

# Determinants of science-business cooperation in pharmaceutical production – case study

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*The subject of the article is commercialization of research which generates innovative products for the company involved. The aim of the research was to identify factors that influence the onset of cooperation and mutual research by scientists and entrepreneurs in the pharmaceutical sector.*

*Empirical part of the research was based on case study method. The authors confront data collected during the desk research with the data obtained from studying a company that has been transforming from a pharmaceutical distributor into a production company in this sector. In order to develop innovative medical products, the company undertook cooperation with scientists who proposed solutions that are demanded in the market. Interviews with representatives of the company and scientists involved in cooperation were conducted. Additionally, the authors interviewed representatives of technology transfer office at Lublin University of Technology, who supported the cooperation with their consulting services, and made participating observations of the initial stages of cooperation.*

*The analysis of the empirical data allowed presentation of success factors in initiating cooperation in implementing innovations for all the actors involved, i.e. companies, scientists and supporting institutions.*

**Keywords:** science-business cooperation, commercialization, technological innovations, pharmaceutical sector, determinants of cooperation.

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## Determinanty współpracy nauki i biznesu w branży farmaceutycznej – case study

*Problematyka prezentowanego opracowania dotyczy komercjalizacji wyników badań naukowych, w efekcie których w przedsiębiorstwie wdrażane są nowe produkty innowacyjne. Celem przeprowadzonych badań była próba identyfikacji czynników wpływających na nawiązywanie współpracy oraz prowadzenie wspólnych prac badawczo-rozwojowych przez naukowców i przedsiębiorców, ze szczególnym uwzględnieniem branży farmaceutycznej.*

*Do realizacji badań empirycznych wykorzystano metodę case study. W pracy zaprezentowano przedsiębiorstwo z branży farmaceutycznej, które w ostatnich latach podjęło próbę przekształcenia z działalności handlowej w produkcyjną. W celu wprowadzenia innowacyjnych produktów analizowana organizacja nawiązała współpracę z naukowcami, zajmującymi się badaniami w obszarze zastosowania nowych technologii w branży farmaceutycznej. Na*

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potrzeby realizacji prezentowanych badań przeprowadzono wywiady z naukowcami biorącymi udział w procesie komercjalizacji technologii, przedstawicielami analizowanego przedsiębiorstwa oraz pracownikami Centrum Innowacji i Transferu Technologii Politechniki Lubelskiej. Wywiady uzupełniono obserwacją uczestniczącą oraz analizą dokumentacji.

Analiza wyników przeprowadzonych badań empirycznych umożliwiła prezentację czynników sukcesu w inicjowaniu współpracy i wdrażaniu innowacji, dotyczących zarówno obu stron procesu komercjalizacji, jak też ich otoczenia.

**Słowa kluczowe:** współpraca nauki i biznesu, komercjalizacja wyników badań naukowych, innowacje technologiczne, wdrażanie innowacji, branża farmaceutyczna, determinanty współpracy.

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## Introduction

The subject of cooperation between science and business has been an interesting topic for researchers and politicians recently. The literature on the subject includes numerous examples of benefits resulting from this type of cooperation, as well as factors determining its onset and effective implementation.

The subject matter of the present article is commercialization of research which generates innovative products for the company involved. The aim of the research was to identify the factors that determine the onset of cooperation and mutual research by scientists and entrepreneurs in the pharmaceutical sector.

### 1. Business-science cooperation in the literature

In recent years, the issue of cooperation between science and business has played an important role in the literature on the subject. Factors contributing to this situation include the changing role of the university, which is currently expected to be highly flexible and open to the needs of all the stakeholders: students, local government institutions and companies (Geryk, 2010). Cooperation with businesses is extremely important in this context, because it can be implemented in many fields, such as conducting university lectures by business practitioners, organizing traineeships and internships for students, conferences and symposia, writing diploma theses for the needs of companies, *etc.* In recent years,

research projects jointly implemented by entrepreneurs and scientists and aimed at commercialization of results of scientific research have gained more and more importance (Plewa, 2013).

