development, i.e. transition to the development stage through innovation, is primarily the creation of environmental and institutional stimulators conducive to innovative entrepreneurship. Support for entrepreneurship and SME should aim to build entrepreneurial skills, including through education, training and promotion of entrepreneurial attitudes, facilitating access to sources of risk financing, incentives to absorb knowledge and transfer of technology (Matusiak 2010, p.11). These functions should be met by the so-called business support institutions. These are non-profit institutions that do not work for profit or that designate profits for statutory purposes in accordance with the provisions in the statute or an equivalent document (Burdecka 2004, p.5). Due to the variety of tasks undertaken, target groups of service recipients or the necessary personnel competences, the support institutions can be classified into (Matusiak 2011, p.182):

- entrepreneurship centres – their tasks is to broadly promote and incubate entrepreneurship (often in discriminated groups), provide support services to small businesses and activate the development of peripheral regions or those affected by the structural crisis,
- innovation centres – are aimed at broad promotion and incubation of innovative entrepreneurship, technology transfer and provision of pro-innovation services, activation of academic entrepreneurship and cooperation between science and business,
- shadow banking financial institutions – their aim is to limit financial discrimination of newly created and small companies without credit history, providing financial services adapted to the specifics of new business ventures.

Business support institutions perform service functions on the market, creating a specific infrastructure that enables the dynamization of development processes and the implementation of designated strategies (Matusiak 2004, p. 2). Support institutions undoubtedly contribute to the development of enterprises that use their services. However, the question is whether there

will be significant differences in the implementation of new solutions between enterprises that use their services and do not do it. The aim of the article is to determine the impact of business support institutions on the innovative activity of enterprises that use the services of business support institutions compared to entities that ~~don't~~ do not. The research hypothesis is that institutions will increase the chances of running innovation activities and cooperation, but the impact will be diversified.

2. Characteristics of the research sample

The industrial system of Lubusz voivodeship is one of the less developed in Poland. In 2014, expenditures on innovative activities amounted to PLN 226 929, and PLN 68,1 million for the research and development activities. In the same year, 32 patents were granted in the region. These amounts qualify the region on the 14.-16. Place among voivodeships on the national scale.

Table 1. Expenditures on innovation activity, research and development and granted patents in the Lubusz Voivodeship in 2014

	Expenditures on innovation activity (in tys. zł)	Place among Polish voivodeships	Expenditures on research and development (in mln zł)	Place among Polish voivodeships	Granted patents	Place among Polish voivodeships
Lubusz	226 929	14.	68,1	16.	32	14.

Source: author's own research based on Local Data Bank of Statistical Office in Zielona Góra on zielonagora.stat.gov.pl

756 industrial enterprises took part in the study of the impact of business support institutions on the innovative activity of the Lubusz industrial enterprises. Their business profile corresponded to section C of the Polish Qualification of Activities, i.e. Industrial Processing. The study was conducted in 2014 for the three full years of operation of enterprises, that is the years 2011-2013.

Taking into account the size of the surveyed enterprises, the micro enterprises had the largest share in the sample, which constituted 41% of all entities. 1/3 of the surveyed companies were small enterprises and 1/5 were medium-sized enterprises. The large entities had the smallest share in the sample, which constituted less than 6% of the surveyed enterprises.

Table 2. Structure of the studied company in terms of size classes in 2014

Company size	Quantity of companies	Percentage
Micro	310	41%
Small	251	33,2%
Medium-sized	153	20,2%
Large	42	5,6%
Sum	756	100%

Source: author's own research based on survey

In the case of cooperation with business support institutions, the sum of percentages is not equal to 100%, because one company could use the services of several support institutions.

Among the surveyed entities, the largest number of them used the services of training and consulting centres. They constituted almost ¼ of the tested sample. Loan funds were also very popular (over 13% of the surveyed enterprises cooperated with them) as well as guarantee funds (nearly 10% of entities used their services). Innovation centres were less popular in this region. In this group, technology parks were the most popular, the services of which were used by 7% of the surveyed entities. Over 2% of enterprises, 1,5% of technological incubators and 0,9% of academic business incubators have cooperated with technology transfer centres.

