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CONDITIONING FACTORS OF INDUSTRY-UNIVERSITY COOPERATION FROM THE PERSPECTIVE OF ENTERPRISES

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Purpose: The cooperation between enterprises and universities varies in terms of character and intensity. Bearing in mind the potential represented by both parties, its low intensity is still noticed, and consequently, the lack or incomplete use of opportunities resulting from this cooperation. The purpose of this research is to present the current factors conditioning the intensity of industry-university cooperation from the perspective of enterprises.
Design/methodology/approach: The research uses the method of targeted, partially categorized interviews. On their basis, transcripts were prepared and a report was prepared. The paper is practical.
Findings: It was found that the cooperation between industry and universities largely takes the form of a project aimed at joint implementation of practical innovations. Current cooperation factors were identified. Among other things, the dependence of the occurrence of factors on the conditions existing in the environment (e.g. the occurrence of SARS-CoV-2 virus) and on the specificity of a given industry were determined.
Research limitations/implications: The paper focuses on researching biotechnology and pharmaceutical companies. In order to make the results more objective, more research should be undertaken, considering further stages and factors verifying the development of industry-university cooperation. It was found that the factors of cooperation are influenced by the current situation in the environment, and the changes taking place therein may modify these factors, which also needs further research.
Practical implications: The presented conditions of cooperation may help universities understand the needs of enterprises and implement a business scheme of conduct based on specific stages in cooperation with them. As a result, the cooperation between industry and universities will be improved.
Originality/value: Current factors of industry-university cooperation were identified from the perspective of companies from biotechnology and pharmaceutical industries, as well as the conditions shaping these factors. The so-called 'overfactors' of cooperation with the university were distinguished, which should be particularly emphasized in order to intensify the cooperation. The dependence and change of factors on the stage of cooperation and industry were found, which may have an impact on the type of factors determining cooperation with universities.

Category of the paper: Research.

Key words: cooperation, industry, university, conditioning factors.

1. Introduction

In Poland, the cooperation between the world of science and industry is far from the expectations of both environments. Enterprises are reluctant to establish cooperation with universities, and the belief that the transfer of knowledge and commercialization of research results may be the key to success does not seem to be interesting enough for economic practice (Oryszczak, 2013). Industry does not fully perceive the financial, substantive or image advantages of cooperation with universities (Tomaszewski, 2019). However, there are many reasons for establishing industry-university cooperation. Enterprises can profit from highly qualified scientists or students (Myoken, 2013) and use research infrastructure (Ankrah, Al-Tabba, 2015). Collaboration should involve a two-way flow of ideas, the results of which could flow from academia to industry, as well as from business as research questions. In recent years, in the wake of the COVID-19 pandemic, attempts to find solutions to complex health challenges increasingly require collaboration between universities and industry. Few organizations have the internal capacity to achieve specific results on their own. A large number of ideas come from many years of research conducted at universities and are implemented by business.

The topic of university-industry cooperation continues to arouse interest among researchers, especially the components of its success, which change along with external factors affecting them, i.e. politics, economy or internal ones, i.e. the need for qualified staff or access to appropriate scientific and research. In the literature on the subject, there are many publications on cooperation on the part of the university. However, there is still relatively little research carried out on the needs of enterprises, indicating their point of view and the conditioning factors of cooperation with universities. The authors decided to fill this gap. Understanding the conditioning factors of cooperation between enterprises and universities will contribute to the intensification of activities in this direction. On the other hand, appropriate management of the stages of cooperation may in the future be a tool for further development of relations between entities.

2. Factors conditioning cooperation between industry and universities

Enterprises more and more often cooperate with universities from outside their local areas, which may be due to the low potential of local universities in relation to high expectations in specialized issues of enterprises (Lejpras, Stephan, 2011). The demand for certain types of resources significantly reduces the number of potential partners for cooperation, which contributes to the search for them further geographically. The quality and usefulness of cooperation is strongly dependent on the resources that a given partner can offer. As Petruzzelli (2011) notes, successful cooperation between business and universities occurs especially between entities that are at a certain geographical distance from each other. Companies cooperating with universities on consultative issues seek partners in the same region, while those cooperating in Research and Development (R&D) or technical consulting seek partners from outside their regions (Isabel et al., 2014).

