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Comparative Analysis of the Impact of the Business Incubator Center on the Economic Sustainable Development of Regions in USA and Poland

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Abstract: The innovativeness boosted by incubator centers has an important role in the sustainable development of the country and its regions. The paper describes a comparative analysis of the effectiveness of the business incubator center on the economic growth of a region. The goal of the paper is a comparison between two business incubators, CAN-BE in Hazleton, PA USA and Technopark in Gliwice, Poland. A number of indicators were used to measure economic growth. These selected indicators reflected social, organizational, technical, and financial aspects of economic growth.

Keywords: economic development; business incubator; economic growth; innovativeness

1. Introduction

Northeastern Pennsylvania used to be (1860–1955) a very economically prosperous region with a large number of anthracite coal mines, steel industry, and various manufacturing companies. The situation changed in the mid-1950s, when the use of oil for heating purposes caused a decrease for the demand of coal. The lower price of coal resulted in the underinvestment in the coal mining industry. This lack of funds led to compromising safety in the coal mining industry. Due to an error, deep mining was done too close to the bottom of the Susquehanna River. In 1954, a tunnel collapsed and caused the Susquehanna River to flow into the underground tunnels of the coal mines. Before the situation could be controlled, most of the deep anthracite mines were flooded. The result was the end of anthracite deep mining in the region [1]. In the 1980s, a decrease in the demand for steel caused the closing of the steel industry. This very prosperous region became depressed with a high unemployment rate. Many residents left the region seeking better employment opportunities. This resulted in a decreasing population and lower real estate values. The lower real estate costs attracted a large number of immigrants to the area because they could afford to provide inexpensive housing for their families [2–5].

Presently, approximately 50% of the students in Northeastern Pennsylvania school districts attend supplementary English as a Second Language (ESL) classes. The incoming workforce and the lower cost of operating a business have been linked to the creation of new entrepreneurial opportunities which utilize innovative technology. To reduce unemployment, local, state, and industry leaders have created business incubator centers.

In Northeastern Pennsylvania, business incubator center (CAN-BE) has significant manufacturing and office space. CAN-BE is a business incubator center (BIC) which is located within one mile of the Penn State-Hazleton Campus. Even though the business incubator center and Penn State Hazleton are not part of the same organization, CAN-BE maintains a close and mutually beneficial working relationship with the Penn State Hazleton faculty and students. This economic model has stimulated the growth of local industry and development of Penn State Hazleton.

Similar changes and transition took place in the Śląsk Region of Poland. Until 1989, the Śląsk Region was a very economically active region with a large number of coal mines and steel mills. At that time, the industry was owned and operated by the central government, "Ministry of Mining and Energy". The economic development was driven by central planning and not by the demands of the market. The price of the product was determined by the production cost. Many companies were subsidized by the central government as needed to make them operational. There was mandatory employment at that time. The government-owned and operated companies were creating as many jobs as needed to keep everyone employed. There was no incentive for innovation due to the lack of competition between the government-owned enterprises.

After 1989, this socialistic system of government-owned enterprises was changing and transferring into free market driven economy. Many existing companies were struggling or could not adapt to the free market economy. The government subsidies ended. The price structures were driven by the demands of the market and not by the inflated costs of manufacturing. Many companies could not compete with inexpensive imports. Due to closure of many government-owned enterprises, unemployment is the Śląsk region became significantly higher [6–9].

The available well-educated workforce in the Śląsk region and existing infrastructure created opportunities for innovative enterprises to open new high technology businesses. A number of business incubator centers were created to stimulate economic development in the Śląsk region. There were a lot of similarities between the economic situation in Northeast Pennsylvania and the economic situation in the Śląsk Region. At the present time both regions show increasing economic growth. A comparison of the model of the business incubator centers in the United States and Poland will allow for identifying the best practices of both countries.

The goal of the paper is a comparison between two business incubators, CAN-BE in Hazleton, PA USA and Technopark in Gliwice, Poland to choose the best practices to manage the academic business incubator center.

We put forth the following research questions:

- What are social, organizational, scientific and financial aspect of functioning academic business incubator centers in USA and Poland?
- What are differences in functioning business incubator centers in USA and Poland?
- What best practices we can distinguish on the bases of our analysis?

2. Literature Review

The concept and practice of business incubation was established in the advanced countries about 50 years ago. The inventor of nowadays innovation concept J. Schumpeter, who first emphasized the importance of innovation within the economic cycles, considered entrepreneurship with a specific emphasis on innovation. In his view, innovation deals with [10,11]:

- new products,
- new production methods,
- new markets,
- new form of organization.

Successful innovation is a marriage of innovation and commercialization, and it is very important to achieve the sustainable growth of the particular organization and the country. It requires the

cooperation between universities, government and private industry. These three partners work in different reward systems and often have different interests and expectations. Business incubator centers are the common grounds between research economy and commercial economy. The purpose of a business incubator center is to nurture new startup companies by surrounding them with an innovation ecosystem. Every new business is given the opportunity to become associated with a business incubator center. Business incubator centers supply many critical services to start-up companies. Some of the services are free of charge, but most of them are offered at a discounted rate. Business incubator centers provide new companies with an environment supporting the culture of innovation and celebrating research and creativity [12–17].

The incubation is a process which tends to be activated whenever there is a strong need to support entrepreneurs in developing their own business [4,18–22]. The process, or parts of it, is put in place whenever there is a need of nurturing would-be entrepreneurs to think over and further develop the business idea and transforming it into a viable and sustainable activity [23–28].

According to European Commission definition an incubator is a place where the incubation activities are carried out, and where the would-be entrepreneurs can find suitable place, in terms of facilities and expertise, to address their needs and develop business ideas to transform them into sustainable realities [1,29,30]. An incubator may still be an incubator even if it does not provide physical incubation services, and concentrate on virtual incubation. Virtual incubation in that case applies to "incubators without walls" and to e-platforms of online services deployed by incubators with physical premises [31].

Very impotent term in the case of business incubators are innovation-base incubators. In this case, the entrepreneur can be seen as the agent of change whose scope is to develop innovation process within the organization [32,33]. He should create value from an innovative idea in a context of change and uncertainty and the market is the trigger for it to happen. Innovation-based incubators work in the intersection between the sets of innovation and entrepreneurship supporting entrepreneurs to profit from added value of innovative ideas. Innovation-based incubators support innovative business projects which could be either technologically-oriented or non-technologically oriented.

Technology incubators is a variant of more traditional business incubation schemes, assist technology-oriented entrepreneurs in the start-up and early development stage of their firms by providing workspace (on preferential and flexible terms), shared facilities and a range of business support services.

