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PRO-INNOVATIVE MOTIVES FOR ESTABLISHING COOPERATION BY ENTERPRISES: AN EMPIRICAL STUDY IN POLAND

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ABSTRACT. The issue of innovation is currently often perceived in the context of inter-organizational cooperation. In literature on this subject one of the ways to win in competition is by seeking synergies resulting from cooperation of companies with other firms, including their competitors, as well as with business environment institutions or research and development entities. The global experience indicates an important role of these ties in generating innovations. Taking all of the above into account, this paper aims to determine whether companies establish cooperation with one another and also with other institutions of their business environment and science, and whether they are ready to strengthen cooperation in the near future in order to improve their innovativeness. Quantitative research included 76 construction companies, 83 food industry enterprises, 76 enterprises in metal and machinery and 82 those in wood and furniture industry. The research carried out has allowed us to specify previous academic achievements with regard to the readiness of companies to undertake cooperation with their competition, with scientific institutions and also with other business environment entities. The obtained results indicate a large deficit both in terms of previous cooperation and with regard to the readiness to increase it in the near future, which, unfortunately, confirms previous conclusions outlined in the already available literature.

JEL Classification: L22, L26, M14

Keywords: companies, business environment institutions, cooperation, business clusters, networks of companies

Introduction

The issue of innovation, viewed nowadays as a necessity (Kirikkaleli, & Ozun, 2019), a fundament of intelligent choice and one of the key factors in building a competitive advantage for both individual entities (Hao, Qi, Gong, Chen, & Shen, 2019) and entire regions (Tidd, & Bessant, 2013, pp. 3-5), is often perceived in the context of inter-companies cooperation (Kijkuit, & van den Ende, 2010) and having a positive effect on the latter (Daniluk, 2018; Karbowski, 2019). This approach is evident, among others, in the concept of the triple helix, which assumes cooperation of business, science and governmental institutions (Cai, 2015). Polish publications on the topic of innovation indicate, apart from the necessary

cooperation between these three areas, the important role of business environment institutions as those which facilitate contact and the flow of information, particularly between the areas of business and science (Daniluk, & Tomaszuk, 2016). Literature on the subject underlines that one of the ways of opposing increased competition from international economic structures (Nguyen, Larimo, & Wang, 2019) is by finding a synergy effect resulting from cooperation of businesses both with other firms (Kim, Dinwoodie, & Seo, 2018; Raišienė et al., 2019), including competing ones (Antonelli, 1992) and with business environment institutions (Daniluk, 2016) and/or research institutions (Lin, Hsiao, & Lin, 2013; Vaiciukevičiūtė, Stankevičienė, & Bratčikovienė, 2019). Practical experience from around the globe indicates the importance of these ties in generating innovations. Quantity and especially quality of the relations between them play a crucial role in increasing the competitiveness of both firms (Rzepka, 2019) and entire regions (Garanti, & Zvirbule-Berezina, 2013).

The need to strengthen inter-organisational cooperation is evident in the assumptions of many European and governmental programs, which result in a multitude of initiatives directed at building cooperation between various organisations, e.g., networking and clusters (European Commission, 2010). It should be noted that authors writing on this subject matter often point to the pro-innovative character of these structures (Hemert, Nijkamp, & Masurel, 2012). It is generally accepted that contemporary economy is characterised by networks, and links of this kind, both formal or informal, penetrate all areas of the economy. Moreover, literature also underlines the importance of the quality of ties/relations rather than their number (Czakov, 2012). A strong network of internal and external entities, alongside technical and social infrastructure and well-functioning strategic management, is one of the factors preconditioning international competitiveness (Gorynia, & Jankowska, 2008; Lis, 2018; Elexa, Lesáková, Klementová, & Klement, 2019).

1. Literature review

A noticeable tendency of the last decades is the shift of businesses from a confrontational orientation in the direction of a more peaceful and collaborative approach towards fulfilling their objectives (Nazarko, & Chodakowska, 2017). Many business leaders began to notice that as they themselves did not possess all the necessary resources, operations carried out autonomously and independently were often set up to fail (eg Schermerhorn, 1975), at the same time, value-oriented business administration is determined by overall business environment (Lašáková et al., 2019). The validity of this action is confirmed by the results of numerous studies, which indicate that cooperation brings tangible benefits (Czakov, 2007; Nazarko, 2013; Kozłowski, & Matejun, 2012; Rzepka, 2017) These advantages appear regardless of whether cooperation is formal or informal (Stańczyk-Hugiet, & Strzelecka, 2015; Lis, 2019).

This does not mean, however, that cooperation always solely brings advantages and ends in success. As pointed out by P. Kale, J.H. Dyer and H. Singh (2002) a significant percentage of inter-organisational cooperation ends in a fiasco, and ties are severed before objectives have been fulfilled. It is often the case that ties between the cooperating entities are weak, unstable and most importantly characterised by an attempt to take advantage of one's partner (Moczyłowska, Korombel, & Bitkowska, 2017). Studies regarding the conditions of cooperation therefore take on an important role, especially those touching on the limits, shortcomings and weaknesses of cooperation (Stein, & Ginevičius 2010; Nowak, 2015).

