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Comparative Analysis of the Level of Satisfaction with the Services Received at the Business Incubators (Hazleton, PA, USA and Gliwice, Poland)

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Abstract: This paper consists of a detailed comprehensive analysis of the client company satisfaction of services received at business incubator centers in the United States (USA) and Poland. This paper also includes how clients rated the importance of different services, which were provided to them at two business incubator centers; clients were generally satisfied with the services they received from the business incubators. Some services were not offered at both incubators to the same extent, which created discrepancy in the assessment results. The clients at the CAN-BE business incubator center already received extensive help from volunteers as well as Penn State faculty and students. However, the highest priority is still assigned to further increase those services. The client companies at the TECHNOPARK business incubator center received very limited help from volunteers, faculty, and students, as they assigned a low priority to those resources. The reason for that may be a lack of exposure and lack of understanding of the extremely valuable services provided by an incubation center. The aim of this article is to compare, analyze, and evaluate the operation of the GLIWICE TECHNOPARK and Hazleton, PA, USA incubation centers from a client satisfaction point of view.

Keywords: business incubator; innovativeness; economic development; quality; satisfaction of client

1. Introduction

Generally speaking, an incubator is a mechanism in which babies born prematurely are kept warm and safe in a controlled environment. In business terms, however, new organizations are born and kept safe by an array of support services provided by an incubator center. Nowadays, business incubator centers are widely used to provide a good environment for new organizations. Without business incubator centers, it is not easy to grow a new organization. Business incubator centers boost innovativeness and help birth important businesses.

The effectiveness of the incubator center depends on the level of services provided by it. Without the appropriate services on all stages of incubation process, it cannot be useful and cannot fulfill its role as a safe environment for a growing organization. For now, it is difficult to achieve a sufficient level of economic development without using business incubator centers. On all stages of the process, we think that incubator centers should achieve a good satisfaction level from their clients.

Each country has their own regulations and methods for business incubation center management, and regulations differ between many of them. In this paper, we think it could be interesting to examine the differences between incubator centers in the United States (USA) and Poland.

Because the problem is important from both a scientific and practical point of view, we used the comparative case study analysis to compare two incubator centers: one in the USA, the other in in

Poland. We think that because these countries and their economies are different, we can identify the main principles important in achieving a successful business incubator center.

Therefore, the main aim of this paper is to build a model of components that should be analyzed before incubation, during incubation, and after incubation.

Our analysis is important for a number of reasons. First, by comparing two case studies from two countries we can find differences between them while also establishing shared principles of all sustainable business incubators. When considering customer satisfaction level, we want to uncover common problems in daily business incubator functions in order to better understand problems that are important from their customer's point of view.

Specifically, we chose the USA and Poland as our two model countries because we wanted to understand the differences of business incubator centers in developed and developing countries. For reference, it is important to compare our analysis with other studies about problems of functioning business incubator centers in developed and developing countries [1–29].

In the first part of the paper, we will review the literature on business incubator centers in order to examine previous investigations of client satisfaction levels and the functioning principles of different centers. The next part of the paper will concentrate on the level of client satisfaction in two researched incubator centers. Next, there will be a discussion of the results and a conclusion.

2. Literature Review

The business incubator center world network was created to stimulate economic growth in underdeveloped regions. Companies in a business incubator center receive services that assist in developing successful business ventures [30]. Every new business is entitled to those services. Some services are free-of-charge, but a majority of them are offered at below market cost. Assessing how clients view these services is necessary from a continuous quality improvement perspective [31–34].

Incubation is a process related to the need to support the activity of enterprises running a business. Further, the concept of incubation is related to innovation [18,35]. About 50 years ago, the concept and practices related to incubation and innovation began in developed countries. Schumpeter is recognized as the creator of the modern concept of innovativeness in economic cycles and in relation to the implementation of innovativeness in enterprises [36–38]. He believed that special emphasis should be placed on new products, new production methods, new markets, and new forms of organizations, while also activating and supporting entrepreneurs for development. Throughout this process, it is essential that all activities within the business are well considered and fit into a sustainable development of the company [31,39,40]. An important element of the incubation process is promoting current and future entrepreneurs' business ideas and translating it into activities throughout the enterprise [41,42]. The incubation process can be divided into three stages: pre-incubation, incubation, and post-incubation.

According to the guidelines of the European Commission, a business incubator is an institution where entrepreneurs can find professional knowledge and assistance in creating business plans and developing business strategies for enterprises, as well as in creating innovative solutions related to the implementation of new technologies [43–45]. Very often, technological business incubators are located at universities. Moreover, there are also so-called incubators on electronic platforms via Internet services [46–49].

The birthplace of the business incubator center was Batavia, New York, USA in 1959 [49,50]. In the following years, other countries adopted this institution as a tool for boasting economic development. Thus, business incubators aim to maximize the chances of success for start-up companies by creating a supportive environment [4,51].

There are many models of business incubator centers across the world. According Montigny [16], the main issues in business incubator center functioning in developed countries are as follows:

- expanding an incubator's function,
- successfully connecting to venture capital,

- forging an optimal path from pre-starting companies towards gazelle creation,
- increasing clients outside the incubator walls, and
- successfully using the internationalization processes for stronger results.

In developing countries we encountered the following problems with business incubator center functioning [20]:

- the lack of financial resources available to incubators,
- the challenge of finding qualified people to staff incubators,
- the lack of partnering opportunities outside the incubator organization because professional services are often scare and focused on large companies,
- the mindset of entrepreneurs often makes them unwilling to give up equity in their companies,
- entrepreneurs may be less willing to trust outsiders,
- the general business environment may be less favorable,
- the propriety rights situation may be less developed,
- some national cultures may be more risk-averse, and
- the lack of venture capital and networks of investors.

Nowadays business incubation is a trendy economic development instrument implemented in around the globe to achieve a wider range of industrial competitiveness caused by globalization. This solution encourages improvement in the case of innovative technologies and can push a country's economy toward industrialization. Business incubator center is widely used as an instrument for encouraging entrepreneurs and helping start-ups. This type of organization can help young companies, especially when encountering problems in the first stage of their potential growth [52].

Academic business incubators make use of academic and scientific knowledge [53–55]. All business incubators are based on innovativeness. All innovative activities conducted within business incubators should be technology-oriented and have significant impact on an entire business. In each stage of the incubation process, we should be able to distinguish various activities. [10,56], especially the demand-pull and technology-pull innovations [45,47].

