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INNOVATION AND ENTREPREUEURSHIP CENTERS FOR THE DEVELOPMENT OF BIOTECHNOLOGY IN THE REGION OF LODZ

Abstract
Centers of innovation and entrepreneurship create a specific institutional infrastructure allowing the development of innovative businesses. The article examines science and technology parks as well as technology transfer centers, and then presents those that are present in the region of Lodz, discussing the potential influence that they may have on the development of the biotechnology sector in the region.

Key words
Biotechnology, center of innovation and entrepreneurship, entrepreneurship, innovation, science and technology park, technology transfer center

Introduction

Countries in many regions of the world have been facing a deep economic crisis since the last quarter of 2008. Even though the situation has greatly improved since then, it has been estimated that crisis's repercussions will be in effect for at least a few years to come. In Europe, most industries have been weakened, unemployment has risen, and innovation investments are still at risk. The global economy may still be facing several difficult years, but innovation, it seems, has remained a hot commodity. Although companies have cut down spending, they have maintained an investment in research and development, as innovation becomes ever more important in today's increasingly global and knowledge-based economy. To a far greater extent today than in the past, competitive advantage depends on the ability of companies to meet changing market needs quickly and efficiently through the application of new technology. The capacity to assimilate and apply new knowledge to improve productivity and create new products and services relies on science and entrepreneurship. It is also affected by conditions which permit, encourage, and sustain innovative creativity. This is the role that must be played by institutions that support business development and cooperation. The paper, first, explains what type of innovation and entrepreneurship institutions exist in Poland, and then discusses the notions of a "science and technology park" (STP) and a "technology transfer center" (TTC). Finally, the paper presents the example of Lodz, which may aid in the development of biotechnology in the region.

Centers of innovation and entrepreneurship

Innovation is a process that uses knowledge or information for the creation and introduction of something new and useful, be it a product, service or procedure. It is the result of technical, social, economic, legal, cultural or organizational processes that can be formed, and involves not only implementing innovations but also socio-economic efficiency. Innovation in companies is not only the creation of knowledge by scientific research and development, but also the various processes by which new technology is diffused, engaged, and implemented [1]. The innovation process is complex and requires many cooperating entities, frequently through inter-company collaboration [2]. Research shows that sharing knowledge among companies in various sectors of industry may improve innovative performance [3]. The significance of external links in innovation processes has been underlined in literature and research, but companies that wish to exploit ideas, created in other entities, meet significant difficulties, especially if they want to use sources that are not commercially available in their supply chain, but belong to public research entities such as universities. The stronger emphasis on cooperation has allowed innovation models to shift from a solely internal orientation to attention upon the need for both horizontal and vertical relationships in more contemporary innovation process models [4]. Advances in technological domains such as biotechnology, nanotechnology, and material sciences open new opportunities for cross fertilization, not only among high-tech companies, but also among low- and medium tech small and medium-sized enterprises (SMEs) [5]. To reduce the probability of failure, specialized institutions that stimulate innovation through aid in technology transfer are created. In Poland, such institutions are known as "centers of innovation and entrepreneurship," although due to the different functions they may serve, they are given various, specialized names [6] and are divided into three main groups [7]:

- Centers of entrepreneurship – promotion and incubation of entrepreneurship (often for discriminated groups), supplying support services for small companies and activating development of peripheral regions or those that are under a structural crisis;

- Centers of innovation – promotion and incubation of innovative entrepreneurship, technology transfer and supplying pro-innovative services, activating academic entrepreneurship and cooperation of science and business;
- Financial institutions – facilitate access to financing the activity of newly-created or small business entities without a credit history, supplying financial services adapted to innovative economic undertakings.

These institutions function under different names, such as training centers, entrepreneurship centers, business centers, entrepreneurship clubs, consultation points, consultation and training centers, pre-incubators, entrepreneurship incubators, technology transfer centers, academic incubators of entrepreneurship, technology incubators, e-incubators, technology parks, science parks, technopoles, regional and local credit funds, consulting agents or institutions, venture capital and business angles networks, and seed capital funds. Their structure, roles, and functioning varies depending on the exact type of institution and who the stakeholders are (local or national governments, supranational institutions, or private owners).

Most of the institutions have the following objectives [8]:

- Dissemination of knowledge and skills through consultation and training, collection and processing of information, assistance in technology transfer by technology transfer centers;
- Assistance in the creation of new businesses in the surroundings of scientific institutions and universities, founded by students, graduates, postgraduates and researchers in pre-incubators and academic incubators;
- Comprehensive services in environments of a certain standard in the surroundings of scientific institutions, assisting innovative business start-ups (pre-incubators, incubators, technology centers);
- Creating clusters and innovative environments in a certain region by linking given business services and various forms of technological assistance to companies in technology parks and science parks;
- Financial support (seed and start-up) in the form of para-bank loans and guarantee funds, an important market supplement in this category are commercially oriented venture capital funds.