Among the barriers of initiating cooperation, subject literature lists: fear of an excessive dependency on one's partner, loss of identity, knowledge and competitiveness, excessive involvement in relations and an uncertainty of the amount and change in expenditure in order to maintain relations (Adler, & Kwon 2014). Many authors underline

that the most significant, even key, barrier to undertaking cooperation is that of human capital (Fawcett, Magnan, & McCarter, 2008), most notably a lack of trust towards new partners (Dobrzyński, Dziekoński, & Jurczuk, 2013; Wasiluk, 2015; Oláh et al., 2017) or traditional attitudes towards some essential features of human capital (Bilan et al., 2017). Researchers point out the existence of mental barriers in the business sector, characterised by mistrust towards other businesses (Wasiluk, 2013; Ryciuk, 2016), but also towards entities in the science sphere (Wasiluk, 2016) and business environment institutions (Stanisławski, 2016). Subject literature also draws attention to the fact that there are often misunderstandings, conflicts and antagonisms between businesses (Leonidou, Barnes, & Talias, 2006). Irregularities and abnormalities with which businesses are met in the market cause them to act in a careful and cautious manner, even at the cost of lower profits (Nowak, 2015).

Cooperation in the innovation sector both in the form of a value chain and in the form of competence type increases the innovative efficiency of companies (Chick, Huchzermeier, & Netessine, 2014; Bilan et al., 2019), and cooperative relations are nowadays regarded as a specific type of resource (Widelska, Michalczuk, & Moczyłowska, 2014). Studies from around the globe have shown that new conceptions of innovative processes or products are not only a result of business operations, which constitute the last stage of the value chain, but of an improvement in the flow of information and cooperation between partners (Roy, Sivaramakrishnan, & Wilkinson, 2004; Myšková & Kuběnka, 2019). For this reason, a significant and current area of discourse in subject literature is the cooperation of businesses (Stańczyk-Hugiet, & Strzelecka, 2015). As studies show, over 50% of cooperative relations are formed between entities within the same sector or competitors (Gnyawali, & Park, 2009) (in Poland 49% of industrial enterprises cooperate with firms of the same sector, and 44% with firms of related sectors – eg. KPMG, 2014), and decidedly less often between business environment institutions or scientific institutions, regardless of the fact that these are immensely valuable (Zeng, 2010). They stimulate the increase in the competitiveness of companies, with an increased intensity of agreements on innovation with various entities having a positive impact on the proportion of profits from innovative operations within the total profits in the given sector (Wojnicka, 2004). There is no doubt that science and its surroundings breed innovative ideas, which are then transferred to businesses. Nevertheless, in Poland, despite the creation of two government programs providing public funding intended for the development of both basic and applied studies, there have been no significant advances in development of science and the supply of innovation. Previous Polish attempts at commercialising innovation have so far also proven ineffective (Romanowska, 2016). The results of the analysis of innovation of businesses in Poland still confirm the thesis of low (it seems that this problem concerns not only Poland but also its neighboring countries – e.g. Adekola, Korsakiene, & Tvaronavičiene, 2008), even steadily decreasing levels of innovation in business (Gryczka, 2017; Braumberger, 2019). The results of the analysis of innovation of businesses in Poland still confirm the thesis of low, even steadily decreasing levels of innovation in business.

2. Methodological approach

Taking into account the above considerations relevant to the author of this paper was to determine whether the competing companies, will cooperate with both one another and the institutions of business environment and science, and whether they are ready to strengthen cooperation in the near future in order to improve their innovativeness. A picture of the current state and future perspective should help largely determine the prospects for the creation and development of a variety of network relations, including clusters.

Bearing in mind the objective set, a research problem was formulated in the form of the following questions:

1. What is the declared level of cooperation of the surveyed companies with competition and business environment and scientific institutions?
2. What is the interest of the surveyed companies in strengthening cooperation with the competition and business environment and scientific institutions in the near future?
3. To what extent do the identified, pro-innovation factors affect the current level of cooperation of the surveyed companies with competition and business environment and scientific institutions?
4. To what extent may the positive changes in the identified, pro-innovation factors contribute to the improvement of the cooperation of the surveyed companies with competition and business environment and scientific institutions in the near future?
5. Is there a correlation between the ratings of the various, pro-innovation factors impact on the present cooperation and the ratings of possibilities for improving it in the future?
6. Is there a dependency in the ratings of the existing cooperation between the different spheres (competition, scientific institutions and business environment institutions)?
7. Is there a dependency in the ratings of interest in strengthening cooperation between the different spheres (competition, scientific institutions and business environment institutions) in the near future?

The analyses presented in this text are based on the results of broad research in which one of the authors of this paper was a member of the research team (Polish – Belarusian joint research project for years 2014-2016 „Readiness of enterprises to create cross-border networking” under the agreement on scientific cooperation between The Polish Academy of Sciences and The Belarusian National Academy of Sciences). The analyses included companies in construction (C), food (F), metal and machine (M), wood and furniture (WF) industries as priority areas for development of the Podlaskie region (UMWP 2013). The sources for selection of entities to participate in the research were various databases, including those obtained from the Regional Statistical Office. Some respondents were obtained through the use of a snowball procedure based on recommendation of certain entities by other study participants. The quantitative research included the total of 381 companies - 76 construction and 305 industrial, therein 83 in food industry, 76 in metal and machinery and 82 in wood and furniture industry based in the area of Podlaskie region.

For the purposes of the carried out research the classification of business environment institutions was adopted in accordance with the recommendation of the Polish Agency for Enterprise Development (Bąkowski, & Mażewska, 2015, pp. 7-8). The identification of factors affecting the establishment of cooperation was based on a critical analysis of domestic and foreign literature, conducted surveys, and was also the result of discussions with experts from both academic society and business.

The questionnaire to be filled in was addressed to the owners of companies or members of senior management. Respondents assessed the phenomenon in a seven-grade scale, where 1 meant a complete lack of influence or a complete lack of cooperation and 7 - a very large impact or very good cooperation.