The literature on the subject emphasizes a number of benefits resulting from the university commercialization process. Researchers indicate that the transfer of technology from the research sector to companies (*i.e.* the commercial sector) contributes to the growth of innovation and the development of a given company (Gibson and Stiles, 2000). Technology transfer is also accompanied by transfer of knowledge, implementation of innovative technologies as well as good practices. This type of cooperation between enterprises and research units should be accompanied by the flow finances and transfer of people involved, as well as demand creation (Lange, Belinko and Kalligatsi, 2000).

The implementation of new solutions from the research to the commercial sector is not an easy process and requires the fulfillment of a number of conditions (Trzmielak and Grzegorzczak, 2014; Wu, Welch and Huang, 2015). The analysis of the literature on the subject allows to classify these factors as external (*i.e.* independent of the parties involved in the commercialization process) and internal ones. External determinants of commercialization process include technological progress, globalization, increased importance of knowledge and access to information in the economy, the specificity of a given sector and the specificity of the country in which the cooperation takes place. According to specialists,

the national innovation system, the legal system (intellectual property protection), supporting institutions, expenditures on technology development, social awareness and the culture of innovation are of fundamental importance to the process of knowledge and technology transfer (Gwarda-Gruszczyńska, 2013; Szarucki, 2012).

However, internal factors that depend on participants in the commercialization process play an important role in this process. These include the organizational culture of the company and research institution, the image of the company, the competitiveness of the offer and access to experts (Trzmielak and Grzegorzczak, 2014). The organizational culture of a given university and faculty, including business approach to building relations with companies and the competences of specialized entities responsible for commercialization, so-called organizational importance, is of crucial importance for initiating and implementing this type of cooperation, *i.e.* technology transfer centers (Plewa, 2013; Gwarda-Gruszczyńska, 2013).

Technology transfer centers (CTT), according to Polish legal regulations, are created by universities to carry out indirect and direct commercialization of research results. Indirect commercialization consists in implementing the results of scientific research carried out in the research and development institution through a spin-off or spin-out company established for this purpose. Direct commercialization is based on licensing or sale of research results. The management of the commercialization process, from identification of the commercialization potential, through establishing contact with the entrepreneur, to negotiating the implementation principles and settlement of the contract, requires various competences in the field of law, economics, technology or marketing from CTT personnel. The interdisciplinary teams that choose their competences for the needs of a given project are increasingly involved in this process. These teams are also responsible for obtaining further financing for conducting R&D works and their implementation.

The competences of participants in the commercialization process, *i.e.* the representatives of companies in which new solutions are implemented and scientists' competences, are extremely important

determinants of cooperation between science and business. Along with the changing role of higher education institutions, their openness to the environment and flexibility, the expectations regarding the competences of academic staff are also changing (Osiri and McCarty, 2013). They are expected to be involved not only in the implementation of scientific research and teaching, but also to have competences enabling them to establish and maintain lasting relationships with stakeholders, entrepreneurs included (Jakubiak and Chrapowicki, 2018).

## **2. Pharmaceutical sector – characteristics and determinants of development**

The subject of the present article is the cooperation of an enterprise from the pharmaceutical industry with scientists. The pharmaceutical sector has been selected for research due to its innovativeness and dynamic development. This is an industry that has been dynamically developing in recent years, occupying the first position in the ranking of the most innovative sectors of the economy. In 2014, the pharmaceutical industry was recognized by the European Commission as strategic for the future of Europe (Kacprzyk et al., 2017).

The pharmaceutical industry covers a wide range of companies, as it includes companies developing and producing medicines, medicine distributors as well as large multinational concerns. The sector consists of companies of different size and ownership structure: SMEs, large companies, those that deal with conducting research and those that focus on production and distribution (Górniak, 2014). The subject of this research was a medium-sized company that initially produced generic medicines and are now developing their own products by conducting R&D processes.