Centers of innovation and entrepreneurship are an important element of the economy. They neither leave innovations solely to the market mechanism, nor do they replace that mechanism with governmental activity. They create a specific institutional infrastructure allowing networking and development of businesses that innovate. Depending on their type and role, they support various types of businesses, including start-ups and small companies as well as large companies, regardless their location.

The scope of this paper does not permit a thorough examination of all the possible types of innovation and entrepreneurship centers. It will concentrate on the notions of “science and technology parks” and “technology transfer centers” as those types of entities are present in the region of Lodz and may influence the sector of biotechnology.

Science and technology parks

Depending on the source, the notion of “science and technology park” (STP) may in general be replaced by any of the following: “technology park”, “science park”, “technopolis”, “technopole” or “research park.” Certain nuances may exist as to the differences between the notions. The notion itself has entered professional literature as late as the seventies, so the concept is quite new even though the actual history of such parks began a few years earlier. The first technology park was converted in 1954 and was later called “Silicon Valley”, a technology park created by Stanford University in Palo Alto, California. The success of this pioneer undertaking gave an impulse for further science parks across the USA, which were (and still are) usually situated in the proximity of one or more universities and have managed to become the birthplace or magnet for many innovative companies. We can thus say that the home of technology parks is the USA. Since the fifties, many others were established in the USA and all over the world.

An STP is an “area” that is usually physical, but can also exist in cyberspace that is created to provide services to stimulate an innovation culture among its “inhabitants”, such as businesses and institutions, by allowing them to transfer knowledge and technology from various sources to the market place. It also oversees and “incubates” the creation of new innovative companies. Creators of science parks have various objectives in what they want to achieve for individual firms and the local region. When considering the first objective, they are mostly constructed to facilitate technology transfer, promote new technology-based firms, attract foreign new

technology, and foster strategic networks. As for the regional policies, these may be vaguer, such as economic development, job creation, or enhancing the image of the region [9]. In short, it is "a specific center of promoting innovation in which there is a symbiosis of scientific research and development, technical consultancy and production" [10].

STPs have been considered by management literature as locations that improve local innovation by promoting knowledge development and transmission among co-located companies [11, 12]. Companies in STPs may benefit from knowledge spillovers that may be the result of research, ideas, and experience stemming from universities or research institutions, as well as from companies that are located in the same park such as suppliers, clients, or otherwise business-related entities [13]. An important reason for creating a science park is the possibility of synergy effect which results from cross fertilization. This phenomenon takes place when the knowledge, experience, ideas, and information can be exchanged directly and often even informally between the human element of these science and industry clusters.

STPs often assemble firms that are in new technology fields. This reduces their uncertainty and transactions costs and enables them to exploit each other's commercial and technical knowledge [9]. New technology based firms that are established in science and technology parks are expected to outperform those created outside such structures due to the advantages offered by this localization. Some authors believe strongly in this theory, while others show examples of more successful companies established elsewhere, but most agree that there is a large influence on the whole economy as other companies who do not profit from such advantages are also motivated to perform and compete with those in science parks [14].

Technology transfer centers

Technology transfer centers (TTC) comprehend a set of diversified institutions that may be either public or private in nature, such as STPs, business incubators, research and testing laboratories or industrial liaison offices [15]. The first centers were created at the beginning of the 20th century in universities in the USA, having the form of university departments of technology transfer [16]. Scientific entities and business units have distinct backgrounds and unfortunately conflicting goals, making interdependence between these actors even more problematic, despite being already high in innovation processes [17]. TTCs are often called "bridging units" because they act where science and business interact [18]. The bridging role of TTCs is principally substantial, since they enable the transfer of scientific and technological knowledge among cooperating partners that are otherwise disparate. Knowledge distance refers to the gap in technological knowledge and between the entity's shared systems of perception, interpretation and evaluation. In the case of bridging between entities whose knowledge distance [19] is significant, as is the case of companies and universities, the role of information sharing could also require activities of "translating" information from one environment to another. This specific bridging activity has been theoretically analyzed by literature on intermediaries aiding technology transfer, but authors point out the little empirical evidence has been provided [15]. Literature shows that the activities of TTCs include adapting new technologies by cooperating with SMEs, and thereby contribute to increasing innovativeness and competitiveness of companies and regional economic institutions.

