New Cooperation Modes: An Opportunity for Polish Biotechnological Clusters

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This article reviews new cooperation forms between companies, referring to the latest data from the ASAP (the Association of Strategic Alliance Professionals). Potential cooperation between companies, universities and research institutes in the field of biotechnology in Poland based on a model of open innovation alliances are presented. Biopharmaceutical companies are looking for new and innovative paths of development. They try to implement new strategies to transfer their research processes to a higher level. To achieve this, biopharmaceutical companies often use open innovation model as an additional tool for developing new products. Thanks to the cooperation with universities in the framework of open innovation alliances, they can significantly reduce the risk, the cost of research, and most of all, through joint work with academic researchers on identifying disease mechanisms and on development of new drugs, they are able to create improved and appropriate medical therapy for patients.

Key Words: biopharma, strategic alliance, open innovation alliance, biotechnological cluster, science and technology parks
JEL Classification: M13, O32, O35

Introduction

Many factors necessitate cooperation in partnerships of companies in different sectors of the economy. These include a greater risk and complex product development process, globalisation of the economies and demand for more and more innovative services and products (Puślecki 2010). This induces the growth of advanced and complex alliances between companies, including increase in global strategic relationships. In such partnerships, the organisational and cultural differences, as well as the involvement of many parties in the implementation of the partnership should be considered. Biopharmaceutical company (BioPharma companies – in the alliance referred literature, defined as a combination of the

biotech and pharmaceutical industries.) pursue joint projects using various types of strategic technological agreements, such as: joint-venture (JV), R&D contracts, R&D agreements, joint R&D agreements, research contracts (Duysters and Hagedoorn 2000). The cooperation within technological alliances enables significant synergy effects and enhances successful research and development projects. Through new and innovative paths of development and successful strategies of knowledge transfer, the entities involved have developed new models of collaboration with industry and universities in recent years. Alliances with universities and academic research institutes allow advanced preclinical and clinical research in the joint development of new drugs. Today's large biopharmaceutical companies can have from 20 to more than 40 alliances with universities and research institutions in their portfolios. Such collaboration allows companies to reduce their R&D cost significantly and to introduce new solutions and technologies to the market much faster than before (Lavietes 2012). Using efficient alliance management tools and qualified alliance managers (also those employed at universities or in research institutes), the biopharmaceutical companies can achieve higher SRA (Success Rate of Alliances) of their alliances (De Man, Duysters, and Neyes 2009; De Man et al. 2012).

This paper reviews new cooperation forms between companies, based on the latest data from the ASAP (the Association of Strategic Alliance Professionals) and from international conferences, including the ASAP Annual Global Alliance Summit 2012 – Mastering the Art and Science of Alliance in Las Vegas, ASAP Annual Global Alliance Summit 2013 – Leadership. Performance. Value, in Orlando. The second and third chapter of the paper constitute a theoretical base of the analysis and are devoted to the different theoretical approaches to the phenomena of technological cooperation, strategic alliances and open innovation. The fourth chapterpresents examples of open innovation alliances in biopharmaceutical industry. The analysis of Polish biopharmaceutical industry is conducted in order to present potential cooperation paths for Polish companies, universities and research institutes. The concept of open innovation alliances in two biotechnology clusters – the Life Science Park in Cracow and Lodz BioNanoPark is discussed. The last part contains conclusions and discussion.

Literature Review

In the economic and management literature we can find many interesting publications on technological cooperation between companies:

the distinction between cooperation based on the transfer and exchange of technology, R&D arrangements and joint-ventures (Auster 1987; Casson 1987; Chesnais 1988; Contractor and Lorange 1988a). Technological agreement can be divided from one-directional to the ones that are based on strong relationships between companies, e.g. joint-ventures, research corporations, on the other hand, those which require less organisational dependencies (contractual arrangements such as joint R&D agreements or technology exchange agreements). Many studies have shown that these types of technological cooperation have different effects on the nature of the sharing of technology, organisational aspects and the possible economic consequences for the companies participating in cooperation (Auster 1987; Root 1988; Contractor and Lorange 1988b; Hagedoorn 1990; Hagedoorn, Link, and Vorontas 2000; Gomes-Casseres, Hagedoorn, and Jaffe 2006; De Man and Duysters 2007; De Man, Duysters, and Neyes 2009). Taking into account strategic alliances and open innovation, we can observe that these two streams of research have developed separately, including distinct assumptions and research questions. However, according to Joel West (2014) 'there is a natural affinity between these streams in terms of phenomena, theoretical predictions and managerial implications. Both streams assume that innovation is collaborative (and often complementary), and that such collaborations are crucial for firms to create and capture value from their innovations.'