To analyze the functioning of incubator centers from a cooperation between university and industry point of view we need to describe the 'triple helix'. This model of innovation has attracted attentions of scholars as a useful policy making tool to enhance innovation and promote economic development [34]. This model advocates the strengthening of the collaborative relationship between academia, industry and government to improve innovations. The triple helix model was developed in 1995 by Etkowitz and Leydesdorf [35]. Proposed model describes different types and degrees of collaboration between the three main actors involved in the innovation creation process: government, universities and industry.

Etzkowitz and Leydesdorff [36] think that the triple helix model is a global phenomenon. Through many years since development of the model scholars used many ways to operationalize the model in many countries [15,37–45]. On the base of their research scholars have argued that the triple helix model could be the key strategy of the national or multinational innovation agenda in the 21st century.

Etzkowitz and Klofsten described three basic elements of this model. First, it provides universities with a more prominent role in developing innovation than previously, making them one of the three pillars together with industry and government. Second, the trend toward a cooperative relationship through interaction between these three institutional spheres means that policy decisions result from interaction rather than regulations. The third element concentrates on changing roles of these institutional spheres in this innovation boasting process [46].

The triple helix model has big potential for innovation and economic development in a knowledge society. It lies in a more prominent role for the university and in the hybridization od elements from university, industry, and government to generate new institutional and social formats for the production, transfer, and application of knowledge [47]. With respect to regional development the triple helix model has often been interpreted normatively, as an argument that the boundaries between universities, industry and government should be blurred [47]. However, neither innovation system theories, nor the triple helix model really offers detailed advice on how to support development and innovation in practice. Authors think that the theoretical discussion presupposes that the network of relationships is present in a triple helix setting [48].

In the helix model, the government should proactively make necessary adjustments that make the network viable but not have a totalizing role. Thus in such a situation the government should stimulate collaboration through incentive system and should also provide some funding as a mechanize to assure social benefits [49].

The proponents of the model argue that the condition for innovation will improve with institutional and normative convergence between academia, industry, and government. In some countries, this model has been highly influential in policy formulation regarding how best to support regional development. Through cooperation these actors can pool resources and agree on joint priorities, and new innovative solutions can be created in the compromise situations that arise. Because several sectors of society are involved in this process, access to a wider range of knowledge is expected, enabling better solutions and increasing the legitimacy of the outcomes [50].

However, the triple helix model is not a simple linkage of three institutions. Each of them would have to develop their special mindset, organization and create mechanisms for triple helix collaboration. Companies should to reorient themselves from innovations in labs to open innovation system and collaborations and networks. Universities had to reorient themselves to collaborate with external stakeholders in solving actual problems and adopt a wider range of research methodologies suitable for the interaction [51]. Also, government would to develop new policies and funding mechanism that would to relate to the interface between industry and academia. In western countries, the government is seen as the strategic partner within the collaborative innovation networks, while the direction and implementation of science and technology innovation in Asian countries like, for example, China is mostly decided by the government [34].

3. Materials and Methods

We chose two incubator centers—one form Poland and one from the United States—to analyze and compare the functioning of the incubator centers within two chosen countries. The main criterion for the choose of incubator was to achieve comparability of the incubator centers—we wanted to choose one incubator from each country and we wanted to choose incubators operating in technical universities. Another criterion of selection was the size of the incubator—two researched incubator centers had the similar size and are similar from the type of operation point of view. We use the case study in the case of business incubator centers. All data were collected with collaboration of incubator centers. American author of the study has collected the data from Pennsylvania Penn State Incubator Center and polish authors has collected the data from Polish Technopark Incubator Center. The data were collected in 2017.

The business incubator center, CAN-BE, in Hazleton, Pennsylvania was established in 2000. It is located in the Valmont Industrial Park immediately across the street from the Penn State Hazleton Campus [52–54]. The objective of CAN-BE is to provide assistance and support for entrepreneurs who are developing new ventures in sustainable economy. CAN-BE nurtures start-up companies by helping them to survive and grow during the beginning stage when they are the most vulnerable. CAN-BE is providing critical business, technical and engineering services to their client companies. Those client companies usually consist of one person who is the inventor and receives family support.

Most of the time, these people are extremely enthusiastic and are willing to devote their entire time and energy to convert their dreams and ideas into reality.

Companies at the beginning stage of operation are 'walk-in' clients. CAN-BE, a business incubator center, has a significant number of 'walk-in' clients (50–100/year). Those are usually very enthusiastic individuals who are convinced that they have a great idea for a new product, new technology, or new business venture [18,55–57].

Technopark Gliwice was established in 2004 by three partners, city of Gliwice, Politechnika Śląska and "Specjalna Strefa Ekonomiczna". The main objective of the Technopark is to assist in the creation, development, and promotion of modern high-tech enterprises. Technopark is also assisting in transferring innovative technologies from Politechnika Śląska and other research institutions to small and mid-size enterprises [30].

Another goal of Technopark is also to assist students, graduates and faculty from Politechnika Śląska in implementing their business ventures. Technopark Gliwice is located in a modern facility in close proximity to Politechnika Śląska [58,59]. The personnel of Technopark Gliwice is offering very specialized training and mentoring programs for future entrepreneurs. Technopark Gliwice maintains ongoing cooperation with institutions of higher education as well as different research and development companies. Technopark Gliwice is trying to encourage undergraduate, graduate, and PhD students to develop their own business ventures [60,61].

To measure the effectiveness of the business incubator centers on stimulating economic growth, there was a need to develop measurable indicators. Selecting the appropriate and measurable indicators is very critical in any assessment process. The indicators have to meet the following criteria:

- to reflect every aspect of economic growth, including social, organizational, technical/scientific and financial,
- to be objective and directly measurable by either using quantitative or qualitative method of assessment,
- to be independent from each other, so that each one of them measures a different aspect of economic growth,
- to allow for direct comparison between the two selected business incubator centers located in two different countries.

We chose appropriate criteria by using Delphic analysis. We choose 20 international specialist from business and academic environment and on the basis of their assessment of the preliminary criteria we have chosen criteria used in the paper.

After considering these criteria, the following indicators were developed and divided into four different categories representing different aspects of economic growth (the division was also suggested by experts), that is, social, organizational/procedural, technical/scientific, and financial. The assessment of the indicators was conducted by using qualitative as well as quantitative methods. The data collection process was conducted simultaneously at the business incubator venter in Hazleton, Pennsylvania and the business incubator center in Gliwice, Poland.

The qualitative method consisted of face-to-face interviews with the director of the business incubator center as well as tenant companies in the incubation stage and post-incubation stage. Interviews were also conducted with faculty and students involved in providing assistance to the business incubator center.

The quantitative method consisted of a survey completed by the tenant companies in the business incubator center. A survey was also conducted with faculty, students and the network of volunteers providing assistance to the business incubator center.

On the basis of mentioned Delphi analysis, we choose four sets of indicator to investigate (Table 1):

- social indicators,
- organizational/procedural indicators,
- scientific/technical indicators,
- financial indicators.

Table 1. Indicators in research procedures.

