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INVESTING IN INDUSTRIAL-TECHNOLOGY PARKS IN CITY DEVELOPMENT - A COST-BENEFIT ANALYSIS

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Abstract

Cities are growing both quantitatively and qualitatively. The quantitative development of a city can be identified with the spatial expansion and changes in the function of certain areas. The city's development, therefore, requires the reconstruction of the spatial layout, but also needs certain capital expenditures, as exemplified by industrial-technology parks (ITPs). ITPs are a combination of the infrastructure function and performance which enable the exchange of information between scientific organizations and entrepreneurs. They are, therefore, a pro-development component of the urban development strategy. The aim of the study is to identify and quantify selected costs and benefits, as well as estimate the effectiveness of establishing certain parks from the point of view of local government units.

Industry parks and technology parks are diverse entities. Their general characteristics and types, based on a review of domestic and foreign literature, are presented in the first part of the work justifying the study. The second part introduces the industrial-technology parks which are present in Poland. In the third part of the study, the specificity of assessing the effectiveness of an industrial-technology park is described. Finally, the fourth part includes an analysis of investing in selected industrial-technology parks; the analysis consists of three phases: the identification of industrial and technological parks, the verification of the industrial-technology park with the legal and practical definition, and cost-benefit analysis. According to the Polish Agency of Information and Foreign Investment (PAIiIZ), industrial-technology parks focus primarily on filling the space with commercially efficient companies using modern technologies, attracting investment and creating jobs. All of these factors are taken into account in the analysis. The analysis is carried out according to the methodology of cost-benefit analysis (CBA) of investment projects.

Despite the diversity and dynamics of the structural features of the parks, the analysis confirms that the investment of public funds in industrial and technological parks is generally efficient in terms of socio-economic development.

Key words: *city development, industrial-technology parks, cost-benefit analysis.*

JEL Classification: D61, D62, H43, H54, O18, O22.

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1. Introduction – study justification, aim, methodology

The issue of development is broad and complex. It relates to the economic, spatial, social, and environmental sphere (MAŁECKA 2012, p. 225). The city grows quantitatively and qualitatively. The quantitative development of a city can be identified with spatial expansion and changes in the function of certain urban or suburban areas. The state of use of each area results from the interaction of the current socio-economic state and physical characteristics of the area. Some forms of use change into others, which are more desirable and more relevant to the needs arising from the current level of socio-economic development (OGRYZEK 2014, p. 9). The development of the town therefore requires not only the reconstruction of the spatial layout, but also specific capital investment.

Investments in the city are primarily expenditures on capital assets, including real estate. Gminas (municipalities) develop when investors create new resources - buildings and equipment, thereby increasing potential output, which leads to economic growth in the long run (SAMUELSON 1999, p. 215). New investment implies numerous benefits for the gminas: new jobs, new sources of tax revenue, an increase in attractiveness and prestige, and new technologies and management methods which appear along with foreign enterprises. Industry and technology parks (hereinafter referred to as parks) are examples of such investments. As a sign and indicator of progress, parks facilitate urban development. They are, therefore, a part of as well as the effect of pro-investment policies of gminas (municipalities), since the goal of both the municipalities' and the parks' policies is attracting new investors.

The parks themselves are diverse entities (GOWER el al. 1996; COLOMBO, DELMAESTRO 2002; HANSON et al. 2005; FUKUGAWA 2006; RATINHO, HENRIQUES 2010; KACZMARSKA, GIERULSKI 2012; RAGUZ et al. 2012; CUMMING, JOHAN 2013; AWAGN et al. 2013). They have different missions, objectives, functions, and forms of action and organization. They differ widely in terms of size and shape, as well as their location, which ranges from rural or suburban to urban areas. The parks contain primarily private sector companies, however, local government and university facilities can be located there too. The individual character of the parks results from the available growth factors, as well as the social, cultural, and economic determinants of the region. Regardless of the differences, the parks' basic task is to stimulate the growth of the local economy by supporting entrepreneurship, innovation and technology diffusion among entities functioning in the given park. This means that parks play an important role in increasing economic competitiveness (BIGLIARDI et al. 2006, pp. 490-1; SQUICCIARINI 2007, p. 45; PELLE et al. 2008, pp. 3-6; RAGUZ et al. 2012, p. 5). In practice, parks stand under different names: science park, technology park, research park, industry park, research and innovation center, business incubator center, and the like (LINK, SCOTT 2003, p. 1324; LINDELÖF, LÖFSTEN 2005, p. 1026). The concept referred to may thus cause confusion; therefore, the present paper concentrates on **industrial-technology parks (ITPs)** in Poland, which are a real estate complex combining the function of infrastructure along with operations enabling the exchange of information between science and business.