The growing need for research and development services in recent years is an opportunity to improve cooperation between universities and enterprises. In the face of these changes, universities are becoming not only the subject of the market of educational services, but also of research services. Poland can draw inspiration from the best practices of the countries best assessed in the cooperation of enterprises with universities in the field of research and development (Global Competitiveness Report 2017-2018), i.e. Switzerland, the United States and Israel.

Knowledge of the factors determining the establishment and maintenance of business cooperation with the university contributes to the improvement of its intensity, and thus influences the increase in innovative activity of enterprises (Lejpras, Stephan, 2011). In order to properly define the factors conditioning cooperation, you must first get to know the expectations of both entities. The figure 1 shows the expectations of business and universities.

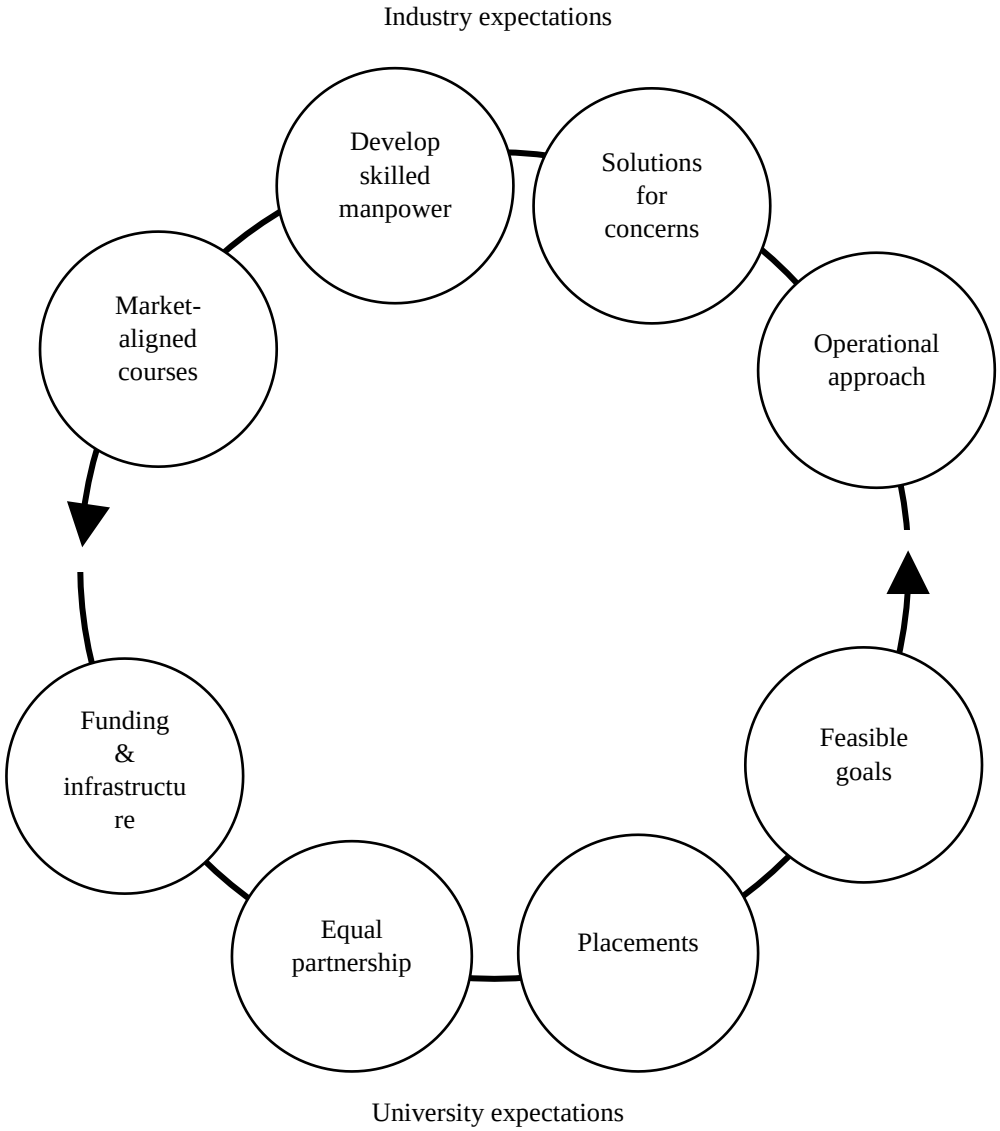

Figure 1. Industry and university expectations.

Source: Gann D., Montresor F., Eisenberg J., 2018, 3 ways to nurture collaboration between universities and industry, World Economic Forum, Nov 2018.

Cooperation will be possible when the expectations of the enterprise and the university meet at the stage of the need to achieve a common goal. Lack of agreement in cooperation may jeopardize the achievement of desired results. For instance, universities want to publish their results, while companies try to keep them out of competition. In addition, industry requires constant availability of research and universities have limitations in terms of their semester structure. Lai and Lu (2016), noting that enterprises and universities pursue different goals, suggest that the most important thing is to strive for a win-win situation with balanced benefits for both parties.

In the literature on the subject, we observe numerous factors influencing the cooperation between industry and universities. However, no factor sparks as much interest as trust. There is often a question of whether a low level of cooperation is the result of low trust or vice versa. According to Tsai (2000), cooperation becomes possible only thanks to trust. According to

Gilbert and Behnam (2013), mutual trust in business relationships promotes cooperation, and vice versa. On the other hand, Wasiluk (2018) in his research proves that there is no clear link between the issue of trust and cooperation. Table 1 presents examples of conditioning factors of cooperation from the past years, depending on the surroundings at that time.