The principal objectives of TTCs include [20]:

- Developing networks between science and business, instituting technology transfer;
- Diffusing scientific achievements and conducting university policy for commercialization of research results;
- Managing intellectual property created in research institutions, granting licenses;
- Promoting research institutions, research teams and their performance;
- Counselling, training and information on the implementation of innovative undertakings, entrepreneurship, intellectual property for the academic community and external partners;
- Valorizing science and innovation potential in a region or industry, creation of databases;
- Evaluating the commercial potential of new technological, product and organizational solutions, development of pre-investment studies;
- Identifying innovative needs of business entities (technological audit);
- Cooperating with risk investors and other types of innovation and entrepreneurship entities;
- Obtaining funds for research, development of personnel and innovative undertakings;
- Promoting and developing technological entrepreneurship.

The main goal of TTCs is, therefore, widely understood to be the commercialization of knowledge. Considering the various roles that the center must play for joint projects to develop, it is indispensable for TTCs to have the right competencies and resources to manage all the potential problems.

TTCs do not act in a vacuum, policy-makers at the regional, national, supra-national levels should be aware of TTCs and their activities, and support initiatives aiming to increase their effectiveness by providing incentives and enhancing their capabilities. In that way, they can organize numerous interfaces, create effective teams, and watch over potential projects. In Poland, TTC creation is regulated by the Higher Education Act [21], which stipulates that TTCs are created with the objective of selling or gratuitous transfer of results of research and development. As to the form of the center, the Act states that it can be in the form of a university-based entity and operate based on regulations approved by the senate of the university, or in the form of a commercial company or foundation and act based on relevant statutory documents.

TTCs are an important element of university and research institutions' policies, allowing them to be in contact with business units and participate in regional and national economies.

Science and technology parks and technology transfer centers in the region of Lodz

The importance of innovation and entrepreneurship centers in Poland has steadily increased since the beginning of the 90's of the twentieth century. Their number reached 821 actively operating centers in the first half of 2012, out of which 40 are STPs and a further 14 are STP initiatives, as well as 69 TTCs [6]. Table 1 shows the growth dynamics in Poland.

Table 1. Growth dynamics of STPs and TTCs in Poland (1995-2012).

Year / Type of center	1995	1997	1999	2000	2004	2007	2009	2010	2012
Science and technology parks	1	1	3	3	12	15	23	24	40
(Park initiatives)							(23)	(21)	(14)
Technology transfer centers	1	5	23	20	39	87	87	90	69

Source: based on [6].

In recent years, the number of STPs is steadily growing. This is largely due to the availability of EU funds for projects which foresee the creation of such structures in the economy. A slight decrease in the number of TTCs in the last years has occurred mainly due to the completion of the period of financial support for those projects. Some of the entities that relied strongly on temporal projects lost their major source of funding and were often forced to suspend their activities.

With 49 entities [6], the Lodz region is well placed in the middle of the list of Polish regions. The greatest density of centers of innovation and entrepreneurship was identified in Silesia (96), Mazovia (92), and Greater Poland (71), and the lowest was in Opolskie Region (15) and Lubusz Land (22) [6]. The number of centers is usually related to the size and socio-economic potential of the region and the participation of local authorities in the creation of centers of innovation and entrepreneurship. Table 2 below presents the STP and TTC existing in the region of Lodz.

Table 2. STPs and TTCs in the region of Lodz in 2013.

Type of center	Units
Science and technology parks and park initiatives	Lodz Regional Science and Technology Park BioNanoPark Belchatowsko-Kleszczowski Industry and Technology Park
Technology transfer centers	University of Lodz TTC Lodz University of Technology TTC Medical University of Lodz Center of Innovation and Technology Transfer Entrepreneurial Innovation Development Center in Lodz

Source: Author's research, 2013.

Not only are the innovation and entrepreneurship centers scarce in Lodz, but also amid the present ones, not all are adapted to aid in the development of biotechnology. The paper will briefly examine the BioNanoPark initiative and existing TTCs which may serve this objective, as biotechnology has been identified by the Regional Innovation Strategy LORIS[1] as one of the key sectors that can be an opportunity for the advancement of the region. Biotechnology is a generic technology that has a large array of applications in various industries. It compromises an assortment of new scientific techniques and is considered by many authors as a crucial technology for the growth and development of the economy.

Out of the existing STPs in Lodz, the park whose goal is to become one of the leading centers in biotechnology in Poland is the BioNanoPark initiative, which belongs to the Lodz Regional Science and Technology Park and officially started functioning in 2012. Other dynamic parks in the sector of biotechnology in Poland that are worth observing as potential centers of the sector are the following four functioning STPs: Pomeranian Science and Technology Park (Gdynia), Life Science Park (Cracow), Wroclaw Technology Park, and Nickel Technology Park (Poznan).