In prior research strategic alliances were defined as a cooperation agreement between two organisations. They can be understood as a special mode of cooperation between at least two parties (competitors or partners) operating in the same or related sectors with the aim of achieving common goals which have been set up with the use of available resources, while preserving the autonomy of each partner, in a range of fields and areas not covered by the partnership agreement (Gomes-Casseres 1996; Das 2005). These alliances are typically formed between two firms but companies may also create alliances with universities, research institutes, nonprofit research organisations, or government institutions (Baum, Calabrese, and Silverman 2000). Taking into consideration technological alliances, they are implemented primarily through joint ventures (an alliance of two or more participants forming a separate entity with the aim of achieving common goals); so-called equity alliances; or, within capital alliances and R&D cooperation agreements, so-called non-equity alliances.

Technological alliances are understood as strategic if they improve the long-term perspective of the product market combinations for at least

one company involved in cooperation. Such strategic technology partnerships differ from other forms of alliances, for example those concluded in order to reduce costs, which are related more to control of transaction or operating costs of companies. Technological partnerships are defined as a form of cooperation which includes at least some innovative activity or an exchange of technology between partners (Duysters and Hagedoorn 2000).

Much of the interest in research on strategic alliances came from the possibility of spreading the costs and benefits of innovation, as a result of cooperation (Hamel 1991; Hagedoorn, Link, and Vonortas 2000; Kale, Harbir, and Howard 2000; Hagedoorn 2002; West 2014; Culpan 2014). For innovative activity of cooperating companies it is really important that alliances are relevant to open innovation and open innovation to alliances. From the beginning, the researchers focused on use of open innovation by companies to allow them improvement of innovation performance by leveraging innovation creation and commercialisation paths outside their firm boundaries (Chesbrough 2003; 2006; West, Vanhaverbeke, and Chesbrough 2006). According to the latest definition by Chesbrough open innovations is 'a distributed innovation process based on purposively managed knowledge flows across organisational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organisation's business model' (Chesbrough and Bogers 2014). The results of research on open innovation have shown how firms manage both the inflows and outflows of knowledge and how they search for partners and the innovations they provide (Culpan 2014; West 2014). Moreover we can also observe how companies in specific industries (like biopharma) use the model of open innovation to create open innovation alliances not only with firms but also with universities, individuals, communities or other organisations (DeWitt and Burke 2012; OECD 2012; Wilks and Prothmann 2012).

Taking into account significant results of such cooperation in form of open innovation alliances, as well as public-private partnerships and research consortia in US and UK in bioparma industry, especially in drug discovery and implementation of new biopharmaceutical products, we discuss in this paper the potential cooperation between companies, universities and research institutes in form of open innovation alliances in Polish biotechnology clusters. Taking into consideration the potential of Polish biopharmaceutical industry we assume that open innovation alliances in biotech clusters could be implemented.

Open Innovation Alliances: Cooperation of Business, Universities and Research

The need for cooperation on innovative projects affected use of modern models of partnerships involving the principles of Open Innovation. Chesbrough (2003) defines *open innovation* as the paradigm stating that companies can and should use external and internal ideas, as well as internal and external paths to enter new markets. This concept can be used within the framework of bilateral and multilateral alliances. Open innovation model is more dynamic than traditional alliances. Alliance partners are not in fact identified in the conventional, purposeful way. Relationships between partners rely more on the exchange of ideas and knowledge during the period preceding the establishment of the alliance. Open innovation alliances are created to support the free flow of knowledge and ideas that will lead to the creation of partnerships aimed not only at joint innovation, but also at risk and income sharing. Companies have defined and implemented open innovation in a number of ways, including building innovative ecosystems or innovations for users, crowdsourcing or through the creation of joint development alliances. Open innovation alliances may include partnerships between profit-based companies and non-profit organisations (e.g. universities). This form of cooperation in recent years has aroused increasing interest of biopharmaceutical companies (Wilks and Prothmann 2012).