Business incubators have a wide impact on enterprise and local community [44,57,58]. In Poland, problems related to academic entrepreneurship are relatively new but very important for the innovativeness of enterprise. Activities related to the implementation of new technologies and the cooperation between universities and organizations, science parks, technology transfer centers, technology parks, and academic entrepreneurship incubators are helpful.

In the literature, many studies detailed the quality of services in incubator centers. Allen and Rahman found [3] that physical advertising and marketing services, risk management, and insurance and government grants are rated as the most useful for an incubator center's urvival. Fry [6] thinks that incubator firms are more active in planning than non-incubator firms. According to Mian [59], incubator firms benefit from a university image, student employees, and university labs and infrastructure. Incubator services have added value contributions. Hsu posits [9] that incubator tenants are more satisfied with incubator services when compared to firms in other incubators. Abetti [1] wrote that incubators receive little funding from the government but are able to create high skilled cost effective jobs.

According to Pena [17], most incubator services have no impact on performance indicators. Lee and Osteryoung wrote [12] that there is a difference between USA and Korean respondents regarding the role of incubator strategy. Peters found [18] that graduation rates are higher in incubators that offer coaching and provide an accessible network. According to Totteman and Sten [60], incubator managers should focus on strategic business networking rather than only providing infrastructure and physical capital to entrepreneurs. Wynarczyk and Raine [25] think that incubators play an important role in nurturing business and creating jobs. According to von Zedwitz and Grimaldi [24], incubator services should be type-specific and the portfolio of the provided services should match with the

objectives of the incubator. Studdard wrote [21] that the knowledge acquired by interacting with the incubator manager has no effect on new product development, technological competence, and sales cost. According to McAdam and Marlow's research in Ireland [14], tangible incubator resources are important for the development of firms in the early stages.

Lin posits that [13] the links between Integrated Service Capabilities and Service Performance in analyzed incubator centers was very weak and negative. According to Tang [22], government-supported incubators are relatively ineffective in providing access to external capital or business-related consulting and networking services, but government-supported business incubators are generally effective in providing physical infrastructure, office support, and access to resources of university and public research institutes.

Poland in recent years has had business incubators appear in many Polish universities. There are currently 48 incubators located throughout the country. Incubators have so far released over 5000 enterprises and 1600 companies operate in Polish Academic Business Incubators. Thus, the aim of this article is to compare, analyze, and evaluate the operation of the GLIWICE TECHNOPARK and Hazleton PA, USA from the point of view of client satisfaction [61,62].

One such incubator is TECHNOPARK GLIWICE, which was founded in 2004 by three partners: the city of Gliwice, the Silesian University of Technology, and the "Special Economic Zone". The main goal of the TECHNOPARK was to help in the creation and development of modern enterprises. It also helps raise technological innovation, as well as aid students and graduates to carry out their business ventures. TECHNOPARK GLIWICE operates an in-house entrepreneurship incubator whose task is to help enterprises at the initial stage of activity [35]. Further, TECHNOPARK also runs training workshops that aim is to focus and raise funds for the implementation of enterprises related to entrepreneurship.

The CAN-BE business incubators center was founded in 2000. It is located in the Valmont Industrial Park, across from the Penn State Hazleton Campus. The aim of the CAN-BE is to provide help and support for entrepreneurs developing new ventures. CAN-BE supports start-ups and then helps them survive. Moreover, CAN-BE provides key business services technical services and engineering services. Initially, enterprises are "walk in" customers. The center has from 50 to 100 customers per year. These clients have their own ideas about new products, new technologies and business ventures [63,64].

3. Methodology of Assessment and Data Collection

The main aim of this paper is to build a model of components that should be analyzed before incubation, during incubation, and after incubation. To achieve this, we measured the customer satisfaction level in incubator centers in all three stages (pre-incubation, incubation, and post-incubation). Our aim was to identify the main problems of incubator center functionality and to propose potential solutions and recommendations. The main part of our research concentrates on country analysis (developed or developing). We wanted to compare solutions used in developed and developing countries, which was our reasoning for our choise of incubators. Our research can help clarify the debate about problems in business incubator centers in both developed and developing countries.

Our developed country, the USA, was compared to developing country Poland. These chosen incubator centers are both academic incubator centers. One (CAN-BE) is situated in Pennsylvania, USA and the second (TECHNOPARK) in Silesian region in Southern Poland.

This article uses a mixed approach regarding the scientific method, which was applied using quantitative and quantitative methods [47,65–69]. We followed similar methodology used in previous research about incubator centers in developing and developed countries [9,12,14,36]. We modified the questionaries and parts of methodology, according to the scope of our research. We especially wanted to build a model of components that influenced how incubator centers functioned in the three stages. This was not analyzed in previous papers. However, the methodology approach was used by Lee and Osteryoung [12]. These studies were aimed at identifying the main factors that affect the functioning

of incubators. The identified factor and the developed model can be used in various countries to assess the level of customer satisfaction in incubators.

To determine the level of satisfaction of client companies with services provided to them by the business incubator center, the same survey was conducted at CAN-BE in Hazleton, PA, USA and TECHNOPARK Gliwice [12]. Two identical sets of surveys (and cover letters) were prepared. An English version of the survey was used for clients of CAN-BE in Hazleton. A Polish version of the survey was used for clients of the business incubator center at TECHNOPARK in Gliwice. The surveys were administered between October 15, 2016 and April 15, 2017. There were 12 companies during the incubation stage at both business incubator centers. The return rate was higher in Hazleton, with 12 surveys returned compared to 6 surveys returned to TECHNOPARK. Surveys were also administered to faculty, students, and volunteers providing services to the business incubator centers. The return rate of those surveys was 16 surveys received from CAN-BE and 12 surveys from TECHNOPARK. After a statistical analysis of the technical data, the results are shown in Tables 1–3. During the statistical analysis, the following values were calculated and recorded:

- N-sample size,
- mean value,
- standard deviation,
- significance (sign): 2-tailed sign,
- T-test for equality of means, and
- standard error mean.

Table 1. Assessment of support received from business incubator center in the post-incubation stage.