Table 1.
Examples of factors conditioning the cooperation between enterprise and university

No.	Factors conditioning the cooperation	Author	Year of publication
1.	Trust, relationship maturity, communication	Bstieler, Hemmert, Barczak	2017
2.	Joint research, informal contacts, licenses, consultations	Goel, Göktepe-Hultén, Grimpe	2017
3.	Experience from the cooperation so far	Wasiluk	2018
4.	Innovations, government support in the field of research and development, human capital, content	Aiello, Cardamone, Pupo	2019
5.	Human capital, strategic partnership	Albats, Bogers, Podmetina	2020
6.	Joint innovations, technological convergence	Hwang	2020

Source: Own study.

Among the factors conditioning the cooperation quoted on the basis of the analysis of the literature, appropriate skills (human capital) and relationships definitely emerge. As Majzel (2020) notes, the skillful use of knowledge is one of the conditions for creating optimal enterprise strategies, which explains their willingness to seek support in this area also outside. Investing in knowledge as well as research and development influences the efficiency of cooperation between industry and universities, constituting the backbone of the innovation ecosystem. On the other hand, relationships play a large role in undertaking joint tasks, which affects the quality and atmosphere of work.

Innovation strengthens the flexibility of the economy and increases its ability to react quickly to market trends. As Jasińska (2019) notes, the innovative development of the economy is stimulated by the cooperation of public and economic entities and the need to promote and stimulate industry-university relations. In terms of the innovation of the economy, Poland differs significantly from most EU countries (Czyżewska, 2016). The knowledge of scientists and university employees is not fully used in cooperation with business in the field of innovation. Cooperation between science and business is one of the key tools to increase innovation and competitiveness of national economies. Therefore, the development of cooperation between the science and business sectors is so particularly important for Poland.

3. The applied research method and research results

In August 2022 a pilot study was carried out. The study focused on collaboration of enterprises from the Life Science sector, including the biotechnology and pharmacy segment with universities.