Set of Indicators	Indicators
Social Indicators	1. The number of new jobs created by start-up companies during the incubation period (1–3 years). 2. The number of jobs created by new companies during the post-incubation period (3–6 years). 3. The number of students finding part-time employment or paid internship in start-up companies. 4. The number of graduates finding full-time employment in start-up companies during the incubation period (1–3 years). 5. The number of graduates finding full-time employment in new companies in the post-incubation period (3–6 years). 6. The percentage of start-up companies owned by women. 7. The percentage of start-up companies owned by underrepresented minorities. 8. The percentage of start-up companies owned by immigrants.
Organizational/ Technical Indicators	1. Annual number of clients receiving help from the business incubator center related to the evaluation of an invention/business idea during the beginning stage. 2. Annual number of clients receiving help from the business incubator center related to the development of a business plan or business model (before the incubation stage). 3. Number of start-up companies during the incubation period (1–3 years) and their success rate, that is, the percentage of companies who have graduated from the business incubator center. 4. Number of companies receiving assistance from the business incubator center during the post-incubation stage (3–6 years). 5. Number of full-time staff employed by the business incubator center. 6. Number of weekly hours that the staff of the business incubator center is available.
Scientific/Technical Indicators	1. Number of faculty from the local university cooperating with the business incubator center. 2. Annual number of students doing projects which benefit start-up companies in the business incubator center. 3. Number of volunteers providing services to the business incubator center, engineers, lawyers, accountants, business leaders, etc. 4. Annual number of innovative projects/technologies implemented by start-up companies. 5. Annual number of training workshops for new entrepreneurs sponsored by the business incubator center (or annual number of participants attending those workshops).
Financial Indicators	1. Average cost of creating a new job by a start-up company during the incubation stage. 2. Annual budget of the business incubator center and level of subsidy from public and private sources. 3. Cost of services provided by the business incubator center. 4. Tax incentives for start-up companies during the incubation stage and post-incubation stage. 5. Annual level of subsidy for start-up companies from regional workforce development funds or economic development funds.

Source: Authors' own work.

4. Results

Based on the data collected at the business incubator center in Hazleton, Pennsylvania, the individual indicators were assessed. The summary of the assessment is listed in Tables 2–5.

Table 2. Assessment of social indicators for the business incubator center in Hazleton, Pennsylvania (USA).

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
The number of new jobs created by start-up companies during the incubation period (1–3 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the incubation stage.	30 jobs over 3-year incubation period 10 jobs/year(average)
The number of jobs created by new companies during the post-incubation period (3–6 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the post incubation stage.	18 jobs over 3-year post-incubation period. 6 jobs/year(average)
The number of students finding part-time employment or paid internship in start-up companies.	This indicator was assessed by administering the survey and conducting interviews with companies in the incubation stage.	20 students over 3-year incubation period. 6.66 students/year (average)
The number of graduates finding full-time employment in start-up companies during the incubation period (1–3 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the incubation stage.	0 (none)
The number of graduates finding full-time employment in new companies in the post-incubation period (3–6 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the post incubation stage.	2 jobs over 3-year post-incubation period. 0.66 jobs/year(average)
The percentage of start-up companies owned by women.	This indicator was assessed by conducting interviews with the personnel of the business incubator center. Business Incubator Center in Hazleton is in possession of the statistical data. That statistical data is collected by CAN-BE to be included in the proposals for public funding.	8%
The percentage of start-up companies owned by underrepresented minorities.	This indicator was assessed by conducting interviews with the personnel of the business incubator center. Business Incubator Center in Hazleton is in possession of the statistical data. That statistical data is collected by CAN-BE to be included in the proposals for public funding.	8%
The percentage of start-up companies owned by immigrants.	This indicator was assessed by conducting interviews with the personnel of the business incubator center. Business Incubator Center in Hazleton is in possession of the statistical data. That statistical data is collected by CAN-BE to be included in the proposals for public funding.	8%

Source: Authors' own work.

As illustrated in Table 2, the CAN-BE business incubator center has a significant impact on the economic development of the Hazleton Area. On average, 16 new jobs are being created annually by companies in either the incubation (10 jobs) or the post-incubation stage (6 jobs). In addition to this, approximately seven Penn State Hazleton students finds temporary employment or internship opportunities (annually) with the companies at CAN-BE. Full-time employment opportunities for engineering graduates is very limited (0.67 graduates annually). The reason for this low number is the high cost of hiring full-time engineering graduates. Approximately 8% of the start-up companies are owned by underrepresented groups (8% women, 8% minorities, 8% immigrants). This factor makes a significant and positive impact on the economic development of the area.

Approximately 90 entrepreneurs annually receive assistance from a business incubator center in the form of an evaluation of their inventions or business ideas. In addition, 50 entrepreneurs receive help in the development of a business plan. At the present time, there are 12 companies in the incubation stage and eight companies in the post-incubation

stage. The success rate during the incubation stage is 66% (Table 3). The office of CAN-BE is open 40 h per week with two full-time employees (Director, Administrative Assistant).

Table 3. Assessment of organizational/procedural indicators for the business incubator center in Hazleton, Pennsylvania (USA).

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
Annual number of clients receiving help from the business incubator center related to the evaluation of an invention/business idea during the beginning stage.	This indicator was determined by interview with personnel of the business incubator center. Business incubator center is keeping record of this data and using them when applying for public funding.	90 (average)
Annual number of clients receiving help from the business incubator center related to the development of a business plan or business model (before the incubation stage).	This indicator was determined by interview with personnel of the business incubator center. Business incubator center is keeping record of this data and using them when applying for public funding.	50 (average)
Number of start-up companies during the incubation period (1–3 years) and their success rate, that is, the percentage of companies who have graduated from the business incubator center.	This indicator was determined by interview with personnel of the business incubator center. Business incubator center is keeping record of this data and using them when applying for public funding.	12 companies 66% success rate
Number of companies receiving assistance from the business incubator center during the post-incubation stage (3–6 years).	This indicator was determined by interview with personnel of the business incubator center. Business incubator center is keeping record of this data and using them when applying for public funding.	8 companies
Number of full-time staff employed by the business incubator center.	Taken from the directory of the business incubator center.	2 full-time staff
Number of weekly hours that the staff of the business incubator center is available.	As posted in the business incubator center.	40 h weekly

Source: Authors' own work.

Table 4. Assessment of scientific/technical indicators for the business incubator center in Hazleton, Pennsylvania (USA).

