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INNOVATIVE MECHANISMS IN TERRITORIAL INDUSTRIAL SYSTEMS – WESTERN POMERANIA CASE

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Abstract

The major objective of the paper is to show the results of research that was made in industrial enterprises of the West Pomeranian region. The main objective of the research was an attempt to find the variable determinants that have an impact of the relationships among enterprises on their innovative performance. The research was conducted within regional industrial systems and the basic aim was to define the constraints for a model regional structure of innovation network tailored to the needs of Poland and one of its regions.

Keywords: innovation, enterprises, region, industry.

JEL classification: L10, L 20, O14, O31.

Introduction

The dynamics and system character of innovation have been so far described in theoretical approaches within the evolutionary or Neo-Schumpeterian economics. In those concepts an innovation process on the level of a single enterprise is perceived as a system of activities which are related by means of feedback, whereas innovation is a result of an interactive learning process which involves usually several actors from within and beyond the enterprise[1].

Innovation and its diffusion become a result of an interactive and collective network process of personal and institutional changes evolving over time. They respond to the challenges of the "new economy" in the region such as globalisation and acceleration of technological progress thus creating an opportunity for economic development in underdeveloped regions.

Innovation systems have become the main theme of numerous theoretical and empirical studies over the last 15–20 years. This approach is focused on determinants of the development and diffusion of process and product innovations[2]. Its essence is the relationships between the internal and external players in the region[3]. The findings provide evidence that manufacturing enterprises are more successful if they are elements of an integrated intensive network.

The operation of systems is based on interactions between individual participants of the network. These relationships can be of either a vertical or horizontal character. Due to the complex character of the subject, this paper concentrates only on the "output" relationships, i.e. the relations with customers of products manufactured by an industrial system.

Modern regional networks aim at diversifying relationships through initiation of interactions with various groups of customers. In a traditional environment such relationships should focus on specialised interactions. It seems interesting to identify whether the innovative performance of regional systems in Poland is determined by diverse or by narrow interactions, based on strong and lasting or weak interpersonal relationships, the distance between partners being close or long.

The conceptual framework outlined above has inspired the author to address the problem of the impact of enterprises on innovativeness of regional industrial systems. The major hypothesis of the study is that innovative mechanisms inherent in territorial industrial systems and their relationships with the environment are largely determined by the character of relationships among enterprises. They include: the type of competitors, suppliers and customer, their localisation and character of the relationship. Those factors determine the present form of industrial systems in Poland. An appropriate identification of the course and constraints of the innovation process in the national system of economising is a basis for the construction of diversified development

paths for innovation networks, allowing for the national and regional features and accelerating the processes of creation, absorption and diffusion of technology.

The major objective of the research was an attempt to find the variable determinants of the impact of the character of relationships among enterprises on their innovative performance within regional industrial systems and hence to define the constraints for a model regional structure of innovation network tailored to the needs of Poland and its regions. The research results presented in this study represent only one finding. From the viewpoint of sampling, the author decided to analyse the case of one region representing **medium-weak** industrial development. Such a solution allowed a more in-depth analysis of the features characteristic of regional industrial systems in Western Pomerania region.

The research was based on a questionnaire distributed among 447 enterprises. The basic method to acquire this amount of data involved an initial phone interview followed by sending the actual questionnaire by e-mail.

1. Methodological conditions of the research – the probit modelling

The methodological part of the analyses is based on the probability calculus. When a dependent variable takes dichotomous values, the possibilities of using the popular multiple regression, widely used for quantitative phenomena, are limited. The problem can be solved by an alternative solution – the logistic regression[4]. Its advantage is that an analysis and interpretation of results are similar to the classical regression method, hence the methods of selecting variables and testing the hypotheses have a similar pattern. However, there are also differences which include: more complex and time-consuming calculations and producing the residual plots usually do not contribute significantly to the model[5]. In a model where the dependent variable can equal either 0 or 1, the expected value of the dependent variable may be interpreted as a conditional probability of an event at given independent values.

The forerunners in using the logistic curve were P.F. Verhulst and R.F. Pearl. A full model was not used, however, until 1994 and 1953 by J. Berkson[6].

Generally, the logistic regression is a mathematical model which can be employed to explain the impact of several variables X_1, X_2, ..., X_k on a dichotomous variable Y. If all the independent variables are qualitative, the logistic regression model is equivalent to a log-linear model. To describe such a phenomenon one could also employ the **probit regression**[7].