The impact on the development of the pharmaceutical sector and its innovativeness occurs through many factors which most often include technical and technological development, aging of societies, increasing level of affluence, progress in medicine, increasing incidence of civilization diseases and development of new diseases. The development of the industry is also significantly influenced by institutional solutions in individual countries (*e.g.* in the financing of research, medicines, access to

treatment of illnesses), legal regulations (e.g. regarding applied procedures and production quality, drug testing, storage and logistics), as well as market conditions and currency exchange rate differences (most companies in the industry operate on the international market). Drug-producing countries are dominated by European countries (where 1/3 of the world pharmaceuticals are produced). The number of over-the-counter drugs (Górniak, 2014; Jerschke, 2011; Michalik et al., 2011) has contributed significantly to the increase in drug production in recent years.

An important aspect of the pharmaceutical industry in the world is research, science and technology, which enable implementation and sales of innovative solutions. According to PWC report, 8 of 10 largest pharmaceutical groups operating in Poland are innovative companies that, apart from sales functions, are involved in research and development (Ignatowicz et al., 2011). Currently, it is research and development (R&D) departments that play a key role in pharmaceutical companies, rather than production. The use of new technologies causes that the production in the pharmaceutical industry is automated without requiring significant numbers of personnel any more.

### 3. Methodology of research

Empirical research was carried out using the case study method. The method involves studying selected objects that have a large internal complexity and intense relationships with the environment. The method uses a variety of information sources (i.e. documents, observations, interviews) (Creswell, 2007; Baxter and Jack, 2008).

The aim of the present research was an attempt to identify factors determining the establishment of cooperation and conducting joint research and development works by scientists and entrepreneurs, with particular emphasis on the pharmaceutical industry. The following research questions were formulated:

1. What is the subject of the business of the analyzed company?
2. Which factors determined the onset of cooperation?

3. Which features of the scientific team influenced the initiation and maintenance of cooperation?
4. Which features of the technology have decided to start cooperation?
5. Which are the key success factors for the ongoing cooperation?
6. Which factors make cooperation difficult?

Seeking answers to the above questions, the analysis of the subject literature and documentation was carried out to formulate research questions and build an interview questionnaire. Then, individual interviews were conducted with five people involved in cooperation, i.e. the director of the research department in two companies from the pharmaceutical industry (Medicofarma SA and VITAMA SA), heads of two scientific teams from the Lublin University of Technology (Faculty of Environmental Engineering and Faculty of Civil Engineering and Architecture) and two employees of the Innovation and Technology Transfer Center of the Lublin University of Technology (CIITT PL). Interviews were supplemented with the analysis of documentation of research projects and direct observation. In order to obtain more detailed information on the projects jointly conducted by scientific teams and companies, participant observations were carried out. They consisted in the inclusion of research authors to research teams during joint work on the preparation of projects. The aim of the observation was to recognize the methodology of teams' work and processes of complementing competences between participants from the business and scientific environment. Thanks to these observations it was possible to familiarize with the culture of the science and business environment, the stages of cooperation and mutual relations between team members. In turn, the analysis of documentation enabled the authors of the article to get acquainted with the details of the implemented projects, the role of representatives of research teams, obligations and findings regarding the cooperation of scientists and company representatives. The desk research analysis allowed the authors to learn about the process of developing common goals by two connected scientific and business teams. Empirical research was carried out

in 2018 in Lublin, in the company facilities and at Lublin University of Technology.

#### **4. Determinants of science-business cooperation in research results**

##### **4.1. Company's business activity**

The presented article was aimed at identifying and assessing the factors determining cooperation between science and business on the example of a pharmaceutical company. Two related companies, *i.e.* Medicoфарма S.A. and Vitama S.A., were subject of the analyzes. The companies operate in the area of production and distribution of pharmaceuticals, having a joint research and development department.

The object of the Medicoфарма S.A. is contract production of medicines and dietary supplements. The company's production plant, located in Radom since 2004, has been equipped with the latest technological lines. The company put a lot of effort to the quality maintenance of its products, while trying to offer medicines at affordable prices.

With the development of the company its managers decided to invest in the creation of a new research and development department, which was located in Lublin. Cooperation of Medicoфарма S.A. with scientists from the Faculty of Environmental Engineering of the Lublin University of Technology is concerned with the development of technology for the production of rare active substances from herbs.