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
Number of faculty from the local university cooperating with the volunteers at the business incubator center.	This indicator was determined by administering the survey and interview with faculty, students, volunteers, and the personnel of the business incubator center.	4 faculty
Annual number of students doing projects which benefit start-up companies in the business incubator center.	This indicator was determined by administering the survey and interview with faculty, students, volunteers, and the personnel of the business incubator center.	35–40 students
Number of providing services to the business incubator center, engineers, lawyers, accountants, business leaders, etc.	This indicator was determined by administering the survey and interview with faculty, students, volunteers, and the personnel of the business incubator center.	10–15 volunteers
Annual number of innovative projects/technologies implemented by start-up companies.	Determined by administering the survey and interview with tenant companies of the business incubator center.	8 innovative projects Annually
Annual number of training workshops for new entrepreneurs sponsored by the business incubator center (or annual number of participants attending those workshops).	This data is available in statistics of the business incubator center.	120 participants annually

Source: Authors' own work.

Table 5. Assessment of financial indicators for the business incubator center in Hazleton, Pennsylvania (USA).

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
Average cost of creating a new job by a start-up company during the incubation stage.	Cost of operating the business incubator divided by the number of jobs created (annually).	$21,000/job
Annual budget of the business incubator center and level of subsidy from public and private sources.	Budget of CAN-BE incubator center is available to the public.	$210,000 Annually
Cost of services provided by the business incubator center.	Provided by business incubator center	Up to 1000 $/month per firm
Tax incentives for start-up companies during the incubation stage and post-incubation stage.	Companies in CAN-BE business incubator center are released from paying taxes over a period of 10 years.	Released from paying any corporate income taxes for 10 years
Annual level of subsidy for start-up companies from regional workforce development funds or economic development funds.	Determined by interview with tenant companies in CAN-BE business incubator center.	$4000/new created job

Source: Authors' own work.

As shown in Table 4, there are four full-time Penn State Hazleton faculty and approximately 35 to 40 students annually maintaining a presence at the CAN-BE business incubator center. In addition, there is a team of 10 to 15 volunteers providing assistance to companies in the beginning and incubation stages of development. On average, eight innovative projects are being developed and implemented by the clients of CAN-BE. CAN-BE is offering professional development workshops free to the general public with approximately one hundred and twenty participants annually.

The annual budget of CAN-BE is approximately $210,000 (Table 5). The cost of creating new jobs at CAN-BE is approximately $21,000 per job. The companies in CAN-BE take advantage of the Keystone Opportunity Zone (KOZ) and are released from paying any corporate taxes for 10 years. In addition, individual companies creating new jobs can receive subsidies from workforce development funds (up to $4000 for each new job created). Based on the data collected at the business incubator center in Gliwice, Poland, the individual indicators were assessing. The summary of the assessment is listed in Tables 6–9.

As shown in Table 6, the business incubator center at Technopark in Gliwice, Poland is effective in creating new employment opportunities. Annually 17.3 new jobs are being created (12 by companies in the incubation stage and 5.3 by companies in the post-incubation stage). Approximately five students annually find employment or internship opportunities at Technopark in Gliwice. Annually, four graduates from Politechnika Śląska find full-time employment opportunities at companies in either the incubation stage (2.7 graduates) or post-incubation stage (1.33 graduates). Approximately 5% of the companies are owned by women. The concept of minority does not exist in Poland. Minorities and immigrants are in very small numbers. Therefore, there is no statistical data related to minorities and immigrants.

Approximately 100 entrepreneurs receive help annually from the business incubator center at Technopark in the evaluation of their inventions or business ideas (Table 7). Approximately 35 entrepreneurs receive further help in the development of their business plan. The success rate of the companies in the incubation stage is extremely high (91.7%). Therefore, there are 12 companies in the incubation stage and 11 companies in the post-incubation stage.

Table 6. Assessment of social indicators for the business incubator center in Gliwice, Poland.

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
The number of new jobs created by start-up companies during the incubation period (1–3 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the incubation stage.	36 jobs over 3-year incubation period 12 jobs/year (average)
The number of jobs created by new companies during the post-incubation period (3–6 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the post incubation stage.	16 jobs over 3-year post-incubation period. 5.3 jobs/year (average)
The number of students finding part-time employment or paid internship in start-up companies.	This indicator was assessed by administering the survey and conducting interviews with companies in the incubation stage.	15 students over 3-year incubation period. 5 students/year (average)
The number of graduates finding full-time employment in start-up companies during the incubation period (1–3 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the incubation stage.	8 graduates over 3-year incubation period. 2.7 graduates/year
The number of graduates finding full-time employment in new companies in the post-incubation period (3–6 years).	This indicator was assessed by administering the survey and conducting interviews with companies in the post incubation stage.	4 jobs over 3-year post-incubation period. 1.33 jobs/year (average)
The percentage of start-up companies owned by women.	This indicator was assessed by administering the survey and conducting interviews with the personnel at the business incubator center.	5%
The percentage of start-up companies owned by underrepresented minorities.	N/A	N/A
The percentage of start-up companies owned by immigrants.	N/A	N/A

Source: Authors' own work.

Table 7. Assessment of organizational/procedural indicators for the business incubator center in Gliwice, Poland

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
Annual number of clients receiving help from the business incubator center related to the evaluation of an invention/business idea during the beginning stage.	This indicator was determined by interview with personnel of the business incubator center. Business incubator center is keeping record of this data and using them when applying for public funding.	100 clients
Annual number of clients receiving help from the business incubator center related to the development of a business plan or business model (before the incubation stage).	This indicator was determined by interview with personnel of the business incubator center. Business incubator center is keeping record of this data and using them when applying for public funding.	35 clients
Number of start-up companies during the incubation period (1–3 years) and their success rate, that is, the percentage of companies who have graduated from the business incubator center.	This indicator was determined by interview with personnel of the business incubator center. Business incubator center is keeping record of this data and using them when applying for public funding.	12 companies 91.7% success rate
Number of companies receiving assistance from the business incubator center during the post-incubation stage (3–6 years).	This indicator was determined by interview with personnel of the business incubator center. Business incubator center keeps a record of this data and uses them when applying for funding.	11 companies
Number of full-time staff employed by the business incubator center.	Taken from the directory of the business incubator center.	8
Number of weekly hours that the staff of the business incubator center is available.	As posted in the business incubator center.	80

Source: Authors' own work.

Table 8. Assessment of scientific/technical indicators for the business incubator center in Gliwice, Poland.

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
Number of faculty from the local university cooperating with the business incubator center.	This indicator was determined by administering the survey and interview with faculty, students, volunteers, and the personnel of the business incubator center.	0—Politechnika Śląska does not have any full-time faculty maintaining a presence at the incubator.
Annual number of students doing projects which benefit start-up companies in the business incubator center.	This indicator was determined by administering the survey and interview with faculty, students, volunteers, and the personnel of the business incubator center.	3–4 students
Number of volunteers providing services to the business incubator center, engineers, lawyers, accountants, business leaders, etc.	This indicator was determined by administering the survey and interview with faculty, students, volunteers, and the personnel of the business incubator center.	6 volunteers
Annual number of innovative projects/technologies implemented by start-up companies.	Determined by administering the survey and interview with tenet companies of the business incubator center.	20 projects/technologies
Annual number of training workshops for new entrepreneurs sponsored by the business incubator center (or annual number of participants attending those workshops).	This data is available in statistics of the business incubator center.	100 participants annually

Source: Authors' own work.