Type of Support	N (Sample Size)	Mean Value	Standard Deviation	Significance (2-Tailed)	T-Test for Equality of Means	Standard Error Mean
Assistance provided by volunteer consultant	12 [1] 6 [2]	5.00 0.00	1.651 0.000	0.000 0.000	7.30 10.48	0.476 0.000
Assistance from faculty and students as consultants	12 6	9.50 1.66	.674 2.581	0.001 0.001	10.12 7.30	0.194 1.054
Assistance from students doing a capstone design project for the company	12 6	9.00 0.00	1.348 0.000	0.000 0.000	16.10 23.12	0.389 0.000
Legal assistance in securing tax-free status or tax advantages for new companies	12 6	9.00 0.00	1.206 0.000	0.000 0.000	18.00 25.85	0.348 0.000
Legal assistance in applying for financial support for creating new jobs	12 6	4.00 9.00	1.537 0.000	0.000 0.000	6.26 9.01	0.443 0.000
Assistance in professional development and training	12 6	5.75 1.66	2.050 2.581	0.002 0.002	3.66 3.37	0.591 1.054
Assistance in developing marketing strategies or internet sales	12 6	6.00 0.00	1.651 0.000	0.000 0.000	8.76 12.58	0.476 0.000
Legal assistance in protecting intellectual property (patent)	12 6	8.50 0.00	1.381 0.000	0.000 0.000	14.83 21.31	0.398 0.000
Engineering assistance in improving innovation	12 6	7.50 0.00	1.732 0.000	0.000 0.000	10.44 15.00	0.500 0.000
Assistance in establishing continuous quality improvement procedures.	12 6	7.50 0.00	1.834 0.000	0.000 0.000	9.86 14.16	0.529 0.000

[1] CAN-BE—upper number. [2] TECHNOPARK—lower number. Scale 0–10: 1 = No Support, 10 = Exceptional Support.

Table 2. Assessment of suggestions for improving the effectiveness of the business incubator center.

Type of Support	N (Sample Size)	Mean Value	Standard Deviation	Significance (2-Tailed)	T-test for Equality of Means	Standard Error Mean
Increase the number of volunteers	12 [1] 6 [2]	9.00 2.00	1.044 0.894	0.000 0.000	14.00 14.782	0.301 0.365
Increase the number of faculty assisting the company	12 6	10.00 2.33	0.000 1.032	0.000 0.000	26.55 18.18	0.000 0.421
Increase the number of students doing a capstone design project for the company	12 6	9.91 2.33	0.288 2.33	0.000 0.000	12.86 8.94	0.083 0.843
Remodel office and manufacturing space	12 6	7.00 4.66	1.758 3.141	0.058 0.058	2.04 1.69	0.507 1.282
Incorporate tax-free status for 10 years for new companies	0	N/A *	N/A *	N/A *	N/A *	N/A *
Increase the financial benefit for creating new jobs	12 6	10.00 7.66	0.000 1.861	0.028 0.028	4.48 3.07	0.000 0.760
Improve legal help (intellectual properties, taxes)	12 6	9.00 6.33	1.206 3.614	0.133 0.133	2.36 1.75	0.348 1.475
Increase engineering assistance (designing structural analysis, quality control)	12 6	9.00 7.33	1.348 2.250	.065 0.065	1.98 1.67	0.389 0.918
Increase help related to business management and accounting	12 6	5.00 7.66	2.593 1.861	0.0261 0.0261	2.23 2.49	0.748 0.760

[1] CAN-BE—upper number. [2] TECHNOPARK—lower number. Scale 0–10: 1 = No Support, 10 = Exceptional Support. * Not available.

Table 3. Assessment of importance of potential benefits from cooperating with business incubator center.

Type of Benefits	N (Sample Size)	Mean Value	Standard Deviation	Significance (2-Tailed)	T-Test for Equality of Means	Standard Error Mean
Additional Income	16 [1]	2.31	2.120	0.054	2.023	0.530
	12 [2]	4.90	4.482	0.054	1.769	1.351
Self-satisfaction	16	8.50	1.414	0.071	2.053	0.353
	12	7.08	2.234	0.071	1.026	0.645
Gaining Professional Experience	16	8.68	1.352	0.048	2.448	0.338
	12	6.16	3.833	0.048	2.178	1.106
Establishing Professional Contacts	16	8.56	1.209	0.045	2.105	0.302
	12	6.66	3.339	0.045	1.877	0.964
Obtaining Full-time Employment in a Start-up Company	16	3.25	1.183	0.058	2.095	0.295
	12	4.33	1.557	0.058	2.013	0.449

[1] CAN-BE—upper number. [2] TECHNOPARK—lower number. Scale 0–10: 1 = No Support, 10 = Exceptional Support.

For a majority of the data, the significance was within 0.05 (chance of error less than 5%). Only one set of data had a significance of 0.258 (chance of error 25.8%). This was due, however, to the relatively small sample size. However, for comparing two business incubator centers, 25.8% error seems to be acceptable.

4. Analysis of the Level of Satisfaction with the Services Received at the Business Incubators in Hazleton PA, USA and Gliwice, Poland

The results of the support assessement research on pre-incubation stages and incubation stages were described in an earlier paper [24].

Table 1 contains an assessment of services during the incubation stage and post-incubation stage. Table 2 reflects suggestions of the client companies to improve the quality and effectiveness of services provided by the business incubator center. The client companies were asked to prioritize the importance in improving some of the selected services.

An assessment of the client satisfaction received at the pre-incubation stage (evaluation of the innovation concept, engineering analysis, etc.) indicates a higher level of satisfaction at CAN-BE (9.0–9.5%) than TECHNOPARK (6.5–7.15%). It seemed that the companies at both business incubator centers were very satisfied with the assistance received at the pre-incubation stage. Both incubators, TECHNOPARK and CAN-BE, had a relatively large number of walk-in clients (90 clients at CAN-BE and 100 clients at TECHNOPARK). Those walk-in clients received help in the evaluation of the invention and business idea. A high percentage of those clients received further assistance in the development of a business plan or business model, as well as introductory engineering analysis and design (50 clients at CAN-BE and 35 clients at TECHNOPARK). TECHNOPARK expected the clients to prepare a draft of the business plan before they received assistance from TECHNOPARK. This policy of expecting the clients to do extensive "homework" before asking for help is effective and increases the retention rate during the incubation stage. (The retention rate is 66% at CAN-BE and 91.7% at TECHNOPARK.) The clients seemed to be satisfied with the evaluation of the innovation concept. (The level of satisfaction was 95% at CAN-BE compared to 71.6% at TECNOPARK). The level of satisfaction in introductory engineering analysis and design was also high. (CAN-BE had a 90% level of satisfaction as compared to 65% at TECHNOPARK.) This is with accordance with Allen and Rahman's results [3], who determine that physical services were important and best assessed in the process of measuring the quality of services provided by an incubator center. The level of satisfaction at the pre-incubation stage was relatively high at both incubators. (It is slightly higher at CAN-BE).