The second analyzed area of cooperation of science and business is the company Vitama S.A. and a research project carried out together with scientists from the Faculty of Civil Engineering and Architecture at the Lublin University of Technology. Vitama S.A. was created thanks to the combination of Canadian and Polish capital, and deals with the supply of pharmaceuticals from many therapeutic categories. It is the exclusive distributor of products of several pharmaceutical companies, including Medicoфарма S.A.

Currently, Vitama S.A., together with scientists from the Lublin University of Technology, is carrying out a research and development project, whose result will be ready to commercialize within the next two

years. The subject of their research project is new care and therapeutic product for skin protection with radiation reaction during and after radiotherapy.

##### **4.2. Determinants of initiating cooperation**

Considering the determinants of establishing research cooperation, it should be stated that it resulted from the practical need of the analyzed companies. In both cases, we deal with medium-sized companies that did not have in-house staff with appropriate preparation and the potential to carry out research projects independently. The initiative to start cooperation with a university came from the enterprise which addressed the Center for Innovation and Technology Transfer of Lublin University of Technology (CIiTT PL), asking it to indicate scientists interested in cooperation in a given area.

Recalling the words of the director of the R&D department from the analyzed companies, functioning in the pharmaceutical field requires innovative activities from enterprises, however, only some companies can implement them with their own resources. Only the largest corporations can afford to build large research and development teams and employ highly qualified specialists. In turn, smaller enterprises, seeking research opportunities, undertake cooperation with research and development units. The respondent stated that in the analyzed cases, the choice fell on a team of scientists from Lublin University of Technology (PL) who are specialists in the area and have the necessary knowledge and competences.

When asked about factors supporting cooperation, researchers indicated the company's experience in a given area and its knowledge by CIiTT PL employees. It was they who knew the needs of the business partner and the possibility of obtaining financing for the initiated cooperation. When making the decision to join the consortium, the researchers were guided by the possibility of applying the results of scientific research in the hitherto unknown industry and the willingness of interdisciplinary cooperation. The key to the decision was the ability to make real use of the research which had been carried out

for research purposes and to commercialize their results (and thus the opportunity to obtain financial benefits). The researchers also pointed out that the decision to cooperate was influenced by the belief that a given company would be a good partner for cooperation. It was mainly about the company's reputation, knowledge of the industry and the market, laboratory procedures as well as the current achievements of various research teams in the area of cooperation.

#### **4.3. Elements of research team that determined the launch of cooperation**

In case of both research teams whose activities are analyzed in the presented research, the company was the initiator of cooperation. When asked about the competences of scientists involved, the representative of company first pointed out the ability of scientists to understand the requirements of industrial production. The researchers that CIiT proposed to join the cooperation had appropriate competences related to conducting research in a given field and engineering skills that were not present in the company. In the companies analyzed there were no people with sufficient skills and knowledge about technological processes. Therefore, it was decided to entrust scientists with the design of new equipment and selection of parameters for its operation.

#### **4.4. Features of technologies influencing cooperation**

Looking for the factors determining the establishment of cooperation between scientists and business representatives, the respondents were asked to indicate the key features of technologies that decided to undertake joint actions. The research project manager said that the technology was chosen because it conditioned access to the solution that the company was looking for. At university, working on this solution was already at final stages of research process, which additionally allowed to assess the features of the technological solution, *i.e.* innovation, adequacy and admission for use in the pharmaceutical industry and laboratory practice.

#### **4.5. Key success factors**

When asked to indicate general factors which, according to the respondents,

can ensure success in mutual cooperation between scientists and entrepreneurs, the respondents declared that mutual trust between the parties was the most important thing. According to the respondents, it is previous experience – in particular if successful – that helps to develop new cooperation. Such activities ensure representatives of the company that scientists have a broader view of business and are reliable partners for further projects. It is more difficult to trust the partner where the first attempt to cooperate was unsuccessful. At the same time, it is important to present research ideas in a less scientific and more popular scientific way, illustrated by documentation, presentation of materials, technological line, to make the scientific team credible for the potential customer. Among the success factors, respondents also mentioned:

- meeting the need with problem solution;
- understanding mutual needs and partners' requirements;
- common goals;
- clear communication of goals and methods of their implementation;
- an appropriate approach of the company and scientists, openness to cooperation, suggestions for the partner.