Table 9. Assessment of financial indicators for the business incubator center in Gliwice, Poland.

Indicators	Method of Assessment of the Indicators' Assessment	Assessment Number
Average cost of creating a new job by a start-up company during the incubation stage.	Cost of operating the business incubator divided by the number of jobs created (annually).	$4200/job (17,000 zl/job)
Annual budget of the business incubator center and level of subsidy from public and private sources.	Budget of Technopark incubator center.	$50,000 Annually (200,000 zl Annually)
Cost of services provided by the business incubator center.	Provided by business incubator center	Up to 350 $/month per firm
Tax incentives for start-up companies during the incubation stage and post-incubation stage.	No tax incentives.	None
Annual level of subsidy for start-up companies from regional workforce development funds or economic development funds.	Determined by interview with tenant companies in Technopark business incubator center.	None

Source: Authors' own work.

Politechnika Śląska does not have any full-time faculty maintaining a presence at the Technopark business incubator center. Annually, there are three to four students doing projects for companies (clients of the Technopark). There are also approximately six volunteers providing assistance to companies in the beginning and incubation stages (Table 8). The concept of volunteer work is not very well known or popular in Poland. The Technopark business incubator center is implementing 20 innovative projects annually. A number of professional training workshops are being conducted with approximately 100 participants annually.

The cost of operating the business incubator center at Technopark is approximately 200,000 zl. Annually ($50,000 annually). Eight employees allow Technopark to extend its hours of operation to eighty hours per week. The cost of creating a new job at the Technopark business incubator center is relatively low (17,000 zl. per job or $4200 per job). The business incubator center at Technopark is very effective in stimulating every aspect of economic development in the Gliwice region.

The performance indicators described above are being used to compare the effectiveness of both incubators (Technopark in Gliwice and CAN-BE in Hazleton). Tables 10–13 contains a direct comparison between the assessment data of performance indicators.

Table 10. Comparison between the assessment results of social indicators for CAN-BE and Technopark.

Indicators	CAN-BE Hazleton	Technopark Gliwice	Comparison
The number of new jobs created by start-up companies during the incubation period (1–3 years).	10 jobs/year (average)	12 jobs/year (average)	Technopark 2 more
The number of jobs created by new companies during the post-incubation period (3–6 years).	6 jobs/year (average)	5.3 jobs/year (average)	CAN-BE 0.7 more
The number of students finding part-time employment or paid internship in start-up companies.	6.66 students/year	5 students/year	CAN-BE 1.33 more
The number of graduates finding full-time employment in start-up companies during the incubation period (1–3 years).	0 graduates	2.7 graduates	Technopark 2.7 more
The number of graduates finding full-time employment in new companies in the post-incubation period (3–6 years).	0.66 graduates	1.33 graduates	Technopark 0.66 more
The percentage of start-up companies owned by women.	8%	5%	CAN-BE 3% more
The percentage of start-up companies owned by underrepresented minorities.	8%	N/A	N/A
The percentage of start-up companies owned by immigrants.	8%	N/A	N/A

Source: Authors' own work.

Table 11. Comparison between the assessment results the organizational/procedural indicators for CAN-BE and Technopark.

Indicators	CAN-BE Hazleton	Technopark Gliwice	Comparison
Annual number of clients receiving help from the business incubator center related to the evaluation of an invention/business idea during the beginning stage.	90 clients	100 clients	Technopark 10 more
Annual number of clients receiving help from the business incubator center related to the development of a business plan or business model (before the incubation stage).	50 clients	35 clients	CAN-BE 15 more
Number of start-up companies during the incubation period (1–3 years) and their success rate, that is, the percentage of companies who have graduated from the business incubator center.	12 companies 66% success rate	12 companies 91.7% success rate	Technopark 25.7% more
Number of companies receiving assistance from the business incubator center during the post-incubation stage (3–6 years).	8 companies	11 companies	Technopark 3 more
Number of full-time staff employed by the business incubator center.	2 full-time	8 full-time	Technopark 6 more
Number of weekly hours that the staff of the business incubator center is available.	40 h/week	80 h/week	Technopark 40 h/week more

Source: Authors' own work.

Table 12. Comparison between the assessment results of scientific/technical indicators for CAN-BE and Technopark.

Indicators	CAN-BE Hazleton	Technopark Gliwice	Comparison
Number of faculty from the local university cooperating with the business incubator center.	4 faculty	0 faculty	CAN-BE 4 more
Annual number of students doing projects which benefit start-up companies in the business incubator center.	35–40 students	3–4 students	CAN-BE 31–37 more
Number of volunteers providing services to the business incubator center, engineers, lawyers, accountants, business leaders, etc.	10–15 volunteers	6 volunteers	CAN-BE 4–9 more
Annual number of innovative projects/technologies implemented by start-up companies.	8 projects	20 projects	Technopark 12 more
Annual number of training workshops for new entrepreneurs sponsored by the business incubator center (or annual number of participants attending those workshops).	120 participants	100 participants	CAN-BE 20 more

Source: Authors' own work.

Table 13. Comparison between the assessment results of financial indicators for CAN-BE and Technopark.

Indicators	CAN-BE Hazleton	Technopark Gliwice	Comparison
Average cost of creating a new job by a start-up company during the incubation stage.	$21,000/year	$4200/year (17,000 zl/year)	CAN-BE $16,800 more
Annual budget of the business incubator center and level of subsidy from public and private sources.	$210,000/year	$50,000/year 200,000 zl/year	CAN-BE $160,000 more
Cost of services provided by the business incubator center.			very similar
Tax incentives for start-up companies during the incubation stage and post-incubation stage.	Released from paying any corporate income taxes for 10 years	None	N/A
Annual level of subsidy for start-up companies from regional workforce development funds or economic development funds.	$4000/new created job	None	N/A

Source: Authors' own work.

5. Discussion

The assessment data is also shown graphically in Figures 1–4. Those graphs demonstrate the comparison of the impact of both business incubators on the economic development of the region from the following perspectives:

- social indicators,
- organizational/procedural indicators,
- scientific/technical indicators,
- financial indicators.