Table 3. Cooperation of the studied company with Business Support Organizations in 2011-2013

Business Support Organizations	Quantity of companies	Percentage
Technology Parks	53	7%
Technology Incubators	11	1,5%
Academic Business Incubators	7	0,9%
Technology Transfer Offices	16	2,1%
Business Angels Networks	5	0,7%
Local and Regional Loan Funds	100	13,2%

Credit Guarantee Funds	74	9,8%
Training and Consulting Centres	187	24,7%

Source: author's own research based on survey

3. Methodical aspects of the conducted study

The included variables are tied to measurement of innovation activity using the Oslo methodology. The dependent variables were divided into four groups:

1. Expenditure on innovation activities – expenditure on (1) research and development activity, on (2) land and buildings and on (3) machinery, instruments and equipment for manufacturing and improvements of new product and process, and on (4) computer software for use in product and process innovation activities (Oslo 2005, pp. 92-93).
2. Implementation of new products and technological processes - including new manufacturing methods, by-production systems and support systems (Oslo 2005, pp. 48-49).
3. Innovation co-operation - active participation in joint innovation projects with other organizations (Oslo 2005, pp.79-80):
   a. along supply chains, with competitor and within the corporate group,
   b. with public research institution, e.g., with universities.

Business support institutions most frequently appearing in Poland were adopted as independent variables, namely technology parks, technology incubators, academic business incubators, technology transfer centres, business angel networks, local or regional loan funds, credit guarantee funds, training and consulting centres.

The adopted variables were dichotomous, i.e., respondents were given the value of 1 when, for example, they used the services of a support institution, or conducted the type of innovation activity under study, and 0 when they did not use services or did not introduce new solutions.

The model estimation process took place in two stages in the Statistica software. In the first stage, using the Interactive model creator tool, these independent variables (business support institutions) were distinguished, which had a significant impact on the dependent variable (attributes or innovation). In the second stage, logit models showing the impact of business support institutions on the attributes of innovative activity were estimated.

Generally speaking, logistic regression is a mathematical model that can be used to describe the influence of one or several independent variables on a dichotomous dependent variable (Danieluk p. 201). When all independent variables are qualitative, the logistic regression model is synonymous with log-linear model (Świadek 2011, p. 102).

In logit models, the probability is expressed by means of odds. Probability expresses the number of successes in relation to the number of attempts, while the odds express the number of successes in relation to the number of failures. This relation is illustrated by the formula:

$$Odds = \frac{p}{1-p},$$

where p is the probability of the phenomenon being studied.

This article presents the so-called odds ratio, which is used when comparing two classes of observation. It is a quotient of odds that a given event (e.g. incurring expenditures on the R&D activity) will occur in the first group of elements (e.g. in enterprises cooperating with a technology park) and that it will also take place in the second one. This relation is recorded with the formula (Giemza, Zwierzchniowska 2011, p. 19):

$$OddsRatio = \frac{p_1}{1-p_1}\frac{1-p_2}{p_2} = \frac{p_1(1-p_2)}{p_2(1-p_1)}$$

The values of the odds ratio are interpreted as follows:

a) *OddsRatio*>1 – in the first group, an incident is more likely
b) *OddsRatio*<1 – in the first group, an incident is less likely
c) *OddsRatio*=1 – in both observation classes, the incident is just as likely

This article presents the quotients of chances of logit models that met statistical significance conditions. This significance was estimated at 0,10, although the tables indicate the value of the limit level of significance at the following levels and with the following designation:

a) * - value up to 0,01,
a) ** - value 0,01>0,05,
a) *** - value 0,05>0,10.

The models also interpret the quotient of the constant odds estimated for the model. It defines the relation between the chances of a dependent variable occurring in entities using the services of a support institution, which "individually" did not affect the dependent variable (together) in relation to the opposite group.

4. Impact of business support institutions on innovative activity of industrial enterprises in the Lubusz voivodeship

Business support institutions in the Lubusz voivodeship make a significant contribution to increasing the chances of incurring expenditure on R&D. The technology parks and academic business incubators increase the chances for their occurrence more than 4 times, and the technology transfer centres almost 4 times. In entities that used the services of the network of business angels, these chances grew over 9 times, and with the training and consulting centres more than 2 times. Other support institutions did not increase the chances of incurring expenditures on R&D.