In turn, when asked to indicate the factors that had the greatest impact on the initiation and maintenance of cooperation in their case, the respondents indicated that mutual understanding of the rules governing the work of the researcher and the company's goals was crucial. Both the company's representatives and the scientists knew that each party had other professional obligations, so the involvement was not expected beyond the capacity of the other party. At the same time, specific rules of cooperation were established and then kept up.

Respondents were also asked to indicate what makes the cooperation between them continue and turn into a mutual long-term project. The following features were particularly mentioned:

- interdisciplinary cooperation, which results in innovative ideas and solutions;
- knowledge and skills team members want to share with their partners;
- engagement in a joint research project;
- striving to achieve the goals;
- involvement of team members.

#### 4.6. Factors hindering cooperation

All the initiatives that are implemented between different environments can be difficult to implement. This is mainly due to the diverging objectives of both cooperating parties, different characteristics of activities, legal and institutional requirements for a university and a pharmaceutical company. A company wants to introduce a commercial solution as quickly as possible, but would not like to invest in a technology or product that “might not sell”. Meanwhile, scientists have to dedicate a lot of time and resources to reach a certain level of specialization and competence, and therefore, expect to ensure that their input will be properly appreciated, also in financial terms.

Difficulty in implementing the cooperation results also from the fact that scientists are not overly encouraged to cooperate with the industry and are often assessed on the basis of research papers which do not necessarily have to be applied in economic practice. Thus, the practical use of knowledge is less valued at universities than academic considerations, which discourages many scientists from cooperating with business.

### 5. Discussion and conclusions

The subject matter of the present research concerned the determinants of cooperation between science and business which results in commercialization of scientific research. Respondents who agreed to participate in the study represented both sides of the commercialization process as well as the intermediary institution, *i.e.* technology transfer center. The analysis of the results of the conducted research allowed to indicate a number of factors facilitating cooperation, also in a longer time perspective. The research results are confirmed by reports from the subject literature (Trzmielak and Grzegorzczak, 2014; Gwarda-Gruszczyńska, 2013).

The implementation of joint projects by scientists and company representatives requires both parties to compromise and be open to the needs of the partner. The respondents indicated a number of difficulties of various types that appear with such initiatives. They concern primarily financial issues (expectations regarding the benefits of commercialization), cultural (different

type of organization), institutional and legal (high demands on the technological process in the pharmaceutical industry, bureaucracy, *etc.*). The research results in this respect also confirm reports from the literature on the subject, in which many barriers in the commercialization process are indicated (Gwarda-Gruszczyńska, 2013; Szarucki, 2012).

However, the respondents recognized that if the cooperation brings results, the difficulties are not very important and do not cause the projects to be stopped. According to managers of research teams, cooperation with business often helps in academic and didactic work, but requires a very high level of self-discipline and the ability to organize own working time. These are competences that can be called entrepreneurial skills of scientists, helping in establishing and maintaining implementation with business. In the results of earlier studies, this type of skills was indicated as an indispensable element of the entrepreneurial competence model of researchers (Jakubiak and Chrapowicki, 2018).

Research has also demonstrated the important role of university technology transfer centers in establishing lasting relationships between participants in cooperation. In all the interviews, the topic of initiating cooperation by employees of the unit appeared. Therefore, it can be assumed that the cooperation of scientists with industrial partners is significantly influenced by the activities of these types of units, and thus also the approach of the university authorities to joint activities, openness and understanding for such initiatives (Geryk, 2010).

The example of cooperation described by the authors focuses on the pharmaceutical industry, which are future-oriented and innovative spheres of the economy. Pharmaceutical companies are also extremely demanding when it comes to cooperation partners. As it results from the presented research, it is worth to make scientists aware of the specificity of the pharmaceutical sector functioning, due to its growing demand for scientific solutions and openness to cooperation with universities.

The presented research can be treated as a contribution to the discussion on the determinants of cooperation between science and business, however, they are not free of restrictions. In the future, it would

be worth conducting a more comprehensive analysis of the relationships between scientists and industry, along with an assessment of the impact of the effects of activities on maintaining cooperation.

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