Biopharmaceutical companies have cooperated with universities for many years. At the beginning, the cooperation focused mainly on individual, single projects, from small research projects to large clinical trials. Then, the companies entered alliances with individual academic institutions, covering a wider range of cooperation, inter alia: research programs, clinical trials and translational research, in order to transfer the results of basic research to practical application. Companies also increasingly began to use different models of alliances, from individual links in research projects to multilateral agreements involving multiple research projects, including various models for open innovation, for example where the main role of an academic institution was the coordination and sometimes funding of other institutions Moreover in last years biotechnology and pharmaceutical companies are more involved in multilateral cooperation in the framework of knowledge networks or open innovation alliances as well as public-private partnerships (for instance Pfizer or GlaxoSmithKline) (OECD 2012; Wilks and Prothmann 2012).

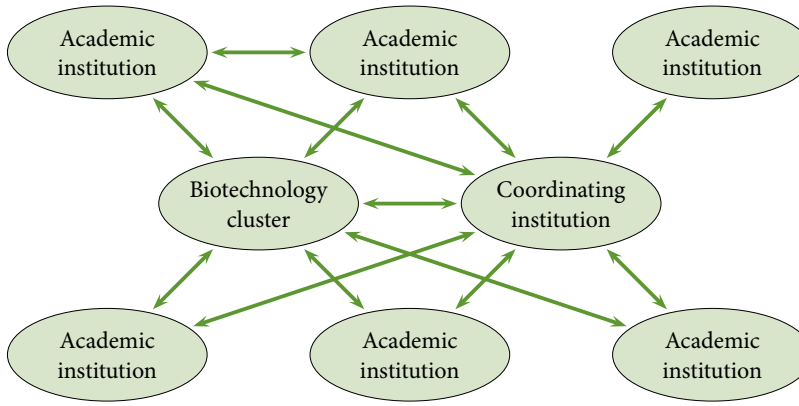

FIGURE 1 An Example of the Possible Use of Open Innovation with Academic Institution As a Coordinating (and Funding) Entity in Polish Biotechnology Clusters (adapted from Wilks and Prothmann 2012, 45)

The goal of these partnerships is to understand the mechanisms of diseases and the discovery of new utility of existing drugs that beyond their current curative role will allow identification and development of new drugs. By the development of partnerships with academic community, new alliance models have been developed, which are based on the open innovation model in order to share entrepreneurial risk and profit. Participation of coordinating institution significantly enhances the introduction of standardisation and has an impact on the effectiveness of the alliance. It also provides networking links and processes between academic institutions and firm, who are willing to form the alliance. Increased trust between companies from the industry and academic institutions thanks to the intermediary role, strengthens the innovation and provides support and funding for research proposals. The use of open innovation model can significantly speed up the production process of new drugs and biotechnology products (Lavietes 2012; Wilks and Prothmann 2012). Moreover, involvement in the cooperation of more interdisciplinary academic teams may also accelerate the production and application of new biotechnological products. That is why the co-operation of the same researchers is very important. With extensive contacts, interdisciplinary research teams have in-depth knowledge of many aspects of the research, which can be beneficial especially in the conceptual phase of product development. This mode of cooperation – open innovation alliance could be also implemented with positive results in Polish biotechnology clusters (figure 1).