The collected empirical material has been encoded and then subjected to conversion to numerical form, which allowed to carry out detailed analyses of the surveyed group. The following statistical measures were used to interpret the research results: measures of dispersion - the coefficient of variation and measures of central tendency - mean, median, dominant. To indicate the strength of interdependence between the ratings a coefficient of Spearman correlation rank was used and then t-Student test to examine its significance. To identify statistically significant differences in the ratings among sectors the Kruskal-Wallis

test was used. Statistical calculations were made with the use of STATISTICA programme version 13.1.

3. Conducting research and results

3.1. Cooperation of enterprises with competition

Respondents from the analysed sectors assessed the level of existing cooperation between their companies and competitors very poorly and although the average scores for individual sectors differ a little from each other, the conducted Kruskal-Wallis test indicated that the differences are statistically insignificant (see Table 1). In all groups of the surveyed companies we are dealing with a wide diversity of the respondents' ratings, although in the case of wood and furniture companies it is somewhat stronger. Little optimism is also seen in assessing the degree of the studied companies' interest in cooperation with competitors in the next 2-3 years. The declared willingness to establish such cooperation differs slightly from the current situation. Conducted Spearman's ranks correlation indicates a high dependency between the ratings of current cooperation and the possibility of increasing it in the near future. The higher the surveyed companies assessed the current level of their cooperation with competition, the higher the level of readiness to strengthen it in the future indicated in their declarations.

Table 1. Current and future cooperation with competitors in the respondents' opinion

Specification	\bar{x}	M_e	D	V
Declared level of cooperation with competitors/ Degree of interest in strengthening cooperation within the next 2-3 years				
Companies in total	2.80/3.01	3.00/3.00	2/3	51.91/50.20
Food companies	2.78/3.02	3.00/3.00	1;3/3	49.25/43.51
Metal and machine companies	2.89/3.04	3.00/3.00	3/3	50.64/51.93
Wood and furniture companies	2.83/2.94	2.50/3.00	1/3	57.93/54.61
Construction companies	2.67/2.89	2.00/3.00	2/2	47.11/49.04
Correlation of Spearman's rank ($p < 0.05$)				
Assessment of the current level of cooperation and possibilities of its strengthening in the future.				
Companies in total				<u>.653550</u>
Food companies				<u>.600907</u>
Metal and machine companies				<u>.677531</u>
Wood and furniture companies				<u>.645989</u>
Construction companies				<u>.626617</u>
Kruskal-Wallis test($p < 0.05$.)				
		H		p
Declared level of cooperation with competitors		.8219888		.8442
Degree of interest in strengthening cooperation within the next 2-3 years		1.039392		.7917

Source: own study

All pro-innovative reasons assessed by the respondents make a weak contribution to establishing their cooperation with competition (see Table 2). The activities aimed at improving the quality of products or services have biggest impact on it, while the possibility of joint research and development projects has the smallest one. Although there are slight differences in the average ratings of the impact of the various conditions in the analyzed

sectors the conducted Kruskal-Wallis test indicates no statistically significant differences between them. There is a high diversity in the respondents' ratings in individual sectors when assessing the impact of various factors on the establishment of cooperation with the competition.

Table 2. Descriptive statistics for the ratings of the impact of various factors on the level of existing cooperation with competitors and of positive changes in various factors on the level of cooperation in the near future

Specification	\bar{x}	M_e	D	V	Spearman's rank ($p < 0.05$)
Companies in total					
Food companies					
Metal and machine companies					
Wood and furniture companies					
Construction companies					
rise of innovation potential (faster generating and implementing of products and technology innovations)	2.80/3.41	3.00/4.00	1/4	59.62/52.70	<u>.652414</u>
	2.96/3.49	3.00/4.00	1/4	54.62/49.24	<u>.648516</u>
	2.67/3.18	2.00/3.00	1/1	62.76/57.96	<u>.747349</u>
	2.85/3.57	3.00/4.00	1/5	60.10/49.95	<u>.581987</u>
	2.67/3.16	3.00/3.00	1/4	62.16/53.50	<u>.615545</u>
	3.09/3.52	3.00/3.00	1/1	57.64/53.33	<u>.663178</u>
products/services quality improvement	3.16/3.53	3.00/4.00	1/3	52.00/48.53	<u>.638370</u>
	3.09/3.47	3.00/3.50	1/1	56.18/56.11	<u>.668037</u>
	3.24/3.98	3.00/4.00	1;3/6	55.56/46.26	<u>.580500</u>
	3.16/3.30	3.00/3.00	1/1	63.34/58.71	<u>.726009</u>
possibility of implementation of joint investment projects (e.g. joint purchase of expensive technologies, equipment, etc.)	2.72/3.28	2.00/3.00	1/1	66.22/55.95	<u>.627716</u>
	2.80/3.20	2.00/3.00	1/3	64.86/51.98	<u>.639489</u>
	2.58/3.04	2.00/3.00	1/1	71.15/64.57	<u>.672434</u>
	2.65/3.38	2.00/3.00	1/1	65.95/52.76	<u>.523889</u>
	2.82/3.45	2.00/3.00	1/1;3	63.72/55.11	<u>.608806</u>
possibilities of implementation of joint research and development activities	2.59/3.14	2.00/3.00	1/1	63.86/56.22	<u>.639891</u>
	2.60/2.95	2.00/3.00	1/1	62.06/54.96	<u>.570179</u>
	2.57/3.07	2.00/2.00	1/1	66.24/64.87	<u>.614060</u>
	2.50/3.11	2.00/3.00	1/1;3	61.02/51.53	<u>.644771</u>
	2.51/3.21	2.00/3.00	1/1	65.14/56.02	<u>.712789</u>
Kruskal-Wallis test ($p < 0.05$)					
		H	p	H	p
rise of innovation potential		2.298173	.5129	3.717109	.2937
products/services quality improvement		.367517	.9469	5.961475	.1135
possibility of implementation of joint investment projects		1.334577	.7209	2.525200	.4708
possibilities of implementation of joint research and development activities		.148658	.9854	.9969672	.8020