The assumptions common for all those models are as follows[8]:

– The data comes from a random sample,

- Y can take only two values: 0 or 1,
- Subsequent *Y* values are statistically independent,
- The probability that Y = 1 is defined by the normal distribution (NCD) for a probit model or a logistic distribution (LCD) for a logit model,
- There is no perfect linear relationship between X_i variables (no co-linearity of independent variables).

In the methods with a dichotomous variable, the parameters are estimated according to the maximum likelihood (ML) method. According to its rules, a vector of parameters is searched for, which gives the highest probability of arriving at the values observed in the sample[9]. Generally, the application of the ML method requires formulation of a likelihood function and finding its extreme value, which can be done in two ways: analytical and numerical. Despite its complex procedure, the ML method has gained popularity since it can be applied to a wide array of models, including models with variable parameters, complex delay structure models, heteroscedastic models, and nonlinear models. The features of the ML method, even for small samples, are in many cases much better than other alternative estimators.

Non-linear estimation comprises six algorithms to find the minimum of the loss function. It allows arriving at best estimators for a given loss function. Each of those methods uses a different strategy to find the minimum of the function[10].

The likelihood function for a logit or probit model is maximised by means of the techniques used for non-linear estimation. There are several user-friendly software tools available for logit or probit analysis.

Considering the fact that the variables are binary (i.e. they take two values – 0 or 1), the majority of the results will be presented at the level of the structural form of the model. A "plus" sign preceding a parameter denotes that the probability of an innovative phenomenon in the selected group of entities is higher than for the rest of the population. Probit modelling is an efficient research tool in the case of big yet static samples where the dependent variable is qualitative.

As mentioned above, some methodical analysis was based on probability theory. Several of the seventeen dependent variables were:

a) the occurrence in industrial investment in innovation activities, but in relation to their structure, namely the R&D, investments in new machinery and equipment, as well as buildings, structures, land and investment in new computer programs:

$$y_i = \begin{cases} \mathbf{0} \text{ if the inputs have not occurred} \\ \mathbf{1} \text{ if the inputs have occurred} \end{cases};$$

b) implementation of new processes and products, taking account of specific solutions in this field and, therefore, new products and new processes:

$$y_i = \begin{cases} \mathbf{0} \text{ if the solution have not been deployed} \\ \mathbf{1} \text{ if the solution have been deployed} \end{cases};$$

c) cooperation in the field of innovation with such entities as suppliers, competitors and customers, as well as universities, R&D organisations and foreign research institutes:

$$y_i = \begin{cases} \mathbf{0} \text{ if there wasn't a cooperative relationship} \\ \mathbf{1} \text{ if there was a cooperative relationship} \end{cases}.$$

Independent variables used for a quarterly survey were: the size of enterprises according to their current employment, distance from customers, suppliers, competitors and relationships with customers, suppliers and competitors.

A set of adopted independent variables are the reference planes, which reflect the activity of industrial enterprises, adopted on the basis of the methodology commonly used in OECD countries since the 1980s[11].

The set of characteristics where distinguished that describe innovative activities of industrial enterprises at the input (effort) and output (implementation and cooperation). Simultaneously to this day the synthetic measurement method has not been developed to describe innovation activities at the enterprise level, although its recognition in the system approach appears in the literature[12]. However, they are sometimes criticised because of the heterogeneous nature of this activity and the difficulty in bringing it to a common denominator, the used measurement methods are specific with limited applications. Statistical verification of models was based on Wald's Chi-square statistics. The verification of the significance of the Wald parameters was made using Student's t-test with the asymptotic standard errors of assessment. Adopted confidence limits of the model and its parameters were ±95%. Due to the number of estimated models the authors decided to present only those that met the test of statistical significance – both models as a whole, as well as its parameter (the factor in question).

It is also worth noting that both the dependent and independent variables had the binary nature. This is due to the fact that on the one hand, there was the need to collect a large number of properly completed survey forms – the system survey while on the other hand to simplify of the questions in the survey form as much as possible. This does not change the fact that the

nature of the questions was in line with international methodological standards and practice in this area. For this reason it was decided to build only unvaried models. It was due to the lack of continuous variables on the input, which could have allowed more precise conclusions, however showing statistically significant directions of the relationships between the variables adopted for the study. This proved sufficient for the evaluation of the studied phenomena. Based on the probability theory , the chances of particular areas of innovation activity can be estimated and provide some boundary conditions, and thus making it possible to plan and strengthen the effects of the impact of regional innovation policy instruments.