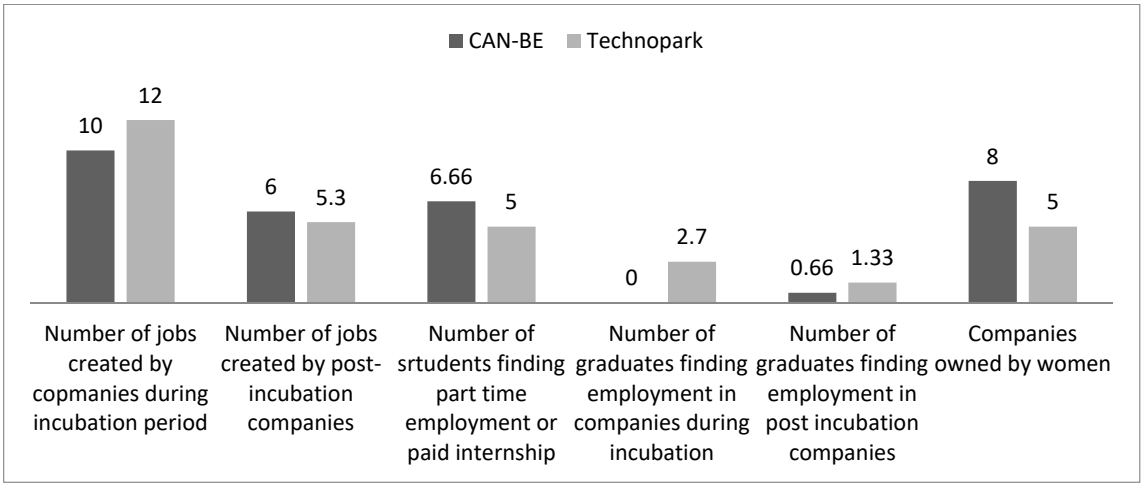

Figure 1. Comparison of the assessment data of social indicators. Source: Authors' own work.

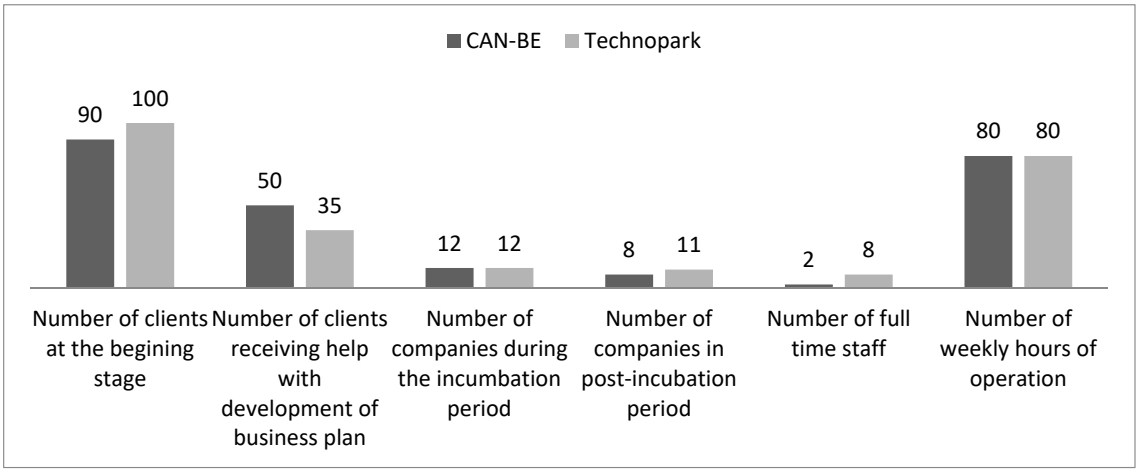

Figure 2. Comparison of the assessment data of organizational/procedural indicators. Source: Authors' own work.

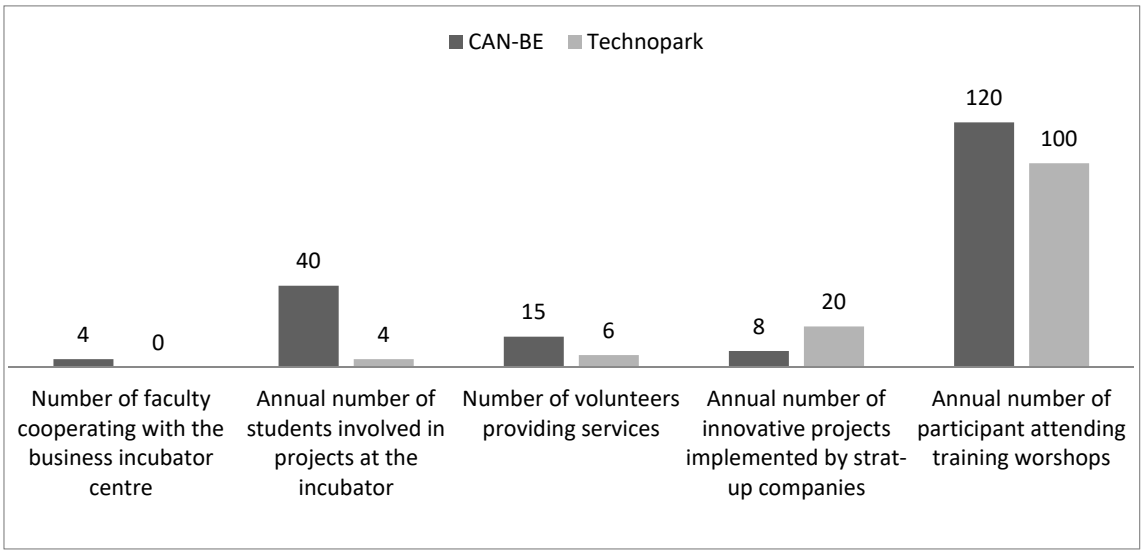

Figure 3. Comparison of the assessment data of scientific/technical indicators. Source: Authors' own work.

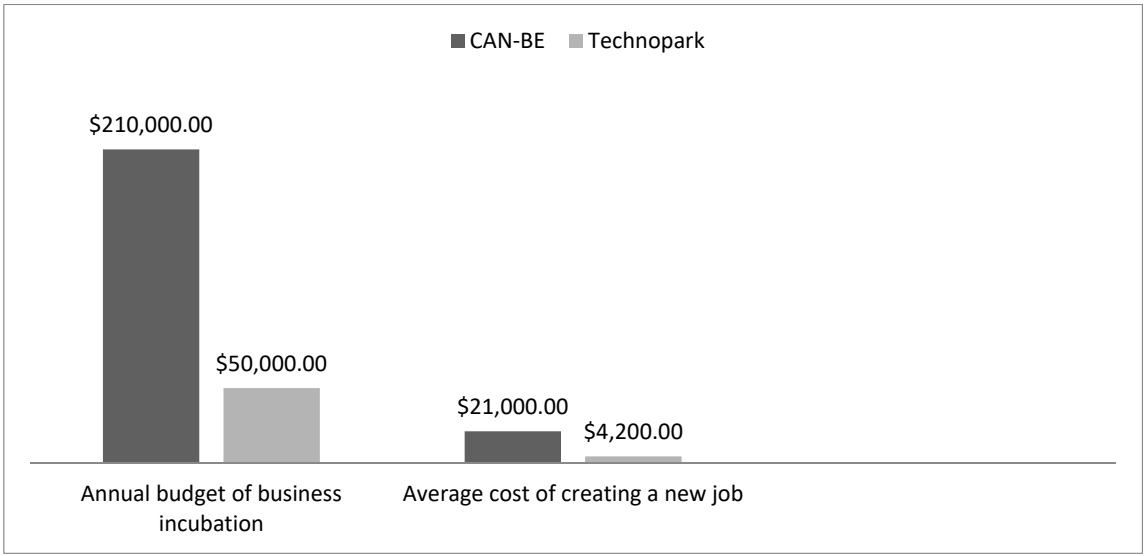

Figure 4. Comparison of the assessment data of financial indicators. Source: Authors' own work.