Source: own study

Pro-innovative reasons were a rare reason for establishing cooperation with competitors. Similar conclusions were reached also by other researchers. Polish publications on the innovativeness of companies (eg.: Baczko, 2012; PARP, 2015; Wasiluk, 2017) notice that Polish companies in general rarely undertake to carry out research and development activities and expenditures on innovation activities are intended mostly for the purchase of

machinery and equipment (Bromski, 2013). Studies by the Central Statistical Office (GUS 2015, pp. 97-110; GUS 2018, pp. 81-92) confirm that the disability of Polish companies to cooperate with various actors in the implementation of innovative projects is their weakness. In 2012-2014 in the field of innovation activities only 30.1% of industrial enterprises cooperated (in the years 2015-2017 - 28.7%), and in the framework of cluster initiatives only 13.7% (in the years 2015-2017 increased to 20%). The research presented by A.M. Kowalski (2010) indicates that the positive impact of cooperation within clusters on the number of innovations implemented by the company was noticed by 35% of the surveyed business entities and the most common were marketing innovations. The least frequent innovations introduced by enterprises in connection with the operation of the clusters were process/technological innovations. The researchers indicate also that the main incentive to initiate cooperation between enterprises is to raise funds (Un, Romero-Martinez, & Montoro-Sanchez, 2009; Klimas, 2015).

In the respondents' opinion positive changes in terms of opportunities for cooperation in order to improve the quality of products or provided services contributed to the improvement of cooperation with competition to the greatest extent. Little effect on it as assessed by the respondents from the food industry and the wood and furniture industry would have the positive changes in the area of possibility of implementation of joint research and development projects, in the case of metal and machine companies – the possibility of implementation of joint investment projects such as for example the joint purchase of technology or equipment and in the case of construction companies – a rise in innovation potential. The Kruskal-Wallis test indicates no statistically significant differences between sectors in their ratings. An analysis of the coefficient of variation allows us to determine the presence of a strong differentiation in the ratings of respondents in the same sector.

There is a positive correlation between the ratings of the impact of various factors on existing cooperation and the evaluation of possibilities for improving it in the future in the case of respondents across all sectors. Spearman's rank correlation leads to the conclusion that the increase of ratings of the impact of individual factors on the current level of cooperation is accompanied by an increase in the average value of the ratings of the impact of positive changes in these factors on the establishment of cooperation in the future. In most cases, we can talk about a high strength of correlations.

3.2. Cooperation of companies with business environment institutions

Respondents assessed the level of existing cooperation between their companies and business environment institutions (see *Table 3*) as low, although the average scores for individual sectors differ a little from each other, the conducted Kruskal-Wallis test indicated that the differences are statistically significant only in the case of the opinions of food companies and wood and furniture companies opinions. In the wood and furniture industry and construction industry the majority of the analyzed companies said that no cooperation has been established with these institutions so far (dominant level 1). In the case of all groups of surveyed companies we are dealing with a strong differentiation of respondents ratings.

Low interest in cooperation of companies with business environment institutions is also indicated by other researchers in their works (Zeng, Xie, & Tam, 2010). J. Rózański (2016) reports that only 1.1% of the enterprises surveyed by him declared frequent contacts with technology transfer centres, technology or industrial parks. Data from the Central Statistical Office data show, however, that only a little over 5% of industrial enterprises indicated cooperation with these institutions as particularly advantageous (GUS 2015, p. 104) (in 2015-2017 - 7.9%, while this indicator also includes commercial laboratories and private R&D institutions, which were not included jointly in previous years (GUS 2018, p. 87). It

seems that this may be one reason for the low interest of companies in establishing cooperation.

Slightly greater optimism in regard to cooperation with business environment institutions is noticeable in the respondents' declarations regarding the near future. Average ratings in various sectors differ a little from each other; however, as indicated by the Kruskal-Wallis test these differences are not statistically significant. Although the diversity of ratings is lower than in the case of current cooperation, it still remains at a high level. In addition, the conducted Spearman correlation rank indicates a moderate (in the case of food industry) or even high (in the case of the other sectors) dependency of the ratings of current cooperation on possibilities of strengthening it in the next 2-3 years. The higher the respondents assessed the current level of their cooperation with these entities, the higher the readiness to strengthen it in the future was declared. This may be due either to a growing awareness of the surveyed companies about the benefits of such cooperation, the challenges posed by the environment or the experience of such cooperation in the past.

Table 3. Current and future cooperation with competitors in the respondents' opinion

Specification	\bar{x}	M_e	D	V
Declared level of cooperation with business environment institutions / Degree of interest in strengthening cooperation within the next 2-3 years				
Companies in total	3.07/3.69	3.00/4.00	3/4	49.88/43.50
Food companies	3.42/3.64	3.00/4.00	3/4	41.61/43.68
Metal and machine companies	3.09/3.97	3.00/4.00	3/3;5	49.59/41.29
Wood and furniture companies	2.77/3.41	3.00/3.00	1/3	52.12/49.55
Construction companies	2.84/3.68	3.00/4.00	1/3	53.61/40.43
Correlation of Spearman's rank ($p < 0.05$)				
Rating of the current level of cooperation and possibilities of its strengthening in the future.				
Companies in total				<u>.644566</u>
Food companies				<u>.550189</u>
Metal and machine companies				<u>.670404</u>
Wood and furniture companies				<u>.724251</u>
Construction companies				<u>.630760</u>
Kruskal-Wallis test ($p < 0.05$)				
		H		p
Declared level of cooperation with business environment institutions		10.13714	WF/F .029861	.0174
Degree of interest in strengthening cooperation within the next 2-3 years		4.529715		.2097

Source: own study

The pro-innovative reasons analysed in this text were not in the respondents' opinion the primary ones to undertake cooperation with business environment institutions (see Table 4). They contributed establishing contacts between the two spheres of economic life only to a small degree. For the majority of sectors the dominant remained at level 1 which proves that the highest percentage of respondents have never undertaken any cooperation in this area. The most active in cooperation with business environment institutions were food companies and metal and machine companies, while the most frequent reason was the possibility to get aid in the transfer of technology. There were no statistically significant differences between the analysed sectors in their ratings of reasons.