In our research we analyzed the following problems:

- office space / secretarial support,
- manufacturing space / warehouse,
- consulting service from volunteers,
- consulting services from faculty and students,
- help from students cooperating with the company in the form of capstone design projects,
- assistance from personal of business incubator center,
- legal assistance in protecting intellectual propriety (patent),
- assistance in creating a website for a company,
- legal assistance in establishing and registering corporation,
- legal assistance in accounting and filling income tax,
- assistance in marketing of the product,
- legal assistance in securing tax-free status during the incubation stage,
- assistance in professional development and training, and
- legal help in obtaining financial subsidies for creating new jobs.

By comparing the level of client satisfaction with the services received during the incubation stage, the discrepancy between CAN-BE and TECHNOPARK is much larger. This is because the business

incubator at TECHNOPARK does not provide some of the services available at CAN-BE. The business incubator center at TECHNOPARK does not provide any services in the following areas:

- assistance in creating internet websites for the companies,
- legal assistance in establishing or registering a corporation,
- legal assistance in accounting and filing taxes,
- legal assistance in obtaining financial subsidies for creating new jobs (there are limited subsidies for creating new jobs in Poland),
- legal assistance in securing tax-free status during the incubation stage (there is no tax-free status for start-up companies during the incubation stage in Poland), and
- legal assistance in protecting intellectual property.

The assessment numbers in those areas would be "0" for TECHNOPARK and no comparison should be made in those specific areas between CAN-BE and TECHNOPARK. The best rated area in CAN-BE are: consulting with faculty students (9,0); legal assistance in securing tax-free status (9,0), legal assistance in accounting (8,75) and help from students cooperating with the company (8,75). In TECHNOPARK the best assessed area were as follows: office space (6,33) and assistance from personnel of incubation centre (3,33).

The results are in accordance with other authors research about the functionality problems of incubator centers in developing countries [56]. In addition, in Poland there are problems with capital, resources, and access to qualified people, especially to volunteers. The problem with the lack of volunteers and students engaging in incubator centers projects is important because according to Mian [37], the cooperation with students is a crucial factor for appropriate quality of service in any incubator center.

Furthermore, tangible resources such as office space and manufacturing space are important in the early incubation stage; McAdam and Marlow [36] obtained similar results in their research. The appropriate level of tangible resources is needed to give the organization access to basic services necessary to run a firm.

By comparing the quality of manufacturing/warehouse space, there is a discrepancy in favor of CAN-BE, i.e., CAN-BE (36) and TECHNOPARK (1.67). However, this discrepancy is due to the nature of client companies. Most of the companies in TECHNOPARK are not involved in manufacturing yet. Client companies at CAN-BE utilize manufacturing and warehouse space to a greater extent. Consulting services provided by volunteers, faculty and students as well as assistance from students doing capstone design projects for client companies is being rated higher at CAN-BE compared to TECHNOPARK.

CAN-BE has a large network of volunteers that provides a wide range of services. The entrepreneurial team building projects involving students from different majors in providing services to the client companies probably makes a big impact on client satisfaction. In accordance with other research [38,59], CAN-BE's situation is better because the results of the quality service assessment for this incubator center better correlate with the key success factors for academic incubator centers.

The graphical comparison of the assessment data represents satisfaction of companies during the post-incubation stage (Figure 1). This refers to the services still provided by the business incubator.

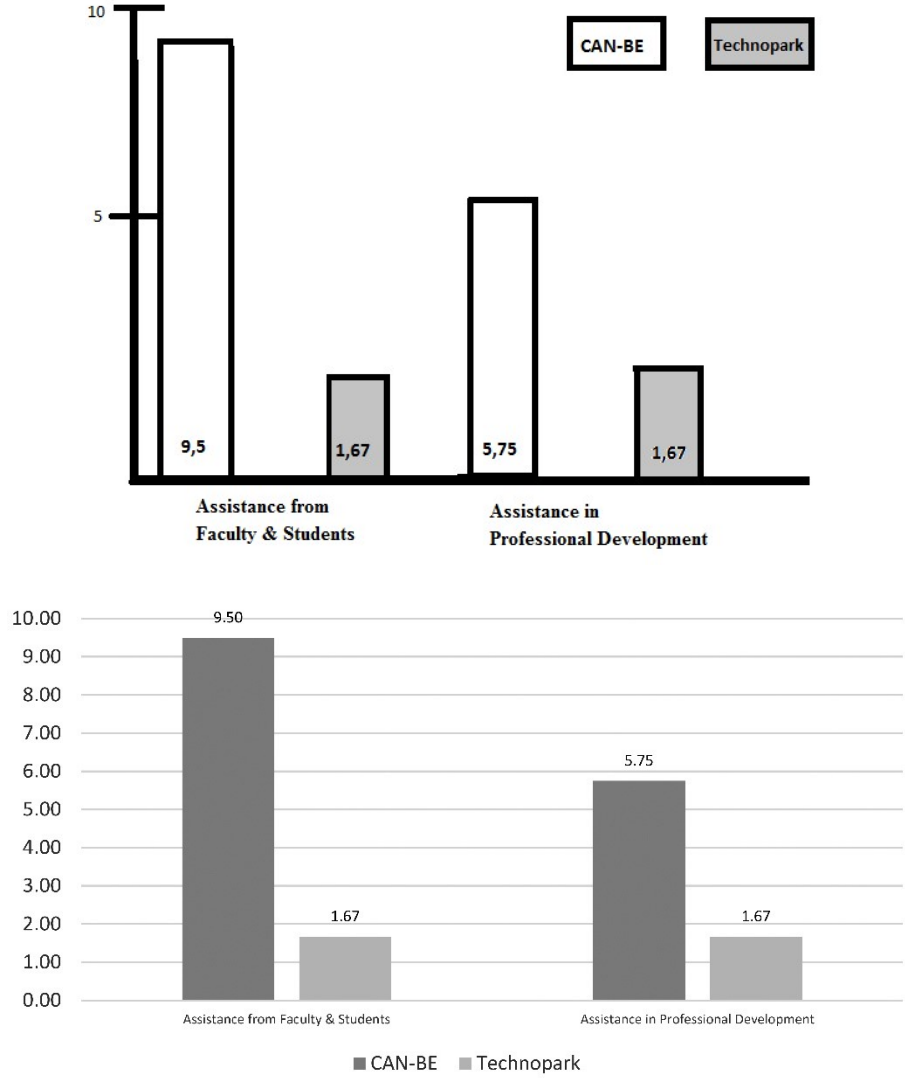

Figure 1. Assessment of support received from business incubator centers in the post-incubation stage.