In Poland there are many ongoing initiatives and projects referring to the concept of cluster. The most common definition of a cluster was developed by Porter (1998), according to whom a cluster is 'a group of companies existing in a geographical neighbourhood along with the institutions which are related to them and deal with a particular activity, connected by similarities and competing with one another.' The most important in this definition are relationships, cooperation and territorial bonds which in consequence should generate added value and lead to a competitive advantage on the market (Ratajczak-Mrozek and Herbeć 2013). Ketels (2004) defined also main attributes of clusters:

- *Proximity:* the entities need to be sufficiently and spatially close to permit positive spill-over and enable the sharing of common resources to occur;
- *Linkages:* their activities need to share a common goal for them to be able to profit from proximity and interactions;
- *Interactions:* being close and working on related issues does not seem to be enough – some level of interaction is essential;
- *Critical mass:* a sufficient number of participants being present is required for the interactions to have a meaningful impact on companies.

Similar definition was provided by European Commission (2003): 'Clusters are groups of independent companies and associated institutions that are:

- Collaborating and competing;
- Geographically concentrated in one or several regions, even though the cluster may have global extensions;
- Specialised in a particular field, linked by common technologies and skills;
- Either science-based or traditional;
- Clusters can be either institutionalised (they have a proper cluster manager) or non-institutionalised.'

According to above mentioned definitions there are usually several parties in cluster initiatives. Those are first of all entrepreneurs, but also financial institutions, public entities – such as local authorities, universities, media and organisations stimulating cooperation. The situation in which the initiative to establish the cluster goes out of firms and is managed by them is so-called bottom-up approach, in contrary to top-down

approach, where activities are undertaken by public authorities. Bottom-up model seems to be more effective because it arises from the need of the market. This does not exclude cooperation with public authorities and public institutions, but allows to build trust, which in effect brings specific benefits (Cooke and Morgan 2002):

- Improving the economic efficiency by saving time and effort related to specific activities, because they can rely on the word of partner;
- Reduction of the risk associated with the activity;
- The development of the ability to learn by the fact that institutions and companies are parties in the process of information exchange.

Examples of Cooperation between Companies, Universities and Research Institutes in Biopharma in Poland

The pharmaceutical and biotechnology industries are considered as one of the most innovative sectors of the Polish economy. Following secondary data from Polish Information and Foreign Investment Agency and FDI Intelligence Ranking, Poland was ranked 5th (in a tie with Russia) in the world ranking of foreign biotechnological investments in 2010, having attracted 14 large investors in biotech industry. It was a huge success since a year before, in 2009, Poland managed to attract only one investment from this sector. Countries who ranked higher were: USA (38 investments), China (27), Great Britain (22) and India (16). FDI Intelligence ranked Poland 11th place in the world in terms of attractiveness for R&D investment in the biotechnology sector (FDI Inteligence 2011).

High ranking positions would not have been possible had there not been top scientific staff available. Moreover, biotechnology is one of the most popular majors in Poland. Also, the pharmaceutical market in Poland is one of the industries with the longest tradition in Poland. This market has undergone a number of fundamental changes in the last twenty years. The ownership structure turned from state-owned into private. Additionally, new regulations (e.g. changes in the regulations concerning the rules for drugs' trading) are in place. The administrative system of public health service management has also been changed (introduction of the National Health Fund – NFZ). There were also structural changes in the industry: an increase in the number of pharmacies and pharmaceutical wholesalers and consolidation of the above mentioned and the growing role of foreign pharmaceutical companies as investors (Trąpczyński and Wrona 2012a; 2012b). According to the data

TABLE 1 The Biggest Pharmaceutical Companies in Poland

Company	Location/s	Market share
Sanofi-Grupa (including Zentiva)	Rzeszów, Chociw	8,5%
Novartis (including Sandoz)	Stryków	8,2%
GSK	Poznan	6,1%
Polpharma	Starogard Gdański, Duchnice, Sieradz	5,2%
Roche	Warsaw	4,6%
Servier	Warsaw	3,9%
Merck (MSD)	Warsaw	3,8%
Pfizer	Warsaw	3,4%
Teva Group	Cracow, Kutno	3,1%
AstraZeneca	Warsaw	3,1%
Krka	Warsaw	3,0%
Adamed (including Polfa Pabianice)	Pieńków, Pabianice	2,8%

NOTES Adapted from PAIiIZ (2012, 5).

included in the report on pharmaceutical market in Poland, provided by Espicom Business Inteligence company and published by Polish Information and Foreign Investment Agency (PAIiIZ 2011), over the past 10 years, the pharmaceutical market in Poland recorded a steady growth and reached PLN 22.3 billion in 2011. In comparison with the previous year, sales increased by an impressive 11%. The average annual growth rate in the period 2003–2010 was 6.5%. The estimated value will probably reach more than 60 billion PLN by 2016 (current prices). The pharmaceutical industry contributed to 0.8% GDP in 2010 (PAIiIZ 2011; 2012).