Table 4. Descriptive statistics for the ratings of the impact of various factors on the level of existing cooperation with business environment institutions and of positive changes in various factors on the level of cooperation in the near future

Specification	\bar{x}	M_e	D	V	Spearman's rank ($p < 0.05$)
Companies in total					
Food companies					
Metal and machine companies					
Wood and furniture companies					
Construction companies					
possibilities of implementation of joint research and development initiatives	3.01/3.70	3.00/4.00	1/4	57.41/49.74	<u>.722554</u>
	3.05/3.60	3.00/4.00	2/5	55.87/47.48	<u>.728707</u>
	3.13/4.04	3.00/4.00	3/3	51.97/45.28	<u>.603880</u>
	2.73/3.39	2.50/3.00	1/2	57.54/53.80	<u>.670122</u>
	2.95/3.62	2.50/3.50	1/2	59.90/49.64	<u>.771040</u>
access to research centres/research infrastructure	3.04/3.69	3.00/4.00	1/4	57.44/48.02	<u>.690034</u>
	3.28/3.61	3.00/4.00	1/4	54.19/46.10	<u>.618498</u>
	3.25/4.11	3.00/4.00	3/5	50.28/40.29	<u>.640082</u>
	2.65/3.53	2.00/3.00	1/1;4	61.24/53.91	<u>.670468</u>
	2.80/3.41	2.50/3.00	1/3	58.56/49.84	<u>.719948</u>
commercialisation of research results	2.86/3.40	3.00/3.00	1/4	55.95/50.39	<u>.689117</u>
	3.13/3.52	3.00/4.00	3/4	50.54/45.57	<u>.704789</u>
	3.01/3.43	3.00/3.00	3/3	50.40/47.15	<u>.615248</u>
	2.66/3.28	3.00/2.00	1/1	57.68/65.95	<u>.674559</u>
	2.76/3.43	3.00/3.00	1/4	59.35/53.18	<u>.646103</u>
help with transfer of technology	3.40/3.99	3.00/4.00	1/4	53.09/44.00	<u>.681178</u>
	3.58/4.08	4.00/4.00	4/5	45.80/41.92	<u>.667024</u>
	3.45/3.88	3.00/4.00	3/4	54.09/45.89	<u>.669412</u>
	3.27/3.96	3.00/4.00	1/4	53.98/43.51	<u>.645785</u>
	3.09/3.88	3.00/4.00	1/4	56.18/44.52	<u>.644284</u>
Kruskal-Wallis test ($p < .05$)					
		H	p	H	p
possibilities of implementation of joint research and development initiatives		2.632104	.4519	5.122168	.1631
access to research centres/research infrastructure		8.918325	.0304	9.701322 WF/M .036128	.0213
commercialisation of research results		5.245654	.1547	1.234965	.7446
help with transfer of technology		3.637536	.3034	.8600864	.8350

Source: own study

In the opinion of respondents positive changes, especially with respect to help in the transfer of technology, would influence the improvement of companies' cooperation with business environment institutions to the greatest extent. Improved possibilities for the implementation of joint research and development projects and easier access to facilities or research infrastructure would also be significant. A positive change in helping to commercialise research would have a relatively smaller impact on it. This seems to be due to the fact that, as mentioned earlier, Polish companies rarely undertake to carry out research and development and if they do it is only for their own needs. In cooperation with the science entities the direct contact is usually preferred, without any entities acting as intermediaries. The Kruskal-Wallis test indicates the presence of statistically significant differences only

between the opinions of wood and furniture and metal and machine companies in the respect of impact of positive changes in access to facilities and research infrastructure. The analysis of the variation coefficient allowed determining the existence of a strong differentiation of respondents' ratings in the same sector.

There was a positive correlation between the ratings of influence of various reasons on the respondents' existing cooperation with the institutions of business environment and the ratings of possibilities for improving it in the future in case of occurrence of positive changes in these areas. Spearman's rank correlation leads to the conclusion that the increase in the ratings of the level of individual factors impact on the current level of cooperation is accompanied by an increase in the average values of the ratings of the level of impact of positive changes in these factors on the establishment of cooperation in the future in all analyzed sectors. In all cases high strength of correlations can be noticed.

3.3. Companies cooperation with the sphere of science

Respondents, especially those in the wood and furniture industry, assessed the level of their existing cooperation with scientific institutions as very low (see *Table 5*). Statistically significant differences were noticed between the opinions of wood and furniture companies and metal and machine and food companies. In all the analyzed sectors as well as in the surveyed companies generally the dominant proportion of respondents stated that so far no cooperation as been undertaken with R&D institutions (dominant at level 1). Apart from the metal and machine industry there is a very strong differentiation of respondents' ratings. It is important to note that in Podlaskie region the level of industrial development is low in comparison to other regions of the country, which further enhances the adverse balance in the field of cooperation between science and business (Nazarko, & Kononiuk, 2013; Radziszewski, Nazarko, Vilutiene, Dębkowska, Ejdyś et al., 2016) and, in turn, demands developments of the cooperation between business and local authorities (Hajduga et al., 2018).