The size of CAN-BE and the business incubator at Technopark are very similar with approximately 12 companies during the incubation stage. Therefore, a direct comparison is possible. The companies in the incubation stage at Technopark create 12 jobs per year (on average). In comparison, 10 new jobs are created by CAN-BE in Hazleton. The number of job created by companies in the post-incubation stage was 6 new jobs in Hazleton (on average) in comparison with 5.3 new jobs created in Gliwice (on average). Therefore, the number of jobs created by companies during the incubation and post-incubation stages at CAN-BE and Technopark are very similar (within 20% discrepancy). The part-time employment opportunities for students is very similar with 6.66 students (on average) employed annually at CAN-BE and 5 students (on average) at the business incubator at Technopark. A much bigger discrepancy exists in creating full-time employment for college graduates.

The number of university graduates finding full-time employment in incubation and post-incubation stages is in favor of Technopark. The business incubator center at Technopark created on average 2.7 jobs annually by companies in the incubation stage and 1.33 jobs by companies in the post-incubation stage. At the same time, the corresponding numbers at CAN-BE is 0 jobs created in the incubation stage and 0.66 jobs created in the post-incubation stage. The difference is probably due to the higher cost in hiring university graduates in Hazleton, Pennsylvania in comparison to Gliwice, Poland.

At CAN-BE, very few companies in the incubation and post-incubation stages have the financial resources to hire college graduates. As an alternative, those students would rather hire part-time students or obtain professional services through co-operation with Penn State Hazleton. CAN-BE, business incubator center, emphasizes and promotes diversity. Approximately 8% of the companies are owned by women, 8% of the companies are owned by underrepresented minorities and 8% of the companies are owned by immigrants. CAN-BE promotes diversity for two major reasons.

- Diversity enhances innovativeness and allows for an approach from a different perspective (thinking outside of the box).
- Diversity is viewed as a very positive factor during the review of an application for public funding.

The business incubator at Technopark has 5% of the companies owned by women. The concept of underrepresented group, minorities or immigrants does not exist in statistical data in Poland. The minorities and immigrants are in very small numbers. (Poland has 0.015% immigrants compared to 13.1% in the United States.) Therefore, it is not possible to engage them in larger numbers in the process of establishing new firms. Businesses in the United States are trying to recruit a diverse workforce to increase advancement and productivity. A diverse workforce CAN-BE a major strength, if properly

managed. If combined with inappropriate management techniques, it can also be a weakness. The United States government and private industry recognize that and uses diversity as a major strength and asset.

Both business incubator centers, CAN-BE and Technopark, provide help for a large number of prospective clients. The number of walk-in clients receiving assistance from a business incubator center in the evaluation of an idea for invention or business is slightly higher in Technopark (100 clients per year) versus CAN-BE (90 clients per year). By comparing, however, the number of clients receiving help in the development of a business plan or business model, CAN-BE helps 50 clients versus 35 clients at Technopark.

Those discrepancies are due to different philosophies adopted by the two incubators. The incubator at Technopark expects clients to do the homework in developing a business plan. Technopark has adopted a philosophy that the development of a business plan should be the responsibility of the client. It is focusing more on refining the business plan or business model which has already been developed by the client and/or inventor.

Technopark has a smaller number of volunteers. Therefore, it does not have the manpower to assist all clients with the development of a business plan. The concept of volunteer work is not very popular in Poland. The firms are very rarely using a volunteer workforce. This is due to a cultural difference in the spending of free time. CAN-BE has a larger number of volunteers as well as ongoing co-operation with faculty and students at Penn State Hazleton. CAN-BE can assist more clients with the development of a business plan and business model. Both business incubators have 12 companies in the incubation stage. The success rate is very different with 91.7% of the companies at Technopark surviving the incubation stage and transferring into the post-incubation stage. The survival rate is much lower at CAN-BE with 66% of the companies surviving the incubation stage. This leads to the fact that the number of companies in the post-incubation stage receiving help from CAN-BE is only eight comparing to eleven in Technopark. The higher survival rate at Technopark is probably due to the fact that Technopark is more selective in accepting companies into the incubation stage. The companies are required to do more homework of developing a business plan. Technopark's philosophy seems to be effective. One-third of the companies at CAN-BE (33%) do not survive and close during the incubation period. This number is only 8.3% at Technopark. CAN-BE has a more open enrollment policy trying to accommodate everybody. Technopark has eight full-time employees and has 80 h of operation per week. CAN-BE has two full-time employees and has 40 h of operation per week. The reason for fewer employees at CAN-BE is the larger labor cost in the United States in comparison to Poland. CAN-BE relies more on volunteers and part-time student interns.

CAN-BE has a well-established ongoing co-operation with a local university, Penn State Hazleton. Four full-time faculty and approximately 35 to 40 students annually are involved in providing comprehensive assistance to client companies in the incubation and post-incubation stages. Some of the faculty members maintain regular office hours at the business incubator center.

The business incubator center at Technopark does not have any full-time faculty maintaining a presence at the incubator. The number of faculty cooperating with the client companies is based on individual agreements. There is no formal presence of the faculty at Politechnika Śląska at the Technopark. There are also three to four students doing capstone design projects at Technopark annually. However, there is a lack of coordination among those projects.

The student projects at CAN-BE are more structured and incorporated into the Penn State curriculum. The projects done by students from Politechnika Śląska are not very well coordinated with the curriculum. There are also discrepancies between the number of volunteers available at both incubator centers. CAN-BE has 10 to 15 volunteers available while Technopark has only six volunteers. CAN-BE, business incubator center, relies more heavily on a network of volunteers (engineers, accountants, lawyers, etc). There are 10 to 15 volunteers representing different professions. Those volunteers maintain a regular presence at the CAN-BE incubator.

The lack of the use of volunteers in the Technopark incubator center is problem from the university—industry point of view. It needs improvement because the knowledge which have volunteers is very impotent and usable for the management of organizations in the incubator centers. It is a pity not to use such a possibility and in polish incubator center it should be resolved by using promotion and of this solution.

They are meeting with the clients daily. There are six volunteers at Technopark, but there is a lack of an organized network due to problems with recruitment of professions who are willing to serve as volunteers. The concept of volunteer work is more popular in the United States than Poland. The annual number of innovative projects/technologies implemented by client companies is higher at Technopark (20) versus at CAN-BE (8). Both incubators organize ongoing training workshops for present and future entrepreneurs. The frequency of those workshops is very similar (120 participants at CAN-BE annually and 100 participants at Technopark annually).