Poland is the largest pharmaceutical market in Central and Eastern Europe (and the sixth in Europe). Nearly 33% of pharmaceutical and biotechnology companies have their headquarters in the Mazowieckie Region (Warsaw) (table 1). Almost 80% of all companies can be classified as micro-enterprises. The significant Polish advantage in the field of biotechnology and pharmacy is the nearly 20,000 university students and more than 3,000 graduates in biotechnology and pharmacy. In addition, biotechnology is one of the priority sectors supported by the Polish government (PAIiIZ 2011; 2012).

In terms of the size of investment in research and development, Poland clearly stands out among the countries of the European Union on two levels. Poland has one of the lowest public expenditure on R&D (as per-

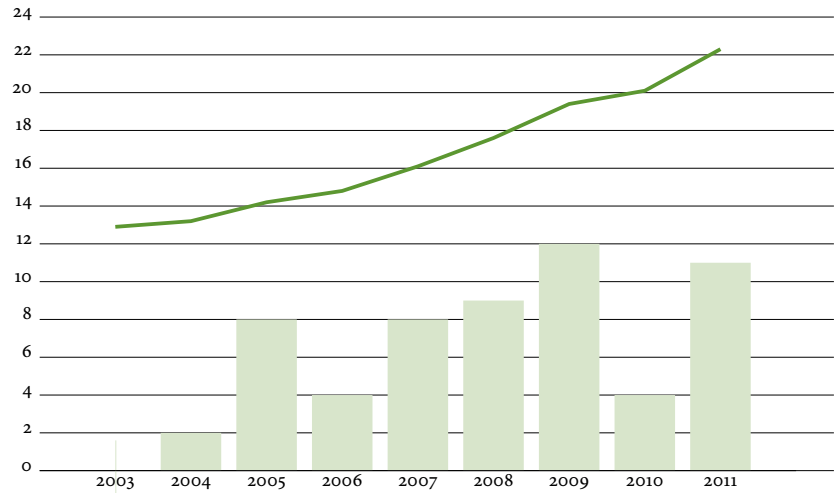

FIGURE 2 Value (Billion PLN, Current Prices – line) and Yearly Growth (% – columns) of the Pharmaceutical Market in Poland (adapted from PAIiIZ 2012, 4)

centage of GDP). Second, the public sector investment exceeds the expenditure incurred by private companies. However, Pelle, Bober, and Lis (2008) pointed five main areas in which government can help to improve the competitive position of the Polish economy:

- *Scientific and technological base* – concentration of public funding for research in strategic areas (including technological foresight), internationalisation of science and innovation, the development of institutions providing advisory and technical services for innovative entrepreneurs, widespread use of information – communication; financial aid should focus on institutions and organisations with the greatest potential to carry out successful research;
- *Formal and informal networks of science and industry* – to improve regulations on public-private partnerships and better protection of intellectual property in universities;
- *Institutional environment* – creating a business friendly environment, by simplifying the law and the tax system;
- *Staff development* – to create incentives for researchers to professional development and cooperation with business; the development of lifelong learning, knowledge transfer between R&D sphere and entrepreneurs through exchange of human resources and highlight the issues of entrepreneurship in educational programs;

TABLE 2 Main Features of Science and Technology Parks

Goal	Enhancing knowledge transfer from universities to business.
Infrastructural	High quality, low building construction ratio, coupled with a wide range of business support services.
Links	University or a suitable R&D centre must be formally committed to collaborate with the science park and firms (normally, universities should have an important role in the science parks management).
Access	Restricted to knowledge activities, with possible sectoral preferences (if knowledge base is significant across different scientific fields and there is entrepreneurial critical mass – not likely in many 'followers' regions).