The BioNanoPark is an STP with strong support of local authorities (98% of the park's shares are owned by the city and region) and still funds its activity with public support from local, national, and EU funds. Its primary goal was to increase the regional wealth and dynamics of local development by attracting innovative enterprises, which are to generate specialized jobs in the region and strengthen local brainpower [22]. The initiative foresaw the creation of fully furnished office space for 50 companies and two laboratories, but presently this has been expanded with further laboratories and infrastructure being created. According to local authorities, the BioNanoPark will start generating profits as early as 2015 [23], although more careful estimates state 2016. In its first years of functioning, the STP will function partly as an incubator for innovative biotech start-ups, not only by providing the needed infrastructure (often cost sharing by companies which cannot afford their own infrastructure), but also by providing consulting services for companies applying for European funds, as well as legal, patent and marketing support in case of commercializing the results of innovation processes. Therefore, the BioNanoPark provides the possibility for researchers to realize their entrepreneurial ambitions as well as serving as an exchange platform for scientists, entrepreneurs and funding institutions by networking with the appropriate institutions. It has been noticed that scientists of the Lodz University of Technology, the University of Lodz, and the Medical University of Lodz have been commercializing the results of their research. Presently, research in the BioNanoPark laboratories is used by the pharmaceutical, medical (surgery, orthopaedics and dentistry) and cosmetic industries.

According to the Regional Innovation Strategy LORIS 2030 [24], the functioning TTCs in the region of Lodz do not operate to their full potential as they do not correspond to their prospects in terms of employment and the profile of the universities that they serve. The authors claim that their sphere of activities is poorly coordinated, particularly due to the lack of coordination between the activities related to technology transfer, entrepreneurship, and support for innovative projects [24]. Of the four TTCs in Lodz, three belong to universities. Each of the TTCs potentially may deal with biotechnology as each of the universities educate and conduct studies in the field. The TTCs have not yet had any spectacular successes in terms of assistance in the creation of spin-offs. For example, the Entrepreneurial Innovation Development Center in Lodz is an effective consultation and training center, but cannot boast the aid to the establishment of a single start-up. The TTCs of the Medical University of Lodz and the Lodz University of Technology claim that spin-offs were created with the assistance of the centers, but unfortunately none in the sector of biotechnology (e.g. two spin-offs in the sector of materials science at the Lodz University of Technology).

University authorities are aware of this and there have been agreements signed by the rectors, such as in 2009 between the University of Lodz and the Medical University of Lodz, or in the BioTechMed Center of Advanced Technologies, which also serves as a contact platform for the universities when it comes to biotech technology transfer and commercialization. In the future, it is possible that the actions that have been undertaken will

[1] RSI LORIS was launched on 10 June 2002 as a common initiative of scientific entities and the local authorities of the region. It has developed since 2002 with follow-ups RSI LORIS PLUS and the most recent RSI LORIS 2030.

enable a more effective usage of the available potential of the TTCs, which in turn will allow the region to become an important actor on the national stage of biotechnology. It must not be overlooked that the BioNanoPark may in certain cases replace the need to use university TTCs, especially when research is done in a joint project by scientists being affiliated in different entities.

Summary and conclusions

The innovation process in biotechnology is complex and requires many collaborating entities. Often, companies exploiting ideas that belong to other entities meet significant difficulties, especially if they want to use sources connected with public research entities. On the other hand, scientists wanting to commercialize the results of their research face various obstacles when trying to reach the market. This lacuna in the economy may be filled by centers of innovation and entrepreneurship, such as science and technology parks or technology transfer centers. Unfortunately, the region of Lodz is not a leader in the number of centers, but hopefully those that are present when properly managed and used to their full potential will allow dynamic development of the sector in Lodz. Recently opened, the BioNanoPark must be further observed as a possibly significant center for biotechnology, serving not only the region of Lodz but potentially nation-wide or acting as the nucleus of a future European bioregion.

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INNOVATION AND ENTERPRISE CENTERS FOR THE DEVELOPMENT OF BIOTECHNOLOGY IN THE ŁÓDŹ REGION

Abstract
Innovation and entrepreneurship centers create a specific institutional infrastructure to enable the development of innovative enterprises. The article analyzes science and technology parks and technology transfer centers. Next, it presents the science and technology parks in Łódź, with a focus on their potential impact on the development of the biotechnology sector in the region.

Key words
biotechnology, innovation and entrepreneurship center, entrepreneurship, innovation, science and technology park, technology transfer center