Taking into account investments in new fixed assets, the chances for their occurrence were increased more than 2 times by technology parks and training and consulting centres, and the loan and guarantee funds nearly 2 times. Other support institutions also increased the chances of buying new fixed assets more than 2 times. In addition, technology parks and training and consulting centres increased the chances for investments in new buildings, premises and lands, machinery and technical equipment, as well as new computer software, and loan and guarantee funds in new buildings.

Table 4. Influence of Business Support Organizations on expenditure on innovation activity in the Lubusz Voivodeship in 2011-2013

Business Support Organizations	Expenditures on R&D	Investment on new fixed assets			Expenditures on computer software
		total	buildings, offices and lands	machinery and technical equipment	
Technology Parks	4,26*	2,34***	2,20*	1,79***	3,74*
Technology Incubators					
Academic Business Incubators	4,39***				

Technology Transfer Offices	3,63**				
Business Angels Networks	9,40**				
Local and Regional Loan Funds		1,73***	1,50***		
Credit Guarantee Funds		1,87***	1,78**		
Training and Consulting Centres	2,27*	2,46*	1,46**	1,69*	1,77*
Constants	0,37*	2,27*	0,37*	1,76*	
chi-square	63,2	31,03	23,89	11,72	28,01
p-value	0,000	0,000	0,000	0,003	0,000

* - statistical significance 0,01 ** - statistical significance 0,05 *** - statistical significance 0,1

Source: author's own research based on survey

Taking into account the introduction of new products and the implementation of new technological solutions, the positive impact of technology parks and training and consulting centres is visible again. It should be emphasized that in the case of these dependent variables, the technological parks are more likely to increase the odds than the centres (the odds ratio is always higher in the case of parks compared to the centres). In addition, the opportunities for creating new products are also increased by technology transfer centres. Considering the constant in the model, it is noticed that the other support institutions (i.e. for which "individual" quotient quotas were not calculated) increase the chances of introducing new products and processes in general. However, in relation to the introduction of new production-related and supporting systems, the chances for their implementation are smaller in entities that use the services of other support institutions.

Table 5. Influence of Business Support Organizations on product and process innovations in the Lebusz Voivodeship in 2011-2013

Business Support Organizations	Implementation of new product	Implementation of new technological processes			
		total	manufacturing methods	production-related systems	support systems
Technology Parks	3,32*	4,30*	3,37*	3,17*	1,73***
Technology Incubators					
Academic Business Incubators					
Technology Transfer Offices	5,80***				
Business Angels Networks					
Local and Regional Loan Funds					
Credit Guarantee Funds					
Training and Consulting Centres	1,39***	3,84*	1,78*	2,45*	1,98*
Constants	1,95*	1,97*		0,29*	0,22*
chi-square	19,34	48,98	27,48	43,27	16,58
p-value	0,000	0,000	0,000	0,000	0,000

* - statistical significance 0,01 ** - statistical significance 0,05 *** - statistical significance 0,1

Source: author's own research based on survey

In the Lubusz voivodeship, there is a visible impact of business support institutions on establishing sectoral cooperation in the area of new solutions. Technological incubators increase the chances of cooperation with suppliers, recipient and within the corporate group more than 6 times, and almost 2 times for competition. The training and consulting centres increase the chances of cooperation with suppliers more than 1,7 times, of cooperation with suppliers almost 1,5 times, and with competitors over 2,8 times. Technology parks

increase the chances of cooperation with suppliers 3 times, and 6 times within the corporate group. In addition, business angel networks over 13 times, and guarantee funds increase the chances of cooperation with suppliers 2,6 times. In enterprises that used loan fund services, the chances for coopetition grew more than 3 times. The chances of establishing innovative cooperation in entities that used the services of other support institutions were smaller than in entities that did not use their services.