Life Science is a broadly defined group of fields of science, which includes biology, biotechnology, genomics, proteomics, pharmacy and biomedicine, as well as bioinformatics. The decision regarding selected industries was influenced by the current market needs for healthcare and their innovative potential. In 2020, 177 companies and over 150 pharmaceutical entities conducted biotechnology activities in Poland. Their development is influenced by the growing patient population, the increasing number of studies, the progress in the development of new drugs, and the crisis that occurred in connection with the COVID-19 pandemic.

The survey involved conducting four one-hour targeted interviews with employees of the life science sector (two entities represent biotechnology companies, two pharmaceutical companies), as well as performing a transcription and developing a report, which was to present the business nature of cooperation between a specific industry and universities. The authors used a previously prepared questionnaire. They changed the order in which they were asked and added new questions.

The respondents participating in the interviews hold managerial positions and are involved or have knowledge in the field of cooperation between the company and universities. These persons represent enterprises with a global reach, registered in the Republic of Poland. Enterprises cooperate and/or collaborated with universities. Enterprises employ over 300 employees in Poland, except for one biotechnology enterprise, which employs about 90 employees (as of August 2022).

On the basis of the research 5 areas of conditions of biotechnology and pharmaceutical enterprises cooperation with universities were verified such as: genesis of cooperation, assessment of cooperation, factors conditioning the collaboration, cooperation priorities and others.

3.1. Genesis of cooperation

According to the respondents, the need for cooperation conditions the type and partner of cooperation. The cooperation of enterprises with universities results from certain types of needs that should be met by a specific action. Industry cooperation with universities is not a disinterested activity. It is an opportunity for the company to generate profit, but also carries the risk of leakage of confidential information or implementation of false data into projects. The purpose of establishing cooperation on the part of enterprises is mainly to expand knowledge and financial savings.

Life science enterprises establish cooperation with local universities and recruit graduates. When local resources are not available, they reach for contacts with foreign universities, mainly from the USA, Scandinavia and Germany.

Every year, cooperation between industry and universities is increasingly heading towards the development of both hard innovations, i.e. specific product solutions, but also soft innovations, understood as communication processes. According to the respondents, innovations are the crucial factor influencing the cooperation between industry and universities, but it should not be the most important factor due to the high risk of failure and the ongoing work of enterprises. According to the respondents, the current activities of cooperation with universities concern research and development, which are principally related to the provision of new diagnostic solutions or preparations in the field of health protection, predominantly in the field of oncology, cardiology and pulmonology.

3.2. Assessment of cooperation

The Ikert scale was used to evaluate the industries – universities cooperation on a scale from 1 (very poor) to 5 (very good). According to the interviews, the initiators of cooperation are definitely companies, whose rates it as quite good, i.e. an average rating of 3.5, which confirms the need to learn about the current conditioning of business-university cooperation in these industries as well as the implementation of factors improving this cooperation.

Good practices of enterprises influence the undertaking of subsequent joint projects and the development of cooperation with universities.

3.3. Factors conditioning the collaboration

The respondents indicated the following factors conditioning their cooperation with universities: communication between cooperation partners, advertising the possibilities of cooperation, implementation of new solutions for the protection and health improvement understood as innovations (i.a. diagnostic and medical applications based on new technologies), relations and trust between entities of cooperation, appropriate competences of the partner (scientist), common interest of both entities understood as the goal of cooperation. In the next part of the study, the authors will use the abbreviated names of factors conditioning cooperation between the business and the university (e.g. table 2).

3.4. Cooperation priorities

Communication between the partners and competences are the main conditioning factors of cooperation between companies from the life science sector and universities. Table 2 shows *prioritization* of factors which condition this cooperation according to the respondents.