The assessment of client satisfaction with services received in the post-incubation stage also shows the discrepancies between both of these incubator centers. This is because, during the post-incubation stage, many services available at CAN-BE are not available at TECHNOPARK. In the post-incubation stage, the company still receives some services from the business incubator, but not all of them are available. Some services may be available at CAN-BE but may not be available at TECHNOPARK. The services not available at TECHNOPARK are as follows:

- assistance provided by volunteer consultants,
- assistance from students doing capstone design projects,
- legal assistance in securing tax-free status,
- legal assistance in applying for financial support in creating new jobs (there is very limited financial support for creating new jobs in Poland),
- assistance in developing marketing strategies and internet sales,
- legal assistance in protecting intellectual property (applying for patent),
- engineering assistance in improving innovation, and
- assistance in establishing a continuous quality improvement process.

In this stage, the lack of volunteers and students is the main problem of the Polish incubator centers. Additionally, there are problems with capital, an impotent problem in incubator center growth in developing countries, which is similar to the issues mentioned by Montigny [16].

The services that were not available resulted in "0" as an assessment number. Those services should not be used for comparison between CAN-BE and TECHNOPARK. Assistance from faculty and students is being rated higher at CAN-BE (9.5) versus TECHNOPARK (1.67). This is because the companies in the post-incubation stage at CAN-BE still receive help from faculty and students at Penn State Hazleton. The entrepreneurial team building projects are extended to companies in the post-incubation stage. The assessment results of the clients' suggestions for improving the effectiveness of a business incubator center are shown in Table 2.

A graphical comparison of the proposed ideas for improvement of services provided by business incubator centers is shown in Figure 2.

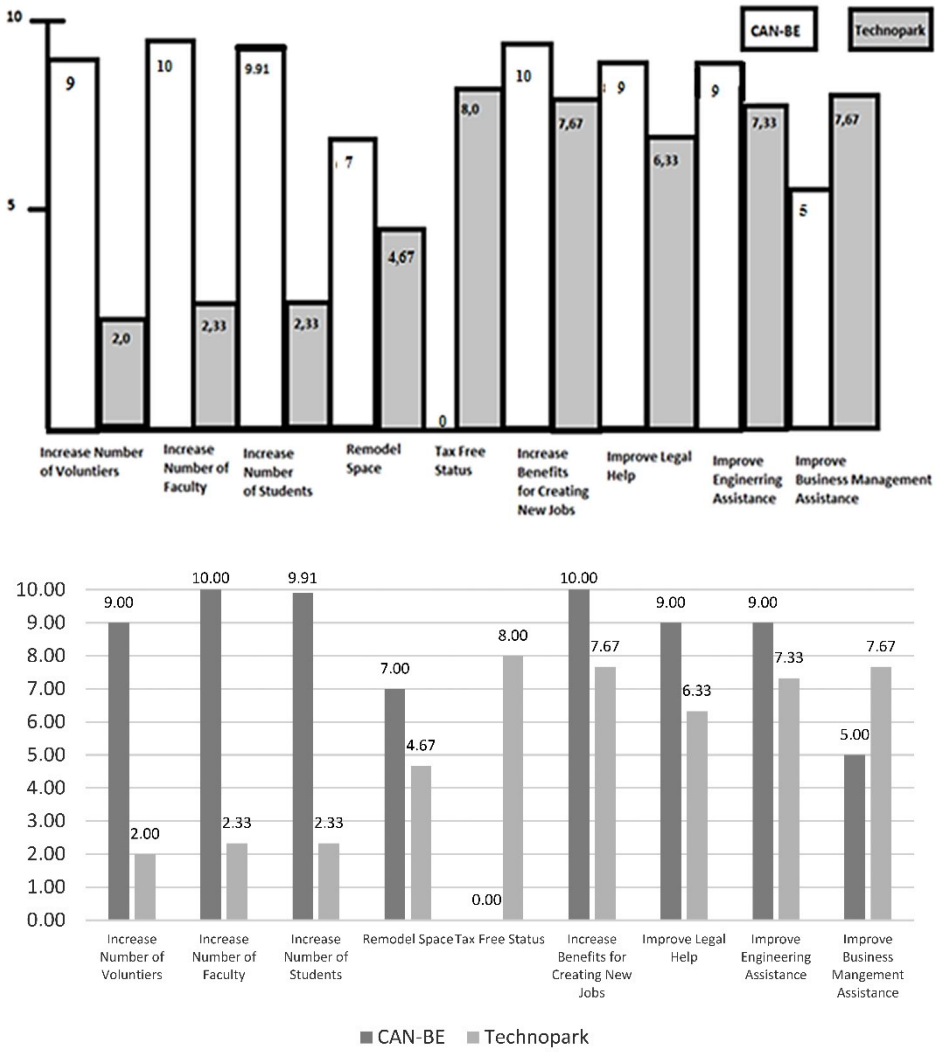

Figure 2. Suggestions proposed by client companies related to the improvement of the quality of services provided by the business incubator centers.

The clients at CAN-BE assigned the highest priority to the following:

- to increase the number of students and faculty providing services to the companies (9.9),
- to increase the financial benefits for creating new jobs (10),
- to increase legal help in protecting intellectual property (9),
- to increase the number of volunteers (9), and

- to increase engineering assistance (9).

The main problems of CAN-BE incubator center from developed country is connected with achieving financial stability. Further, creating new jobs are a very important issue, which is with accordance with Wynarczyk and Raine research [25].

The clients at CAN-BE assigned the lowest priority to the following:

- tax free status (CAN-BE already has it (0),
- improve business management assistance (6).

The client companies at the business incubator center at TECHNOPARK assigned the highest priority to the following:

- to incorporate tax-free status for new companies (8),
- to increase financial benefits for creating new jobs (7.67),
- to increase help in business management and accounting (7.67),
- to increase engineering help (7.33), and
- to improve legal assistance (intellectual property, taxes, etc.) (6.33).

The problems mentioned above should be resolved to improve the functioning of the TECHNOPARK business incubator center in Poland. These findings are similar to other results that have been done in developing countries [3,6,17,21,24,25,59,60]. The main difference with Poland is the problem with volunteers. Even when comparing Poland to other developing countries, this problem is bigger because in Poland there is no precedent for using volunteers in business activities. In the last 10 years, we can observe an increasing number of volunteers in nonprofit organizations, but it is not easy to implement this idea in business incubator.

The clients at TECHNOPARK assigned the lowest priority to the following:

- increase number of volunteers (2.0),
- increase number of faculty (2.33), and
- increase number of students (2.33).

The clients at the CAN-BE business incubator center already receive extensive help from volunteers, as well as from Penn State faculty and students. However, the highest priority is still assigned to further increase those services.