Table 6. Influence of Business Support Organizations on innovation cooperation along supply chains, within competitor and in corporate group in the Lebusz Voivodeship in 2011-2013

Business Support Organizations	Cooperation with/in			
	supplier	recipient	competitor	corporate group
Technology Parks	3,05*			6,22*
Technology Incubators	6,09*	6,15*	1,88*	6,23**
Academic Business Incubators				
Technology Transfer Offices				
Business Angels Networks	13,19**			
Local and Regional Loan Funds			3,23*	
Credit Guarantee Funds	2,60*			
Training and Consulting Centres	1,72*	1,43***	2,84*	
Constants	0,28*	0,25*	0,03*	0,03*
chi-square	53,10	12,02	28,63	21,90
p-value	0,000	0,002	0,000	0,000

* - statistical significance 0,01 ** - statistical significance 0,05 *** - statistical significance 0,1

Source: author's own research based on survey

In the surveyed enterprises, institutional cooperation was initiated more often by innovation centres. Technology parks increased the chances of cooperation with universities and national research units more than 4 times, and more than 8 times with the foreign ones. In entities that used the services of PAN units, the chances of cooperating with PAN units increased almost 10 times. Similarly, academic incubators increased the chances of cooperation with universities. The network of business angels increases the chances of cooperation with domestic and foreign research units, 13 times and almost 35 times, respectively. In companies that use loan fund services, the chances of cooperation with PAN units increase almost 4 times. Other support institutions do not affect the establishment of institutional cooperation.

Table 7. Influence of Business Support Organizations on innovation cooperation with science research sector in the Lebusz Voivodeship in 2011-2013

Business Support Organizations	Cooperation with			
	Polish Academy of Sciences departments	universities	national R&D centres	foreign R&D centres
Technology Parks		4,41*	4,30**	8,32*
Technology Incubators	9,94**			
Academic Business Incubators		9,72**		
Technology Transfer Offices				
Business Angels Networks			13,17**	34,65*
Local and Regional Loan Funds	3,92***			
Credit Guarantee Funds				
Training and Consulting Centres				
Constants	0,01*	0,03*	0,02*	0,01*
chi-square	5,59	13,14	7,44	10,23

p-value	0,06	0,001	0,025	0,006
* - statistical significance 0,01		** - statistical significance 0,05		*** - statistical significance 0,1

Source: author's own research based on survey

5. Conclusions

The presented analysed clearly show that in the Lubusz voivodeship the innovation of industrial enterprises is most affected by technology parks and training and consulting centres. However, it should be emphasized that the effectiveness of parks is slightly better, as the odds ratios estimated for them were higher than in the case of centres. This may be related to the nature of services provided by these institutions. Technology parks focus on pro-innovative services, centres also provide those related to stimulating entrepreneurship, accounting, etc. For this reason, parks have a stronger impact on innovation than centres. These two institutions affected all the analysed attributes of innovation related to expenditures on innovative activity and the implementation of new products and processes, so it can be concluded that their impact was systemic in these areas.

It is worth noting that under the influence of innovation centres (with the exception of academic business incubators), entrepreneurs incur more expenditures on research and development activities. The R&D works contribute to the creation of own innovations that can be competitive on the international arena, which strengthens the potential of the region.

Taking into account the cooperation in the area of new solutions, it is visible that in the region it is much easier to stimulate cooperation within the sector than with institutions in the field of science. The use of services provided by technology incubators contributes to establishing cooperation along the supply chain, within the capital group and with competitors. The latter type is also stimulated in enterprises by training and consulting centres and loan funds. From the perspective of the regional innovation system, this type of cooperation is particularly desirable because it contributes to the initiation of cluster networks. These networks significantly improve the competitiveness of the region.

For the technology transfer centres and academic business incubators, quotas meeting the conditions of statistical significance were not estimated. It is difficult to determine what their impact on establishing cooperation is.

In the region, the innovation centres mostly contribute to the transfer of knowledge from the sphere of science to business. This is confirmed by the fact that the sphere of science creates highly innovative products and technologies. However, there are not many models that meet the criteria of statistical significance (technological parks increased the odds of cooperation with universities and domestic and foreign research units, business angel networks with the last two units, technology incubators and loan funds increased the chances of cooperation with PAN units, and academic incubators with universities). This shows that institutional cooperation is a weak link in the regional industrial system of the region. Of course, it should be stimulated, but taking into account the low level of development of the region (cooperation with the sphere of science is characteristic of developed countries) and slightly better results in the field of sectoral cooperation, it is better to focus on the latter. It is already bearing fruit, so it will be easier to strengthen and stimulate it. Support institutions in this area have the potential to overcome the negative trends associated with a low level of public trust.