Each questionnaire was entered to the *Excel* spreadsheet for initial processing based on formal logic. The actual calculations were made with the *Statistica* software.

2. Agglomeration economy in a medium-weak region – a case of West Pomerania

As far as the type of customers in West Pomeranian (447 questionnaires) is concerned, there is a variety of interactions representing innovative behaviour in the region.

Table 1A. Values of parameters for independent variable "type of customer's activity" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Customer's activity: mining and quarrying							
R&D expenditure	1.220	0.455	2.676	0.007	0.800	0.352	8.222	0.004
Investment in new buildings, premises and land	1.276	0.456	2.799	0.005	0.800	0.331	9.036	0.003
Implementation of new production-related systems	0.854	0.421	2.028	0.043	0.700	0.370	4.351	0.037
Cooperation with domestic R&D units	1.182	0.410	2.879	0.004	0.400	0.076	7.822	0.005
	Customer's activity: processing industry							
Investment in new fixed assets	0.358	0.163	2.199	0.028	0.871	0.780	5.027	0.025
Investment in new buildings, premises and land	0.343	0.135	2.550	0.011	0.435	0.306	6.486	0.011
Computer software	0.298	0.150	1.986	0.047	0.814	0.724	4.038	0.045
Implementation of new production-related systems	0.293	0.134	2.191	0.029	0.459	0.347	4.796	0.029
Cooperation with universities	0.617	0.191	3.233	0.001	0.129	0.040	10.355	0.001
Cooperation with foreign R&D units	0.423	0.211	2.006	0.045	0.081	0.034	3.935	0.047

Source: own study based on research evidence.

Table 1B. Values of parameters for independent variable "type of customer's activity" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Customer's activity: power industry							
R&D expenditure	1.122	0.282	3.979	0.000	0.760	0.339	17.439	0.000
Computer software	0.767	0.371	2.059	0.040	0.080	0.261	5.093	0.024
Implementation of new production-related systems	0.825	0.268	3.078	0.002	0.680	0.360	9.904	0.002
Implementation of new support systems	0.579	0.261	2.220	0.027	0.600	0.372	5.008	0.025
Cooperation with domestic R&D units	1.018	0277	3.674	0.000	0.080	0.063	12.620	0.000
	Customer's activity: trade							
Cooperation with suppliers	–0.265	0.123	–2.146	0.032	0.281	0.377	4.623	0.032
Innovation cooperation	–0.304	0.120	–2.534	0.012	0.357	0.475	6.442	0.011

Source: own study based on research evidence.

Development of new solutions is supported by relationships with the whole industry, not only the area of mining and industrial processing[13]. A positive yet less significant impact can also be observed for power industry and trade industry. Other sectors seem to play a marginal role, nonetheless it is noteworthy that the companies which represent the final link in the production chain, i.e. sell their goods, tend to be less interested in innovative activities.

As we can see in Table 2B below, the geographic factor (distance) becomes critical for innovative performance in industrial horizontal relations. However, it takes a different direction from this pointed out in the literature. In West Pomerania, the shorter the distance from the main competitor, the weaker innovative activity is. The necessary condition to stimulate introduction of new solutions is competition beyond the region. It happens because of two reasons. The first one is a consequence of geographical location and the resulting considerable share of pro-export production. The other is connected with the weakness of the economic potential of the region. The models described herein suggest that in this region there are not too many enterprises which can compete with one another in similar areas. This means polarization of economy according to the "weak-strong" convention, thus proving operation of two industrial systems weakly related with each other. Relations in the plane of competitiveness should have the character of close cooperation if a high level of innovativeness is expected. Nevertheless, the number of models differs considerably from the number of those generated for the "distance" variable. This negative difference proves rare interactions with competitors while implementing innovative processes. The planes under discussion, i.e. the space and the relations, are mutually dependant,