NOTES Adapted from Almeida, Santos, and Silva (2009, 5).

- *Long-term innovation management program at the national level* – building planning system on innovation in the long term, and better individual institutions in the creation and implementation of innovation policy.

The answer to these demands is the concept of science and technology parks which was successfully implemented in more developed countries, like United States, Great Britain, Finland, Sweden or Germany. Science and technology parks (STPS) also contribute to the development of biotechnology and pharmacy in Poland. STPS promote the transfer of knowledge from universities to business (Staszków 2013). Table 2 presents the features of the park initiatives that facilitate networking between scientific institutions and entrepreneurs.

According to the PwC (2011) survey, every innovative pharmaceutical company participates on average in around 5 projects aimed at building a coalition inside the industry. There is a number of clusters and numerous technology parks in Poland that provide the infrastructure for the development of innovative biotechnological and pharmaceutical products – in particular, the laboratory space.

In 2012–2013, with funding from the Innovative Economy program, there were established organisations whose objective is the development of biotechnology in Poland. These include, the Life Science Park in Cracow and Lodz BioNanoPark.

Companies from the biotechnology, pharmaceutical, medical, food and environmental protection, research institutes, hospitals and foundations related to health care, local authorities, consultancies and other business support units from the Małopolska region clustered into the

1. Gdánsk Science and Technology Park
2. Pomeranian Science and Technology Park
3. Poznan Science and Technology Park
4. Nickel Technology Park Poznan
5. Wielkopolska BioRegion
6. Polish Technological Platform of Innovative Medicine
7. Biocentre Ochota Consortium
8. InnoBioBiz Łodź Cluster
9. BioTechMed Technology Centre
10. Łodź Technopark
11. Nutribiomed Cluster
12. Wroclaw Research Centre EIT+
13. Wroclaw Technology Park
14. LifeScience Cluster Krakow
15. Jagiellonian Centre of Innovation

FIGURE 3 Location of Clusters and Science and Technology Parks Specialised in the Biotechnology and Pharmacy (Biopharma) in Poland (adapted from PAIiIZ 2012, 5)

Life Science Cluster Cracow in 2006. To date, more than 70 entities have joined in. The largest group of businesses are SMEs (47%), other public institutions (31%), while large enterprises account for 18%. The managing entity is the Jagiellonian Centre of Innovation, which was founded by the Jagiellonian University. Beside Jagiellonian, the cluster cooperates with other universities, including the AGH University of Science and Technology, the University of Physical Education in Cracow, Cracow University of Technology, Agriculture University of Cracow, the Chemical School of Cracow, R&D institutes, including Polish Academy of Sciences institutes: Institute of Pharmacology, Institute of Nuclear Physics, Institute of Catalysis and Surface Chemistry. Two other institutions are Oil and Gas Institute and the National Research Institute of Animal Production. Cooperation of the entities listed within the cluster aims at increasing the efficiency of use of the scientific, cultural, and economic potential of entities from Cracow and Malopolska. It also contributes to the commercialisation of research results and knowledge transfer to the business. Promotion and support of innovation in the field of life science is another activity of the cluster. The Cracow cluster in particular offers cooperation, facilitates access to knowledge and specialised research teams. It supports entrepreneurship and enhances links between companies and research centres (see http://lifescience.pl/o-klastrze-lifescience).