There is a gap in financing the innovation activity in the region. The research covered three types of financing institutions – business angel networks (financing innovative projects), loan and guarantee funds (financing innovative projects and ones related to entrepreneurship). Of these, only loan and guarantee funds significantly increased the chances of investing in new fixed assets. There were no dependencies related to the introduction of new products and technological processes. This may mean that there is a shortage of external capital for innovative projects on the scale of the entire region and entrepreneurs finance them with their own funds or seek financing in banks. It would be necessary to precisely identify these relationships, conducting in-depth research among the recipients of funds and networks, and the centres themselves.

In the context of the above conclusions, it can be assumed that the research hypothesis at the beginning of the article has been confirmed – business support institutions increase the chances of running innovation activity and cooperation, and influence them to a different degree.

Summary

The impact of business support organizations on the innovative activity of Lubusz industrial enterprises

Business support institutions are one of the institutional solutions that are aimed at stimulating innovation, and influenced by innovation policy. The aim of the article was to determine the

impact of business support institutions on the innovative activity of enterprises that use their services in comparison to entities that do not. However, the research hypothesis was that institutions will increase the chances of running innovation activity and cooperation, but the impact will be diversified.
756 industrial enterprises from the Lubusz voivodeship took part in the survey. It was carried out in 2014 for the years of 2011-2013. The multifactorial logit modelling was used as the research model. As a result of the conducted analyses, it was established that technology parks and training and consulting centres are a strong link of supporting the innovation of industrial enterprises in the region. In addition, innovation centres, such as technology parks, technology incubators, technology transfer centres and business angel networks increase the chances of incurring expenditures on research and development activities. In the voivodeship, the institutions also initiate cooperation in the area of new solutions. Entrepreneurs are more likely to cooperate with each other than to transfer knowledge from the sphere of science to business.

Keywords: *business support organisations, innovation, technological park, business angels.*

Streszczenie

Wpływ instytucji wsparcia biznesu na aktywność innowacyjną lubuskich przedsiębiorstw przemysłowych
Dynamiczne zmiany zachodzące w świecie powodują, że coraz ważniejszy w życiu gospodarczym staje się rozwój oparty na wiedzy i innowacjach. Właściwe założenia polityki innowacyjnej spowodują, że wdrażanie nowych rozwiązań będzie łatwiejsze. Jednym z rozwiązań instytucjonalnych, które mają na celu pobudzanie innowacyjności, a na które wpływ ma polityka innowacyjna, są instytucje wsparcia biznesu. Celem artykułu było określenie wpływu instytucji wsparcia biznesu na aktywność innowacyjną przedsiębiorstw, które korzystają z ich usług w porównaniu do podmiotów, które tego nie czynią. Hipotezą badawczą było natomiast twierdzenie, że instytucje będą zwiększały szanse na prowadzenie aktywności i współpracy innowacyjnej, jednak oddziaływanie to będzie zróżnicowane.

W badaniu wzięło udział 756 przedsiębiorstw przemysłowych z województwa lubuskiego. Było ono przeprowadzone w 2014 roku za lata 2011-2013. Wykorzystaną metodą badawczą było wieloczynnikowe modelowanie logitowe.
W wyniku przeprowadzonych analiz ustalono, że mocnym ogniwem wsparcia innowacyjności przedsiębiorstw przemysłowych w regionie są parki technologiczne i ośrodki szkoleniowo doradcze. Ponadto ośrodki innowacji takie jak parki technologiczne, inkubatory technologiczne, centra transferu technologii oraz sieci aniołów biznesu zwiększają szanse na ponoszenie nakładów na działalność badawczo-rozwojową. W województwie instytucje inicjują także współpracę w obszarze nowych rozwiązań. Przedsiębiorcy są bardziej skłonni do kooperacji między sobą aniżeli do transferu wiedzy ze sfery nauki do biznesu.

Słowa kluczowe: *instytucje wsparcia biznesu, innowacja, park technologiczny, aniołowie biznesu.*

JEL Classification: O31, O32, L60

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