The poor cooperation of companies with the sphere of science was already indicated in Polish publications a decade ago. They highlighted the poor level of cooperation between the two spheres (MRR, 2006; MNiSW, 2006). In comparison to other EU countries it has also been assessed as very low by the World Economic Forum (ZDSP, 2008). Unfortunately, this unfavorable situation has not improved over the past years. As indicated by J. Różański (2016, p. 4) less than 24% of the enterprises surveyed by him declared their frequent contacts with universities, 15.6% with industrial research institutions and 14.4% with R&D units. The Central Statistical Office data show, however, that in 2012-2014 only about 17% of industrial enterprises indicated cooperation with higher education institutions as particularly advantageous (in 2015-2017 - 24.4%). Research institutes were indicated by 14.3% of the companies (in 2015-2017 - 15.9%) and scientific units of the Polish Academy of Sciences by less than 2% (in 2015-2017 - 1.0%) (GUS 2015, p. 104; GUS 2018, p. 87). The results of A. Sopińska and P. Wachowiak's (2016, p. 20) survey also indicated low use of universities and research institutions as a source of innovation. Only 17.6% of the managers researched by them indicated entities of science as an external source of innovation.

Slightly more optimism in regard to cooperation with the institutions of science, however there is still leaving a lot to be desired, is noticeable in the respondents' declarations about the near future. Although the average ratings in various industries slightly differ from each other, the conducted Kruskal-Wallis test indicates that the differences are statistically insignificant. And although the differentiation in the ratings is lower than in the case of current cooperation, it is still present on a high level. The conducted Spearman's ranks correlation indicates a high dependency between the ratings of current cooperation and the

possibility of increasing it in the next 2-3 years. The higher the respondents assessed the current level of their cooperation with these institutions, the bigger readiness to strengthen it in the future they declared. This is the right line of action. The increase in innovativeness of Polish enterprises is necessary so that they can be competitive in the market, both domestic and international (e.g.: Ejdyś, 2014; Ejdyś, Ustinovicus, & Stankevičienė, 2015). It will not be possible without cooperation between business and the sphere of science.

Table 5. Current and future cooperation with science sphere institutions in the respondents' opinion

Specification	\bar{x}	M_e	D	V
Declared level of cooperation with science sphere institutions / Degree of interest in strengthening cooperation within the next 2-3 years				
Companies in total	2.51/3.20	2.00/3.00	1/3	62.05/52.00
Food companies	2.66/3.05	2.00/3.00	1/3	60.18/51.97
Metal and machine companies	2.76/3.42	3.00/3.00	1/2	54.76/52.99
Wood and furniture companies	1.93/2.71	1.00/3.00	1/1;3	64.10/54.91
Construction companies	2.38/3.07	2.00/3.00	1;2/3	62.08/50.06
Correlation of Spearman's rank ($p < 0.05$)				
Rating of the current level of cooperation and possibilities of its strengthening in the future.				
Companies in total				<u>.672574</u>
Food companies				<u>.676079</u>
Metal and machine companies				<u>.644969</u>
Wood and furniture companies				<u>.654470</u>
Construction companies				<u>.756689</u>
Kruskal-Wallis test ($p < 0.05$)				
		H		p
		16.17590		
Declared level of cooperation with competitors		WF/M .002015		.0010
		WF/F .013992		
Degree of interest in strengthening cooperation within the next 2-3 years		6.448962		.0917

Source: own study

The most common area of establishing cooperation by respondents with institutions of science was primarily help in improving employees' qualifications, help with resolving technological problems and the transfer of knowledge (see Table 6). It seems that universities fulfill this role particularly well since today they not only play the role of research centres that are merely teaching facilities, but are also the institutions providing the education process that will be used in the future economy. Poorly rated area of undertaking cooperation between both spheres was help with resolving organisational problems. On the one hand this may be due to a lack of conviction of many entrepreneurs of the significance of the impact of these problems on the efficiency of their businesses' operation and therefore if something is unimportant it is not worth investing any financial resources and time in solving it. Meanwhile on the other hand, many members of top management are convinced of their sufficient knowledge in order to solve such problems (Wasiluk, 2016).

Table 6. Descriptive statistics for theratings of the impact of various factors on the level of existing cooperation with science sphere institutions and of positive changes in various factors on the level of cooperation in the near future