Table 2.
Prioritization of factors conditioning the cooperation between enterprises and universities according to the respondents from the Life Science sector

Prioritization of factors conditioning the cooperation	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Weight in the life science sector	Priorities
	Importance of factor according to pharmaceutical companies		Importance of factor according to biotechnology companies			
Communication	40%	20%	25%	10%	24	1
Advertising	5%	10%	5%	0	5	6
Innovations	10%	20%	10%	10%	12,5	4
Relations	5%	10%	20%	10%	11	5
Trust	15%	10%	10%	10%	11	5
Competences	10%	20%	20%	40%	22,5	2
Common interest	15%	10%	10%	20%	14	3
Total:	100%	100%	100%	100%	100	

Description: The weight of the factor in the Life Science sector is the average of the answers of all respondents assigned to a given factor conditioning the company's cooperation with the university.

Source: Own study based on interviews - August 2022.

The common interest understood as the goal was also noted in the top three most important conditioning factors of cooperation. This factor undoubtedly that develops good practices (experiences). The higher the priority of the factor, the greater the influence on the cooperation.

For a better illustration, the figure 2 below displays the factors influencing the development of cooperation between Life Science enterprises and universities.

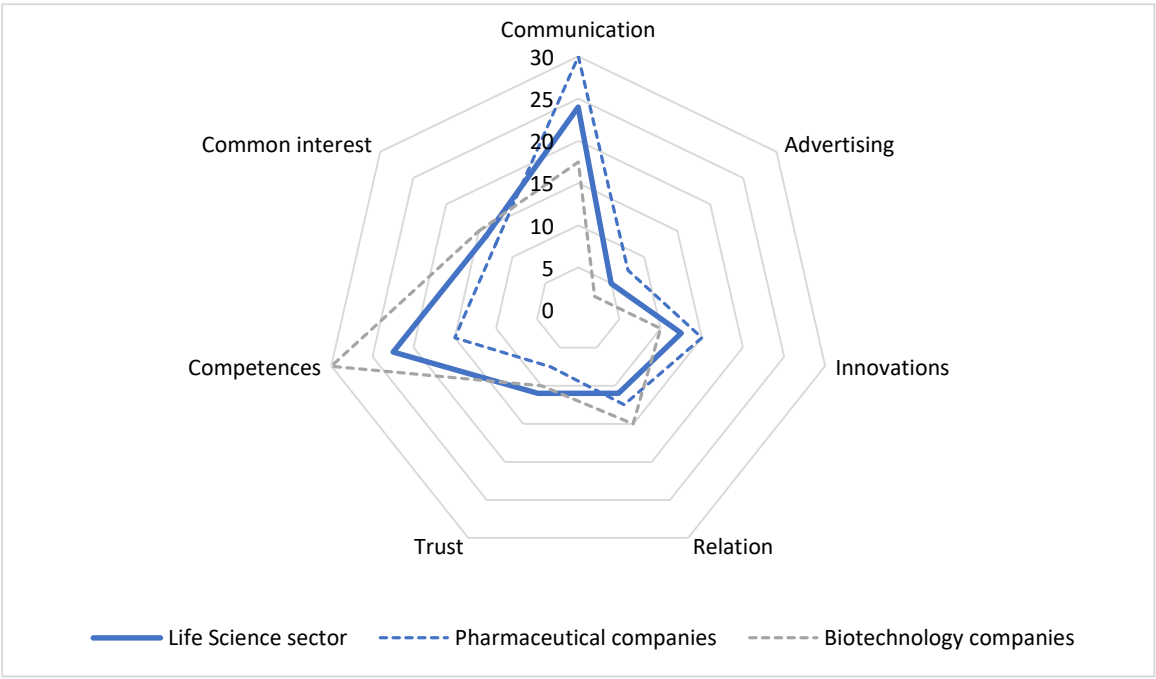

Figure 5. Conditioning factors of cooperation between Life Science enterprises and universities.
Source: Own study, based on interviews August 2022.

Within the sole Life Science sector, we observe different main conditioning factors of cooperation between individual segments with universities, i.e. biotechnology - competences vs pharmacy - communication. On this basis, the authors state the existence of the main factor conditioning cooperation with the university for a given industry, the so-called ‘overfactor’.