Table 2A. Values of parameters for independent variables "distance to competitor" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Distance to competitor: local							
R&D expenditure	–0.574	0.131	–4.395	0.000	0.233	0.439	19.831	0.000
Cooperation with universities	–0.633	0.235	–2.695	0.007	0.024	0.089	8.471	0.004
Cooperation with domestic R&D units	–0.404	0.194	–2.080	0.038	0.048	0.103	4.602	0.032
Cooperation with foreign R&D Units	–1.047	0.369	–2.836	0.005	0.006	0.071	13.107	0.000
	Distance to competitor: beyond region							
R&D expenditure	0.359	0.137	2.613	0.009	0.465	0.327	6.820	0.009
Investment in new buildings, premises and land	0.374	0.138	2.710	0.007	0.693	0.553	7.325	0.007
Computer software	0.848	0.181	4.682	0.000	0.306	0.088	25.176	0.000
Launching new products	0.386	0.180	2.142	0.033	0.464	0.317	4.565	0.033
Implementation of new production-related systems	0.356	0.179	1.987	0.047	0.500	0.361	3.943	0.047
Implementation of new support systems	0.367	0.137	2.685	0.007	0.491	0.348	7.208	0.007
Cooperation with suppliers	0.355	0.180	1.968	0.049	0.446	0.312	3.849	0.500
Cooperation with universities	0.683	0.192	3.548	0.000	0.140	0.034	12.436	0.000
Cooperation with domestic R&D units	0.451	0.181	2.487	0.013	0.140	0.063	6.035	0.014
Cooperation with foreign R&D Units	0.483	0.213	2.269	0.024	0.088	0.033	5.009	0.025
Innovation cooperation	0.438	0.137	3.183	0.001	0.544	0.372	10.173	0.001

Source: own study based on research evidence.

Table 2B. Values of parameters for independent variables "relations with competitor" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Relations with competitor: non contacts							
Cooperation with universities	–0.514	0.222	–2.319	0.021	0.029	0.086	5.983	0.014
Innovation cooperation	–0.310	0.125	–2.482	0.013	0.341	0.461	6.202	0.013
	Relations with competitor: close contacts							
Cooperation with competitors	0.939	0.245	3.824	0.000	0.105	0.014	14.921	0.000
Cooperation with universities	0.438	0.202	2.166	0.031	0.116	0.051	4.515	0.034

Source: own study based on research evidence.

since it is difficult (but not impossible) to expect an intensive level of horizontal cooperation in a situation when the distance between entities grows.

From the point of view of the character of relations with competitive entities, not only few models proved to be statistically significant, but also they concerned diversified areas acting non-unidirectionally. This proves that relations with competitors do not affect innovative activity of the entities under consideration. This again is the characteristic of economies which are on a low technological level, i.e. in the weakest regions. This is indirectly confirmed by the geographical factor which indicates that close proximity of a competitive company does not favour stimulation of innovative behaviour.

Table 3A. Values of parameters for independent variables "distance to supplier" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Distance to supplier: regional							
R&D expenditure	–0.341	0.165	–2.069	0.039	0.262	0.384	4.379	0.036
Computer software	–0.436	0.132	–3.295	0.001	0.199	0.342	10.845	0.001
Implementation of new production-related systems	–0.390	0.165	–2.371	0.018	0.262	0.403	5.772	0.016
Implementation of new support systems	–0.335	0.127	–2.630	0.009	0.304	0.430	6.988	0.008
Innovation cooperation	–0.277	0.126	–2.201	0.028	0.348	0.454	4.876	0.027
	Distance to supplier: beyond region							
Computer software	0.347	0.147	2.358	0.019	0.822	0.718	5.709	0.017
Implementation of new support systems	0.549	0.131	4.203	0.000	0.533	0.320	17.769	0.000
Cooperation with universities	0.403	0.189	2.128	0.034	0.048	0.104	4.457	0.035
Innovation cooperation	0.292	0.129	2.254	0.025	0.496	0.381	5.084	0.024

Source: own study based on research evidence.

In the case of relations with suppliers, most of the areas of innovative activity is of great importance. If an entity is in close contact with the supplier, then it implements innovative activities more frequently. It is the opposite when relations with this group of companies are marginalized. Similarly, high technological activity is connected with the performance of region industry within domestic and international supply chains.

A locally based supplier limits the efforts to finance new solutions. Considering the industrial weakness of the region and the number of local range relations, it is one of the basic structural and quantitative destimulants observed in the region. A low financial potential of enterprises in this region prevents dynamic development of new technologies. However, there

are chances to relate to a large group of domestic suppliers, but based beyond the region, to accelerate innovative processes in the regional industrial system.