Specification	\bar{x}	M_e	D	V	Spearman's rank ($p < 0.05$)
Companies in total					
Food companies					
Metal and machine companies					
Wood and furniture companies					
Construction companies					
possibilities of implementation of joint research and development initiatives	2.80/3.36 2.77/3.08 3.16/3.84 2.45/3.16 2.71/3.17	2.00/3.00 2.00/3.00 3.00/4.00 2.00/3.00 2.00/3.00	1/1 1/1 1/5 1/1 1/1	62.61/55.22 64.59/54.82 57.36/50.66 61.87/53.69 63.99/58.35	<u>.683753</u> <u>.653557</u> <u>.596941</u> <u>.685003</u> <u>.724568</u>
access to research infrastructure	2.92/3.49 2.92/3.39 3.43/3.80 2.43/3.13 2.82/3.34	3.00/4.00 3.00/3.00 4.00/4.00 2.00/3.00 3.00/3.00	1/1 1/1 4/5 1/1 1/1	59.52/52.43 58.48/52.36 52.38/48.59 62.12/55.10 60.74/54.09	<u>.694548</u> <u>.705578</u> <u>.620312</u> <u>.713017</u> <u>.746824</u>
help with resolving technological problems	3.15/3.77 3.33/3.66 3.32/4.04 2.78/3.56 3.12/3.53	3.00/4.00 3.00/4.00 3.00/4.00 2.00/3.00 3.00/3.50	1/4 1;4/4 1/5 1/3 1/4	56.90/49.59 50.17/49.41 55.55/46.70 60.08/49.55 59.47/53.50	<u>.643645</u> <u>.726979</u> <u>.686456</u> <u>.583621</u> <u>.705288</u>
help with resolving organisational problems	2.93/3.55 3.19/3.57 3.16/3.78 2.70/3.44 2.82/3.30	3.00/3.00 3.00/3.00 3.00/4.00 2.00/3.00 3.00/3.00	1/1 1;3/3 1/2 1/1;3 1/2	58.33/52.97 51.41/50.73 58.52/51.09 61.89/54.47 59.34/54.39	<u>.647524</u> <u>.636925</u> <u>.770746</u> <u>.556266</u> <u>.646517</u>
help with transfer of knowledge	3.03/3.68 3.18/3.90 3.25/3.80 2.71/3.44 2.88/3.29	3.00/4.00 3.00/4.00 3.00/4.00 2.00/3.00 2.50/3.00	1/4 1;3/4;5 1/4 1/4 1/3	57.72/64.84 51.76/93.88 54.84/49.71 60.73/54.27 62.59/57.21	<u>.700059</u> <u>.754775</u> <u>.767503</u> <u>.654532</u> <u>.749103</u>
help with improving employees' qualifications	3.39/3.99 3.43/3.77 3.51/4.16 3.15/3.93 3.50/3.93	3.00/4.00 4.00/4.00 3.50/4.00 3.00/4.00 3.00/4.00	1/5 4;5/5 1/6 1/5 1/4	54.26/47.01 46.43/47.64 52.48/47.14 58.48/49.30 58.37/46.28	<u>.639314</u> <u>.643227</u> <u>.748199</u> <u>.605072</u> <u>.698335</u>
Kruskal-Wallis test($p < 0.05$)					
		H	p	H	p
possibilities of implementation of joint research and development initiatives		5.863313	.1185	7.960380	.0468
access to research infrastructure		13.15606 WF/M .0027	.0043	5.892933	.1169
help with resolving technological problems		5.357636	.1474	3.882346	.2745
help with resolving organisational problems		5.113793	.1637	2.529383	.4700
help with transfer of knowledge		5.746336	.1246	3.668772	.2995
help with improving employees' qualifications		2.084954	.5550	1.834360	.6075

Source: own study

The possibility of undertaking common research and development initiatives was also rated very poorly. In the case of this factor in all analysed sectors as well as for all surveyed enterprises, the dominant amounted to 1. This means that the highest percentage of respondents in general have not cooperated in this regard. On the one hand this is certainly due to the fact that a lot of Polish companies never undertake such activities, as mentioned earlier in this text, and on the other hand this may be due in part to the stereotype of the scientist as a person detached from reality who creates only theories. And for most entrepreneurs, that which is theoretical is automatically impractical.

Kruskal-Wallis' test indicates the presence of statistically significant differences between the opinions of companies from the wood and furniture and metal and machine industries only in regard to access to research infrastructure as a condition for undertaking cooperation. Analysis of the value of the variation coefficient allows us to determine the presence of a strong differentiation of respondents' ratings across the same sector.

In the opinion of many respondents positive changes in all the identified areas of undertaking cooperation can contribute to strengthening the cooperation in the near future. However, a significant percentage of the surveyed companies do not intend to contact the sphere of science in the next 2-3 years. Bearing in mind that the good experience of the past cooperation result in a habit and conviction as to the reliability of the partners as for their compliance with obligations (Braun 2010, p. 229) they should seek to initiate such contacts. On the one hand we need to break the stereotype of a scientist as a person completely detached from reality, who conducts research which no one needs and on the other hand strive to improve business awareness of the need for learning throughout life, improving knowledge and valuing the specific benefits of lifelong learning. Non-existing cooperation with institutions of science was also reflected in the low ratings of possibilities to influence positive changes in the analysed factors in the future.

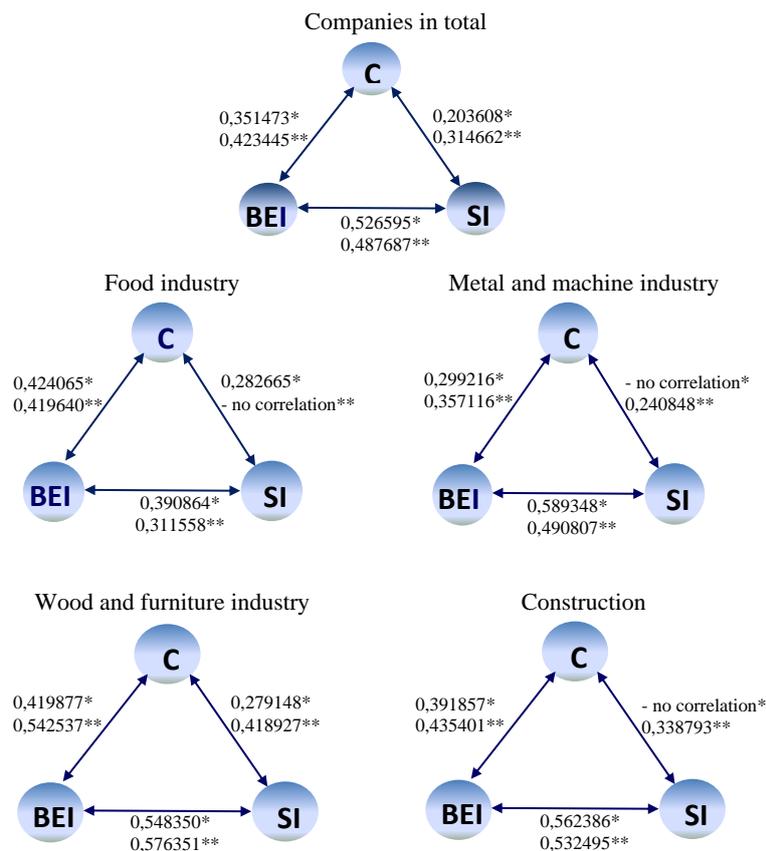
Average ratings in individual sectors slightly differ from one another; however, as the Kruskal-Wallis test indicates these differences are not statistically significant. An analysis of the value of the coefficient of variation allows us to determine the presence of a strong and in the case of ratings by food companies in regard to help in the transfer of knowledge even very strong, diversity of respondents' ratings across the same sector.