The client companies at TECHNOPARK business incubator center receives very limited help from volunteers, faculty, and students; they assigned a low priority to those resources. The reason for that may be the lack of exposure and lack of understanding of those extremely valuable services.

Companies at TECHNOPARK assigned the highest priority to tax free status as well as financial benefits for creating new jobs. Companies in Pennsylvania like CAN-BE already have that advantage. The engineering and legal assistance in protecting intellectual property is a high priority to companies in Hazleton and Gliwice.

When the client companies at the business incubator centers were asked open-ended questions regarding the assistance they received during the incubation stage, the responses were as follows:

Most helpful (TECHNOPARK)

- "Office and manufacturing space"
- "Close proximity to the university"
- "Lower than market value rent for office space"
- "Help with professional market analysis"
- "Networking meetings"
- "All forms of assistance was very helpful"

Needing improvement (TECHNOPARK)

- "More networking meetings"
- "Faculty from Silesian University of Technology should be more involved and provide their expertise to the client companies on an ongoing basis"
- "They should be more involved in individual projects"

Most helpful (CAN-BE)

- "Students and faculty from Penn State Hazleton"
- "Assistance provided by volunteers"
- "Low cost of office and manufacturing space"
- "Help with market analysis"
- "Convenient location"
- "Modern facilities"

Needing improvement (CAN-BE)

- "Increased opportunity for commercial loans"
- "More networking"
- "More professional training"

The open-ended comments are not necessarily in line with the results of the surveys. Open-ended comments usually represent the opinion or point of view of a company. However, there is a suggestion that is consistent for CAN-BE and TECHNOPARK: "More networking". Networking can be a very important factor contributing to success. It should be taken under consideration in proposing a model for a business incubator center.

To determine the potential benefits to volunteers, faculty, and students from cooperation with the business incubator center a survey was administered. The same survey was conducted among volunteers, faculty, and students at both business incubator centers: CAN-BE in Hazleton and TECHNOPARK in Gliwice. The summaries of the survey results are shown in Table 3.

The graphical representation of the data assessing the potential benefits for faculty, students, and volunteers as a result of their cooperation with the business incubator centers is shown in Figure 3.

By analyzing the results of the survey listed in Table 3, it became obvious that the most important reasons in providing services to the business incubator center are as follows:

- self-satisfaction (7.08–8.50),
- gaining professional experience (6.16–8.68), and
- establishing professional contacts (6.66–8.56).

The least important reasons in providing services to a business incubator center are as follows:

- additional income (2.31–4.90) and
- obtaining full-time employment (3.25–4.33).

The three factors listed above were chosen as the most important benefits volunteers, faculty, and students are expecting from cooperating with the business incubator center.

This was true for both business incubator centers, CAN-BE, in Hazleton and TECHNOPARK, in Gliwice. The fourth and fifth factors was chosen as addition income and possibility of full-time employment.

The volunteer, faculty, and student surveys were conducted together for the purpose of identifying the reasons (and motivating factors) to be involved in providing support for client companies in the business incubator centers. The discrepancy for the results between CAN-BE and TECHNOPARK can be due to the larger number of volunteers at CAN-BE. The results for CAN-BE put more emphasis on self-satisfaction, gaining professional experience, and establishing professional contacts. The

volunteers are more likely to seek those benefits. The expectation for extra compensation or possibility for full-time employment was more visible at TECHNOPARK. Students would probably be more attracted to seeking those values.

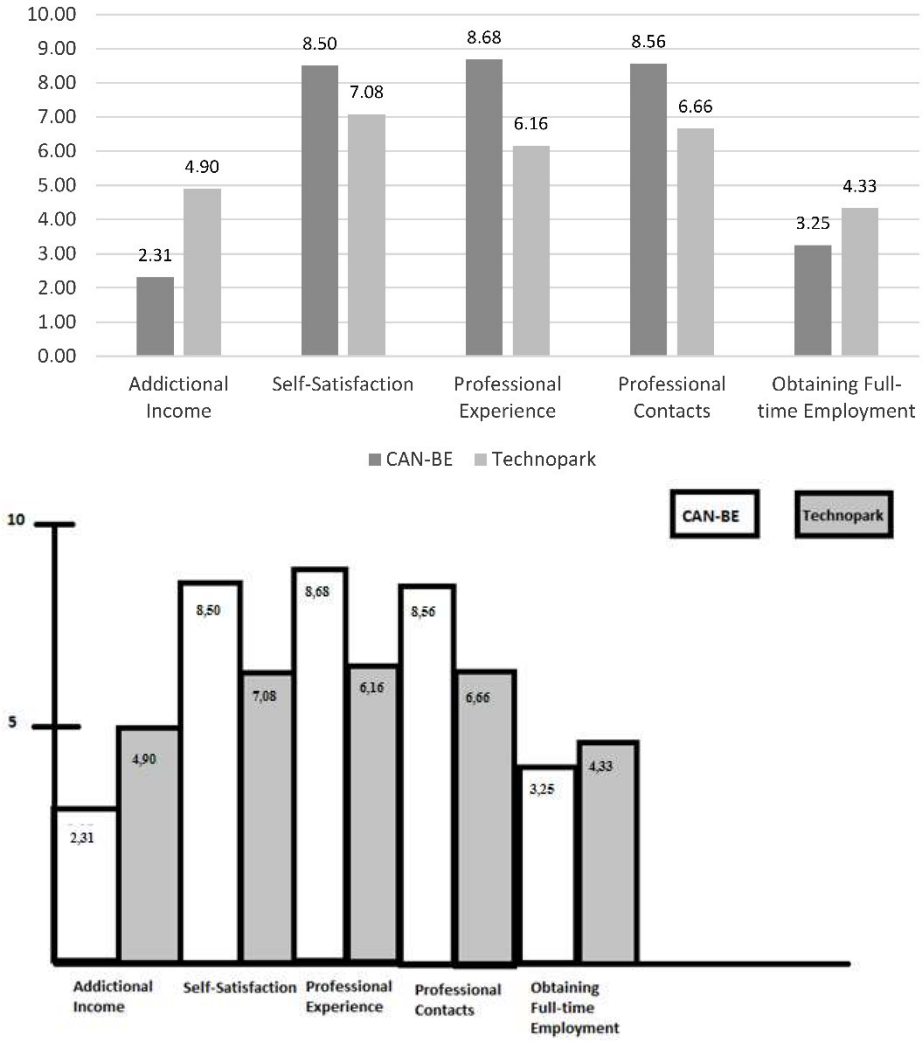

Figure 3. Assessment of importance of potential benefits from cooperating with business incubator.