Table 3B. Values of parameters for independent variables "relations with supplier" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Relations with supplier: typical							
R&D expenditure	–0.381	0.192	–1.984	0.048	0.245	0.379	4.063	0.044
Investments in new fixed assets	–0.789	0.184	–4.294	0.000	0.579	0.838	18.107	0.000
Investments in technical equipment and machinery	–0.615	0.182	–3.381	0.001	0.579	0.792	11.265	0.001
Computer software	–0.392	0.183	–2.137	0.033	0.631	0.767	4.499	0.034
Implementation of new technological processes	–0.581	0.185	–3.142	0.002	0.631	0.820	9.656	0.002
Implementation of new production methods	–0.497	0.181	–2.747	0.006	0.368	0.564	7.679	0.007
Cooperation with suppliers	–0.409	0.198	–2.063	0.039	0.210	0.346	4.434	0.035
	Relations with supplier: close							
R&D expenditure	0.354	0.146	2.423	0.016	0.393	0.266	5.989	0.014
Investments in new fixed assets	0.517	0.150	3.447	0.001	0.843	0.688	11.717	0.001
Investments in technical equipment and machinery	0.529	0.145	3.639	0.000	0.808	0.633	13.111	0.000
Computer software	0.387	0.145	2.667	0.008	0.781	0.651	7.043	0.008
Implementation of new technological processes	0.507	0.149	3.401	0.001	0.834	0.679	11.418	0.001
Implementation of new production methods	0.298	0.138	2.152	0.032	0.568	0.449	4.649	0.031
Implementation of new production-related systems	0.480	0.148	3.251	0.001	0.420	0.247	10.884	0.001
Cooperation with suppliers	0.310	0.148	2.090	0.037	0.355	0.248	4.453	0.035

Source: own study based on research evidence.

In the case of relations with suppliers, financing and the implementation of new solutions are of predominant significance. If a given entity has close contacts with suppliers of materials, then it implements innovative actions more frequently, whereas it is the opposite when relations with this group of companies are marginalized. High technological activity is connected with the performance of the region industry within domestic and international supply chains. Nonetheless, the fact that there is a limited number of models for the spatial variable proves the strong diversification in terms of the flow of materials and half-finished products to the regional industrial system. Considering the universality of innovative processes in this region it can be

concluded that the significance of mutual interactions with suppliers in the region and their complexity are growing.

Table 4A. Values of parameters for independent variables "distance to customer" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Distance to customer: local							
Implementation of new support systems	–0.362	0.137	–2.648	0.008	0.289	0.423	7.118	0.008
Innovation cooperation	–0.264	0.134	–1.971	0.049	0.344	0.445	3.916	0.478
	Distance to customer: foreign							
Computer software	0.408	0.143	2.862	0.004	0.830	0.830	8.425	0.004
Implementation of new technological processes	0.340	0.149	2.285	0.023	0.856	0.765	5.361	0.021
Implementation of new support systems	0.415	0.127	3.285	0.001	0.490	0.330	10.812	0.001
Cooperation with domestic R&D units	0.390	0.174	2.243	0.025	0.124	0.061	4.996	0.025
Innovation cooperation	0.287	0.126	2.286	0.023	0.490	0.378	5.229	0.022

Source: own study based on research evidence.

The proximity to the suppliers, as well as the nature of relations with suppliers, do not destimulate innovative processes, but for customers these elements cumulate. In other words, the local environment as a potential customer of innovative goods remains unfriendly.

The character of an industrial system and its tendency to innovate are conditioned by its position in complex national industrial chains in the relation to suppliers and in terms of international or domestic relations with customers. The region has acquired the internal capability to generate new technological solutions basing on the absorption of knowledge from beyond the region. There is still an imperative to act as an indirect link in the supply chain. The regularities observed prove once again that the activity of the region industry focusing on the development of new products and technologies requires the enterprises to overcome the barrier of distance (space) in order to transfer knowledge.

Vertical relationships with customers clearly indicate that the relationship factor is more relevant than the spatial one. Nonetheless, it should be stated that the number of statistical models is close to that generated for the West Pomeranian Region. An essential condition to encourage the right activity in terms of new products and technologies is a significant distance to customers although in such a case it needs to be accompanied by close cooperation along the production chain. It provides evidence supporting the previously formed thesis about

the dichotomy of industrial systems in Poland and their close relationships with innovative interregional and even international networks. An internal industrial system, being weak, does not provide proper conditions for dynamic development of regional interactions which become essential to improve innovative performance in the leading group of enterprises, forcing them to incur costs of covering the distance in order to acquire knowledge. Moreover, it should be observed that it requires more than good neighbour relations with the analysed groups of entities; typical (basic) relationships with customers are even more harmful (negative) to the stimulation of innovative activity.