A positive correlation was noticed between the ratings of influence of various conditions on the existing cooperation with institutions of science and the assessment of possibilities for improving it in the future in case of occurrence of positive changes in these areas.

The Spearman' rank correlation conducted for ratings of the surveyed companies leads to the conclusion that the increase in ratings of the level of impact of individual factors on the current level of cooperation is accompanied by an increase in the average value of the ratings of the level of impact of positive changes in these factors on the establishment of cooperation in the future, in all analysed sectors. In all cases we can talk about high strength of correlations.

3.4. Dependencies in the rankings of the current and future cooperation between the different spheres

It seemed interesting to examine whether there was a correlation between the ratings of cooperation in one of the analysed areas with the ratings of cooperation with another? Do the companies which rated their current cooperation with competitors highly also rate highly their cooperation with institutions of science and business environment institutions? Do the respondents who rated their cooperation with the institutions of science highly also rated higher their cooperation with business environment institutions?



C – cooperation with competition; SI – cooperation with scientific institutions; BEI – cooperation with business environment institutions.
 *Spearman's rank correlation for ratings of cooperation between A & B spheres
 **Spearman's rank correlation for ratings of interest in strengthening cooperation between A & B spheres

Figure 1. Spearman's rank correlation between the ratings of current and future cooperation in different spheres (Spearman's rank $p < 0.05$)

Source: own study.

The conducted analysis allows us to notice that the strongest correlations exist between the ratings of current cooperation and also readiness to strengthen it in the near future, in regard to the sphere of science and business environment institutions (with the exception of respondents from the food industry). Therefore, we can conclude that the higher the respondents rated their cooperation (current and future) with the sphere of science, the higher they rated it also with business environment institutions. The strength of these correlations is at a moderate level, so we can talk about significant dependence. However, in the case of companies in the food industry the strongest correlations were between the ratings of cooperation (present and future) with competing companies and business environment institutions. Thus, the higher these companies rated their cooperation with competitors the higher they rated it also with business environment institutions. However, it should be noted that the strength of these dependencies was also at a moderate level.

A low or even non-existent dependency between ratings can be stated in the case of ratings regarding cooperation (current and future) with competing firms and entities of the sphere of science. The only exception is the strength of Spearman's rank correlation for ratings regarding future cooperation of the respondents in the wood and furniture industries, which indicates a significant correlation. Therefore it should be stated that the higher the

respondents rated the possibility of strengthening their cooperation with competing firms the higher they rated such a possibility with scientific institutions.

Conclusion

The modern economy demands a new approach to cooperation processes from modern businesses. One of the methods of coping with an uncertain environment is through cooperation, allowing entities to, among others, aggregate resources, reduce costs, increase elasticity and adaptability to new environments and so on. Cooperation is realised through various configurations of relations between partners. As mentioned earlier, a specific form of inter-organisational cooperation is clusters, defined as networks of entities interacting with one another, based on social and business relations. In subject literature authors often point out the pro-innovative character of these structures as one of their advantages. Keeping in mind the low levels of innovation in Polish businesses, the development of cluster structures seems to be highly desirable. An increase in the innovation of Polish businesses is necessary in order for them to become competitive in the national and international market. Cooperation between entities of different spheres plays a significant, if not deciding role both in creating and in developing cluster structures. Here we have in mind active and practical forms of cooperation between members of each cluster. Without a readiness of entities to undertake cooperation, efforts aimed at developing these structures are doomed to fail from the very beginning (Jirčiková, Pavelková, Bialic-Davendra, & Homolka, 2013).

In conclusion, the research carried out has allowed us to specify previous academic achievements with regard to the readiness of companies to undertake cooperation with their competition and with scientific institutions and business environment entities. The obtained results indicate a large deficit both in terms of previous cooperation and with regard to the readiness to increase it in the near future, which unfortunately confirms previous conclusions in literature. As mentioned above, this kind of cooperation is a necessary condition in forming effective cluster structures, whose benefits include, among others, increasing the innovative potential of firms as well as their competitiveness. In these conditions it is difficult to speak of real possibilities of creating and developing effective cluster structures that are able to compete on the global market. If the situation does not improve, networks will play only a local role.

Finally, it must be underlined that although the study carried out contributed towards filling in the existing gaps in research regarding the cooperation of companies with other competing firms and with scientific institutions and business environment institutions in a regional scope, it is not free from certain restrictions, stemming from the methodological approach that was used and resulting above all in a lack of ability to generalise the results. This is part of the reason for which an additional direction of academic research could be undertaking a replication of this study on a representative and national scale, in companies in Poland.

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