The main scientific aim of the paper was to build a model of components that should be analyzed in the three incubation stages. In the following part of the paper, we complete the principle component analysis and prepare three models for three incubation stages.

To reduce the number of assessment results, a principle component analysis was done for both business incubator centers, CAN-BE and TECHNOPARK. Figure 4 shows the principle component analysis for the beginning period (before the incubation stage). There were two components: C_1 and C_2.

Assuming that both components, C_1 and C_2, are equally important ($W_1 = W_2 = 0.5$); the final assessment of support which was received before the incubation stage was calculated as follows:

$$C_{BI} = C_1 W_1 + C_2 W_2 \quad (1)$$

For CAN-BE and TECHNOPARK, the calculated assessment numbers are as follows:

- CAN-BE: $C_{BI} = 9.25$ (92.5% satisfaction)
- TECHNOPARK: $C_{BI} = 6.83$ (68.3% satisfaction)

The difference between the satisfaction rate between CAN-BE and TECHNOPARK is relatively close. The satisfaction with services at CAN-BE is slightly higher probably because the clients at CAN-BE received more extensive help in the development of a business plan.

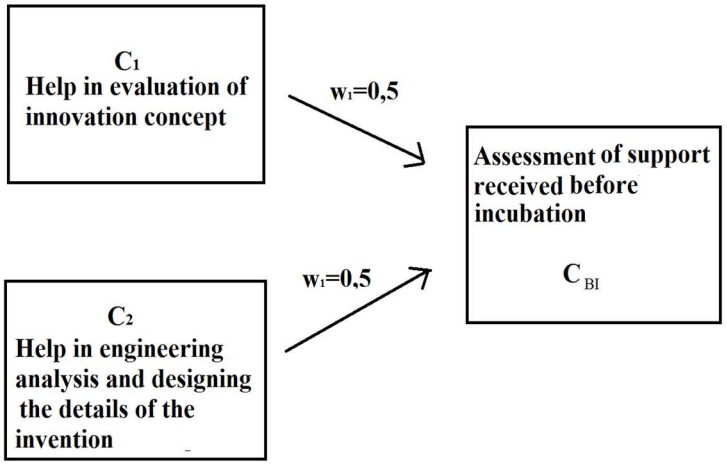

Figure 4. Principle component analysis before incubation stage.

The principle component analysis was also conducted for the assessment results during the incubation stage as shown in Figure 5.

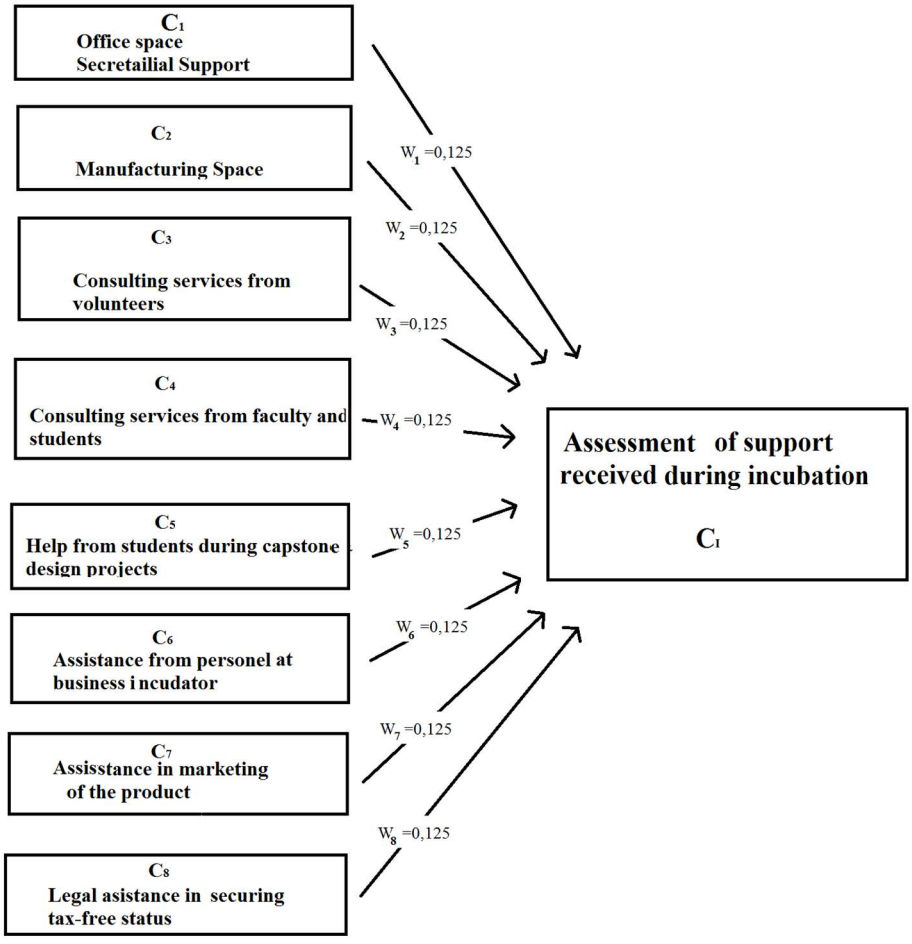

Figure 5. Principle component analysis for incubation stage.

There were eight different assessment components for CAN-BE and TECHNOPARK. (Only the assessments of the services available at both incubators were taken into consideration.) Assuming all eight components to be equally important ($W_1 = W_2 = W_3 = W_4 = W_5 = W_6 = W_7 = W_8 = 0.125$), the combined assessment value for the incubation period was calculated as follows:

$$C_I = \sum_{i=1}^{8} C_i W_i \quad (2)$$

For CAN-BE and TECHNOPARK, the calculated assessment numbers are as follows:

- CAN-BE: $C_I = 7.186$ (71.86% satisfaction)
- TECHNOPARK: $C_I = 2.357$ (23.57% satisfaction)

There is significant discrepancy between the level of satisfaction at CAN-BE and TECHNOPARK. The difference is probably due to the larger number of volunteers, faculty, and students providing services at CAN-BE as compared to TECHNOPARK. The principle component analysis for assessment results for the post-incubation stage is shown in Figure 6.