Table 4B. Values of parameters for independent variables "relations with customer" in the probit models describing innovativeness of industry in West Pomerania

Innovative feature	coef	Std. Err.	*t*	P > |z|	p_1	p_2	Chi^2	p – model significant
	Relations with customer: typical							
Investment in new fixed assets	–0.514	0.202	–2.538	0.011	0.659	0.822	6.276	0.012
Computer software	–0.488	0.197	–2.475	0.014	0.596	0.767	6.031	0.014
Implementation of new technological processes	–0.673	0.199	–3.386	0.001	0.596	0.820	11.224	0.001
Implementation of new production-related systems	–0.459	0.211	–2.175	0.030	0.234	0.395	4.932	0.026
Implementation of new support systems	–0.479	0.211	–2.267	0.024	0.234	0.402	5.369	0.021
	Relations with customer: close							
R&D expenditure	0.569	0.157	3.631	0.000	0.406	0.210	13.800	0.000
Computer software	0.417	0.149	2.805	0.005	0.781	0.640	7.781	0.005
Implementation of new technological processes	0.603	0.152	3.971	0.000	0.650	0.839	15.553	0.000
Implementation of new production-related systems	0.539	0.154	3.493	0.001	0.421	0.230	12.679	0.000
Implementation of new support systems	0.331	0.149	2.224	0.027	0.412	0.290	5.030	0.025
Cooperation with suppliers	0.333	0.154	2.166	0.031	0.354	0.240	4.798	0.029
Cooperation with domestic R&D units	0.777	0.303	2.562	0.011	0.101	0.020	8.700	0.003
Innovation cooperation	0.362	0.147	2.453	0.014	0.447	0.310	6.118	0.013

Source: own study based on research evidence.

It should be also observed that development of an industrial system is accompanied by an increasing number of models describing the analysed phenomena where the parameters are statistically significant. It is a proof for a better transparency of innovative networks described by the selected variables. The role of those factors becomes more and more significant over time.

Conclusions

The regional industrial systems in the West Pomeranian voivodeship analysed in this study reveal an evolution in the approach to innovative activities, considering the character of competitors, suppliers and customers, their location or relationships with them.

Unlike enterprises in the technologically developed countries where innovative activities are focused in regional systems, Polish enterprises are forced to overcome the distance barrier. Nevertheless, it seems a natural direction for new knowledge which affects the development of national industrial systems. It is also noteworthy that in the strongest case, the regional environment is no longer a destimulant in innovative activities.

Enterprises which are the final link of the production chain are less innovative than those producing for industry. It is an indication of a low technological level of solutions offered and a still insufficient demand pressure which would drive innovation. Regional systems have not yet become mature enough in terms of competitiveness to participate in the dynamic changes based on the technological factor in the international market.

Along with the growing economic potential of Polish regions, there is increasingly stronger diversification of entities following an innovative path. The value of close long-term relationships with suppliers and customers becomes more and more relevant as it raises mutual trust and enables involvement in more risky areas of business. It follows that innovative activity is determined by the existence of repetitive, long-term yet typical interactions, which seems consistent with the results of the research carried out worldwide.

Notes

[1] *National Systems of Innovation*… (1992).
[2] Edquist, McKelvey (2000).
[3] Sternberg (2000), pp. 389–407.
[4] Frenkel (2000), pp. 315–341.
[5] Stanisz (2007), p. 217.
[6] Berkson (1944), pp. 357–365.
[7] Gruszczyński, Kluza, Winek (2003).
[8] *Wspomaganie procesów decyzyjnych...* (2003), pp. 129–130.
[9] Welfe (2003).
[10] Stanisz (2007), p. 218.
[11] *Zasady gromadzenia i interpretacji danych...* (2005).
[12] *European Innovation Scoreboard...* (2010).

[13] According to the Polish Classification of Activities, the categories of industry are: mining and quarrying; processing industry; gas, electricity and hot water supply. In this study, the terms industry and industrial production are used interchangeably since only the D section has been analysed in detail, which does not imply that the conclusions formulated here apply to the entire industrial activity.

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