Another example of biotechnology cooperation at a science and tech-

nology park is BioNanoPark in Lodz, which operates within the Technopark Lodz. Technopark Lodz was established in 2003. Its main shareholders are the Municipality of Lodz, Lodz Marshal's Office, the University of Lodz, Lodz University of Technology, Medical University of Lodz and the Chamber of Industry and Commerce of Lodz. The BioNanoPark is one of Poland's state of the art laboratory complexes, worth PLN 76 million. Notably, PLN 53 million were the EU funds. By 2015, the BioNanoPark should receive additional PLN 100 million investment via the EU funding programmes. The BioNanoPark+ was founded within the European Centre for Bio- and Nanotechnology project, which was prepared by the Lodz University of Technology. There are two other universities who take part in this project – the University of Lodz and the Medical University of Lodz. The goal of the project is for the existing laboratories in biotechnology and biophysics laboratories to be complemented by laboratories of biosensors, food authentication, physical-chemical characterisation of nanomaterials and personalised medicine. Laboratories will be provided with the DLL machine, the so called supercomputer. FIRN EU, the Russian company that intends to use the scientific potential of Lodz students and a modern infrastructure of BioNanoPark, will also invest in techno park in Lodz (see Biotechnologia.pl).

Analysing the number of entities involved in the operation of the Life Science Cluster Krakow and Lodz BioNanoPark, especially universities and research institutes, one can conclude that they can successfully apply the open innovation alliances cooperation model. In addition, the involvement of a coordinating institution in a cluster or park, can improve communication, strengthen standardisation and create networks and processes for academic institutions who are willing to form an alliance within a cluster. The model may also improve the efficiency of scientific, cultural, economic, and most of all, innovative potential. A greater focus of the businesses on cooperation with universities and research institutes may result in faster product commercialisation or reducing research-to-outcome schedules, which is of utmost importance for the development of biotechnology products. To achieve those goals it is important to create alliances with interdisciplinary research teams. Bilateral cooperation between the entities mentioned – Life Science Cluster Krakow and Lodz BioNanoPark is necessary. Joint activities within an alliance will contribute to the dynamic development of the biotech sector in Poland and improve the use of research potential both in Lodz and Cracow.

Conclusions

Taking into account the development of the biopharmaceutical sector in recent years (the largest number of newly established technology strategic alliances (Puślecki 2012), it can be concluded that the sector is currently the most advanced platform for cooperation between different parties at different levels (e.g. sectoral alliances between companies, public-private partnerships, alliances between universities and research institutions, non-governmental organisations (NGOs), homogeneous and heterogeneous networks of alliances) (DeWitt and Burke 2012). Biopharmaceutical companies seek various forms of cooperation that will minimise the risk and will share the costs of R&D investment. Increasingly, in addition to partnerships within the industry, entities establish relationships with universities or research institutes. Thanks to the creation of the partnership and use of various tools, such as technology parks, firms may use the resources, competencies, technology and knowledge from partners, and thus easier respond to changes in the environment, and most of all, quickly launch new services and products (Wach 2005). We are seeing a slow process of extracting industry specialisation in Polish STPs. Profiles residents' specialisation include selection, cooperation with specific scientific entities and the development of specific services for a particular type of business. The most popular are in order: (1) ICT (65% of the parks), (2) health care, medical engineering and e-health (48%); (3) biotechnology (36%). Further areas include: electronics, renewable energy, environmental protection, advanced chemistry. Several indications also apply to industrial design and new materials (Portal Innowacji, n. d.). The results of research conducted by IASP on a sample of 78 parks in 34 countries confirm the trend of the development of these sectors in technology parks. 87.3% of STPS have Computer/Informatics as a technology sector represented in their park, 81% have IT/Telecommunications, 74,7% have Software, 70,9% have Internet technologies and services and 68,4% have Biotechnology/Life Sciences as a technology sector in their park (IASP 2014). The development trend in Polish parks is therefore positive, however, taking into account the demands set out in the OECD report, technology parks can become even more effective tool for building relationships and technology transfer.

Cooperation enables a number of innovative projects and allows significant synergy effects. Firms apply the model of open innovation as an additional tool in product development. The aim of the alliance is to sup-

port open innovation, the free flow of knowledge and ideas that will lead to the creation of partnerships aimed at joint innovation, as well as risk and profit sharing. Cooperating with academic institutions, particularly in the model of open innovation alliances, biopharmaceutical companies operating in clusters or technology parks in Poland can significantly reduce the risk and cost of research, and above all increase the likelihood of the development of new, or improve present biotechnology or pharmaceutical products.

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