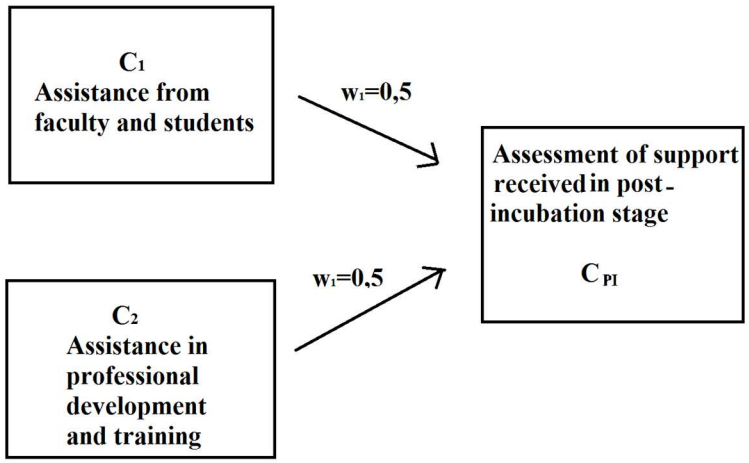

Figure 6. Principle component analysis for post-incubation stage.

There were only two components, C_1 and C_2, taken under consideration for principle component analysis. The results of the assessments for the post-incubation stage are shown in Table 3. Only the assessment of services which were available at both incubators during the post-incubation stage were taken under consideration. CAN-BE offered a wider variety of services during the post-incubation stage than TECHNOPARK. There were only two services that were available at both incubators. Assuming both components, C_1 and C_2 are equal ($W_1 = W_2 = 0.5$), the combined assessment value for the incubation period was calculated as follows:

$$C_{PI} = C_1 W_1 + C_2 W_2 \quad (3)$$

For CAN-BE and TECHNOPARK, the calculated assessment number is as follows:

- CAN-BE: $C_{PI} = 7.62$ (76.2% satisfaction)
- TECHNOPARK: $C_{PI} = 1.63$ (16.3% satisfaction)

There is a significant discrepancy between the level of satisfaction with the services received at both incubators during the post-incubation stage. The services provided to companies during the post-incubation stage is limited in comparison to services received during the incubation stage. However, CAN-BE provides more services in the post-incubation stage as compared with TECHNOPARK. This is probably the reason why the satisfaction level at CAN-BE is higher.

5. Conclusions

This study focused on two business incubator centers: CAN-BE in Hazleton, PA, USA and TECHNOPARK in Gliwice, Poland. Both centers provide a wide variety of services to client companies in the pre-incubation, incubation, and post-incubation stages. In this paper, we realized the main goal of the research was to prepare models of components that should be analyzed on three incubation stages. The model is presented on three figures: Figure 4 (pre-incubation stage), Figure 5 (incubation stage), and Figure 6 (post-incubation stage). In each figure we presented components of each model.

The importance of our analysis is based mainly on the competition of incubator centers in developed and developing countries, which is a rare type of research [27]. Mainly authors concentrate on developed or developing countries [1–25].

Clients are generally satisfied with the service that they receive from business incubators. Some services are not offered at both incubators to the same extent. That created some discrepancy in the assessment results.

A summary of suggestions proposed by client companies related to the improvement of the quality of services provided by the business incubator centers are as follow.

The clients at CAN-BE assigned the highest priority to the following:

- to increase the number of students and faculty providing services to the companies,
- to increase the financial benefits for creating new jobs,
- to increase legal help in protecting intellectual property,
- to increase the number of volunteers, and
- to increase engineering assistance.

The client companies at the business incubator center at TECHNOPARK assigned the highest priority to the following:

- to incorporate tax-free status for new companies,
- to increase financial benefits for creating new jobs,
- to increase help in business management and accounting,
- to increase engineering help, and
- to improve legal assistance (intellectual property, taxes, etc.).

The clients at the CAN-BE business incubator center had already received extensive help from volunteers, as well as Penn State faculty and students. However, the highest priority is still assigned to further increasing those services.

The client companies at TECHNOPARK business incubator center receive very limited help from volunteers, faculty, and students. At the same time, they assigned a low priority to those resources. The reason for that may be the lack of exposure and lack of understanding of those extremely valuable services.

The problems of TECHNOPARK (taxes, creation of new jobs, and engaging students) are similar to other results from developing countries [2,3,6,16,20,59]. The specific problem of polish incubator center is a problem with volunteers. This result and the indication of this problem's importance is because of our research. It is a specific problem that exists within Poland and also other post-communist countries. For many years, this solution was not used and it is difficult to convince potential volunteers (students, retirees, etc.) that this activity is worthwhile and could be beneficial.

Another specific problem observed in TECHNOPARK is connected with the concentration of business center activity almost exclusvley on the pre-incubation and incubation stage, erstwhile neglecting the post-incubation stage. In the CAN-BE business incubator center, they concentrated equally on all three phases. It could be the problem in TECHNOPARK because many firms need help longer and achieving this help may be beneficial to them and to all of society, when the particular organization grows.

Companies at TECHNOPARK assigned the highest priority to tax free status as well as financial benefits for creating new jobs. Companies in Pennsylvania like CAN-BE already have that advantage. The engineering and legal assistance in protecting intellectual property is a high priority to companies in Hazleton and Gliwice.

The analysis made it possible to compare how incubators operate in a developed country like the USA and a developing country like Poland. An important element of the analysis was to show how the expectations of TECHNOPARK and CAN-BE customers are problems that occur in the daily functioning of other incubators. Earlier studies [1–25] analyzed differences in incubator functionality across the world, whereas in this study, the research was conducted from the client's point of view and expectations both in developed and developing countries. It also indicates what actions should be taken both in TECHNOPARK (Poland) and CAN-BE (USA) in order to improve incubator functioning.

The limitations of this paper are connected with the range of the research. We analyzed only one incubator center form a developed country and one from a developing country. Thus, this is not a strict quantitative analysis but a mixed qualitative–quantitative analysis. To achieve better results in the future, we can broaden the range of the research and analyze more incubator centers. Further, in the future it will be worthwhile to compare incubator centers from more countries. Due to access to data, however, this is possible only with the aid of a big international scientific group. Moreover, it is possible to do meta-analysis of existing international research, but our literature analysis showed that it is difficult because of the lack of compatibility of existing researches.

Previous research and analysis of business incubators focused on how the incubator functions as a beneficiary and how they are financed. In this previous research conducted in various countries, including the USA and Korea [10–25,60], it was noticed that in the functioning of incubators, it is important that they are supported by local businesses and entrepreneurs, entities who impact the development of new technologies. Conducted research in Ireland has made it possible to indicate that resources accumulated in incubators are important for the development of enterprises. Research conducted in Germany showed that incubators should define services in accordance with their specificity and objectives.

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