3.5. Other identified conditions of cooperation

According to the respondents, the cooperation of both entities resembles working on a project. It consists of the stages of learning (initiation), preparation, implementation (execution) and evaluation, to which individual factors can be assigned at individual stages, as shown in Table 3

Table 3.
Examples of conditions for cooperation within the project

Stage of cooperation	**1**	**2**	**3**	**4**
Name of stage	Learning about common needs and opportunities	Preparation for the project	Project implementation	Project evaluation
Conditions of cooperation	Communication and competences of scientists	Common interest	Implementation of new solutions and mutual trust of both entities	Good practice

Source: Own study based on the interview report, August 2022.

Factors conditioning the cooperation of enterprises with universities change over time, both at the stages of cooperation and as a result of activities coming from the environment. However, despite many recent political and economic changes, they did not significantly affect cooperation with universities, as stated by the respondents.

4. Discussion

The conditioning factors of cooperation in the Life Science sector are definitely more oriented towards communication, the so-called hard competences and a common goal, than generally understood human capital and relations from the literature on the subject of cooperation of generally understood business with universities (see chapter 2). The authors observed that the more specific the segment of the economy, the more characteristic factor verifying the cooperation with the university is assigned to it, the so-called 'overfactor'.

Based on the results of the research, it is stated that various factors conditioning the cooperation between enterprise and university at its various stages and better understanding of the partner's needs and expectations contributes to the improvement and/or increase in the number of cooperation undertaken.

The authors note that when undertaking cooperation between enterprises and universities, its types should be distinguished as other factors may condition the cooperation regarding innovative processes than the acquisition of new employees.

In addition, there is a need to identify the factors of cooperation on an ongoing basis due to changes in the environment.

Factors influencing cooperation between industry and universities may affect it in a direct or indirect manner. The factor directly influencing the development of an enterprise is e.g. innovation, the achievement of which requires the ability to build interdisciplinary research teams, where a scientist contributes intellectual property, and an entrepreneur brings both business experience and knowledge of market mechanisms.

According to the results of the research, innovations were not included in the top three most important cooperation factors, which explains the low level of innovativeness of Poland in relation to other EU countries.

As stated by the respondents, the pandemic period has not affected the cooperation with universities. However, there has been an increased interest towards joint R&D activities (a form of collaboration). Enterprises more and more frequently decide to outsource research and development, which enables faster implementation of innovative solutions at low costs and a greater possibility of focusing on their core activities. The surveyed enterprises undertake local cooperation particularly in this area, unlike the global trends that refer to the globalization of R&D.

At the large enterprise level, respondents did not identify the need for government funding. Focused on optimizing their profits, they have little knowledge of the needs of universities, despite the clear communication of the common interest.

The authors note the need to take actions aimed at better reconciling the expectations of both entities of cooperation and its improvement at the initial stage - understanding the needs and possibilities of both sides. Properly managed cooperation has a chance to develop quickly in the next stages. Good practices will influence its development in the future.

5. Summary

The conducted research showed that the current factors conditioning business-university cooperation are not consistent with those identified in the literature studies which factors are the results of previous studies. Changes in the factors result from changes in the influence of the environment on functioning of the cooperation between the enterprises and the university.

The current conditioning factors the intensification of industry-university cooperation from the perspective of enterprises include:

- project management cooperation,
- goal orientation in managing cooperation,
- efficient communication between partners at all stages of cooperation,
- appropriate competences of scientists to current needs,
- mutual benefits for partners,
- innovations jointly implemented in the market,
- activities of a global nature,
- development of good practices.

The above factors are the starting point for universities wishing to establish or improve cooperation with business.

Each sector of the economy is characterized by its own needs, hence it is essential to know the current conditioning factors impacting cooperation with universities in a specific industry. The individual segments are characterized by the main factor of cooperation, which is unique for their specificity.

It is advisable to conduct further research on a larger group of enterprises and confirm the results of the research presented as well as identify the directions of changes in the studied cooperation with the passage of time and environmental conditions.

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