The annual budget of CAN-BE is $210,000. This amount includes a $110,000 subsidy from public funding and $100,000 from private sources. The annual budget for Technopark is approximately $50,000 (200,000 zl.) and does not contain any public subsidy. The entire amount of funding comes from the budget of Technopark (Technopark is a shareholder in many companies in the post-incubation stage).

The individual companies at Technopark may receive some public funding, but those are individual arrangements between the company and the funding agency. In order to estimate the cost of creating a new job a very simplified method has been used. The annual budget of a business incubator was divided by the number of new jobs created annually. This was done for the purpose of the comparison of both incubators. The cost of creating one new job at CAN-BE in Hazleton was $21,000. The cost of creating a new job at Technopark was $4200. A comparison of those numbers is very much in favor of the incubator at Technopark.

The client companies at CAN-BE are released from paying any corporate income taxes for 10 years. This state program is titled, Keystone Opportunity Zone (KOZ). This opportunity program is offered in regions requiring an economic boost. Northeastern Pennsylvania is one of those regions. There are also Workforce Development Funds available to client companies. A company can apply for a $4000 subsidy for every new job being created. Companies at the business incubator at TECHNOPARK do not receive a release from taxes and subsidies for creating new jobs are very limited.

During the process of selecting the indicators, one of the objectives was to create them as independent as possible, so that the economic growth can be measured from different perspectives. There is some correlation, however, between the assessment results of some indicators. On the basis of analysis we can say that a higher job in creating a new job in Pennsylvania resulted in fewer new full-time jobs being created. Instead of creating full-time jobs, CAN-BE companies in Pennsylvania hire more student interns. Student interns are a more cost-effective way than hiring a full-time employee. The lower cost in creating a new job at Technopark companies in Poland resulted in more full-time jobs being created and less student interns.

There is also a correlation between the number of full-time staff at the business incubator centers and the number of hours of operation. The business incubator center at Technopark has more employees allowing it to operate for 80 h per week. CAN-BE has fewer employees which allows for only 40 h per week of operation. On the basis of the research we identify a correlation between the number of university faculty cooperating with the business incubator center and the number of students involved in doing design projects with companies at the business incubator centers. Cooperation between a business incubator center and the local university is beneficial to the faculty. It allows them to stay aligned with the demands of industry. It increases faculty visibility and recognition as an expert in the field. Cooperation between a business incubator center and the local university is also beneficial for students by providing them with real world multidisciplinary educational experiences which are not possible to achieve in the classroom. In Hazleton, Pennsylvania, there are five full-time faculty members maintaining a presence at CAN-BE. At the same time, there are at least 10 students cooperating with the business incubator center in the form of design projects.

By comparison, there is no faculty maintaining a presence at the Technopark incubator in Gliwice, Poland and an average of only 3.5 students are involved in doing projects for the companies.

There is also a correlation between the success rate (survival rate) of the companies during the incubation period and the number of companies in the post-incubation stage. Both incubators, CAN-BE and Technopark have 12 companies during the incubation stage. The success rate at the Technopark incubator is 91.7% compared to 66% at CAN-BE. This resulted in 12 companies in the post-incubation stage at Technopark compared to 8 companies at CAN-BE.

6. Conclusions

On the basis of the paper, we can say that a business incubator center is an effective method of stimulating economic sustainable growth. It has a positive effect on social, technical, and financial indicators. A business incubator center is a cost-effective method of stimulating economic growth. The cost of creating new jobs is approximately 6x lower than creating jobs by other kinds of investments.

After comparing the two incubator centers: from United States and Poland, we cannot say directly which one operates better. Every incubator center has its own advantages and problems. The cost of creating new jobs at the business incubator center in Pennsylvania is $21,000/job (compared to a range of $120,000–$280,000 by other forms of investments.) The cost of creating new jobs at the business incubator center in Gliwice, Poland is 17,000 zl ($4200). This is compared to a range of 100,000 zl.–1 M zl. by using other forms of investments. Both incubator centers provide comprehensive level of help for many prospective clients. More clients are in CAN-BE (50) compared to Technopark (35). In Poland, the development of the business plan is on the client side, but in USA incubator give more help to create good business plan and use the help of volunteers which are not in Technopark. The polish incubator center is better from survival rate point of view which is higher. However, the CAN-BE is well-established cooperation with local university which is on the better level comparing to Technopark.

On the basis of the study, we found two main managerial implications for incubator centers. Firstly, very important for CAN-BE is to change the model of financing into a self-sustainable model. We think that the self-sustainable model is better and can be used as a role model in the management of business incubator center. This could be accomplished by acquiring a share of the company in return for providing financial support during the beginning and incubation stages. The profit generated from being a shareholder of the company after the incubation stage can be used to provide financial support for other start-up companies. This model is established at Technopark and allows recirculating research and development funds.

Second implication is connected with operating model of the center from their connections with University point of view. For the Technopark the main goal should be to establish closer working relationship with the faculty and students from Politechnika Śląska and volunteers. We think that model operating on volunteers which is used in CAN-BE is better and should be promoted in academic incubator centers. Also, the relations of the incubator to the university should be closer—they can use students to cooperation which can be beneficial for both part of it—firms in incubator centers and students. This model is successfully used by CAN-BE which is cooperating with Penn State Hazleton. Faculty and students from different majors can provide low cost comprehensive assistance to start-up companies during the pre-incubation, incubation, and post-incubation stages. This assistance is very comprehensive and high quality. Students gain very valuable learning experiences.

The conception presented in the study is in accordance with the triple helix model. We think that a knowledge society needs a detailed and deep cooperation between university, industry, and government. In the analyzed incubators the linkage between those subjects was on lo low level. Increment of this linkage can improve the functioning of the incubator center and give it a potential to achieve bigger output in the field of innovativeness. The main managerial implication of the study is a need to improve of mentioned linkage between three subjects in the triple helix model. It is not functioning well in analyzed incubator centers and the improvement of it has great potential.

The profit generated model needs close relationships of university and industry and reduction of the governmental role in incubator center management and functioning. We think this is the main theoretical implication of the study. The governmental role is important, but in the market economy the key to build financially independent innovative incubator center is to concentrate on the university—industry corporation and financial stability of the incubator without the need of external funding. Such a model should be optimal and could ensure long term prosperous functioning of the incubator center.

The study presented in the paper has some limitation. The main limitation is connected with the character of the study based of the choose of only two incubator centers—one from Poland and the second from USA. In the future, this paper can serve as a basis for more extensive study based on more incubator centers and many more countries. The limitation is also the selection of collected indicators. The indicators were based on expert opinion using the Delphi method. However, other experts could suggest another set of indicators to use.

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