Justification of the second step of the research comes from the need to provide evidence on the parks' performance. There are three fundamental reasons to measure the parks' effectiveness (GOWER, HARRIS 1996, p. 24; BIGLIARDI et al. 2006; p. 490; MONCK, PETERS 2009, p. 2): assessment of options, accountability, and information on performance. Stakeholders need to evaluate their investment options. This means that they require a clear indication of investment effectiveness. Private investors rely on standard methods of measuring return on investment, while the public sector, which often financially supports the parks, must remain accountable, with spending remaining transparent. Parks are often the result of public–private partnerships; thus, there are likely to be many entities/shareholders (GOWER et al. 1996, p. 30; PHAN et al. 2005, p. 178) who express interest in the parks' performance. The success of these parks builds up the image of the region and, in consequence, attracts lessees and talented people, as well as facilitating the building of local support and networks. Moreover, performance assessment is essential in order for park managers and stakeholders to review the park's business model, especially in terms of any shortcomings. Finally, evidence of the parks' performance is also needed as some authors are critical of their effectiveness (COLOMBO, DELMAESTRO 2002, p. 1105; SIEGEL et al. 2003, pp. 13-67) and claim a rather moderate local impact (RATINHO, HENRIQUES 2010, p. 227).

Evaluations of individual science parks have been carried out in different countries across the world, at different levels of detail and depth (COLOMBO, DELMASTRO 2002; LINDELÖF, LÖFSTEN 2002a;

LINDELÖF, LÖFSTEN 2002b; Link, Scott 2003; HANSSON et al. 2005; LINK, SIEGEL 2005; PHAN et al. 2005; BIGLIARDI et al. 2006; FUKUGAWA 2006; SQUICCIARINI 2007; MONCK, PETERS 2009; KACZMARSKA, GIERULSKI 2012; AWANG et al. 2013). The need to develop a consistent approach to the assessment of performance and impact has also been recognized in various publications. SQUICCIARINI (2007, p. 46), MONCK and PETERS (2009, p. 17), and DĄBROWSKA (2011, p. 18) agree that, due to the characteristics of parks, it is necessary to design a distinct performance measurement system (PMS) which will reflect the requirements of different stakeholders and help to measure the multidimensional performance of parks. SRIMARI and others suggest (2011, p. 663) that societal and organizational context provides the clues for the appropriate design and use of a performance system, and emphasize transition from an operational to a strategic approach in order to ensure that performance measurement relates to and reflects an organizational strategy. TATICCHI and others (2008, p. 57) state that extensive studies have been carried out to investigate PMSs in large organizations, while there is a distinct lack of available research on small and medium enterprises as well as specialized organizations such as parks. Implementing the findings of the above-mentioned research, DĄBROWSKA (2011) proposed a comprehensive and multidimensional matrix of indicators based on the balanced scorecard approach (KAPLAN, NORTON 1992, pp. 71-79) to evaluate parks. Still, it does not include the local government perspective. The aim of this research is, therefore, to fill this gap and estimate the effectiveness of selected parks from the local government's point of view. According to the Polish Agency of Information and Foreign Investment (PAIiIZ), industry-technology parks are aimed primarily at filling the space with commercially efficient companies using modern technologies, attracting investment and creating jobs. These factors are taken into account in the analysis.

The research uses the following methods: analysis of literature, analysis and logical design. Research tools include, in particular: observations, questionnaires and interviews. The questionnaire covers chosen parks throughout Poland. Parks were selected according to the criterion of compliance with the legal definition and the availability of data. The main secondary sources are Polish and foreign publications, professional journals, reports, studies and data from the national statistical offices, legal regulations, documents and papers on the parks covered by the analysis. The survey research (e-mail questionnaire) and phone interviews are addressed to directors (general managers) of selected parks. Questionnaires include closed questions and generally refer to the period between 2004 - 2013. Respondents answer questions which aim to identify and quantify selected external benefits of the parks' performance. A cost-benefit analysis is applied.

2. Industrial-technology parks (ITPs) in Poland

In Poland, parks exist within the various forms of investment zones. An investment zone is relatively compact and set apart land intended for new investments. Industry, technology, and industrial-technology parks are examples of investment zones, managed and operationalized in program documents of various levels of local government (HUCULAK 2011, p. 26). The different types of zones and, consequently, parks, no matter if managed by units of gminas, the parks themselves, local and regional development agencies, industrial companies, or district offices (poviat starosty), focus on the same priority of attracting new investors (HUCULAK 2011, p. 30).

The concepts of an *industry park* and *technology park* have been separately defined in Polish legislation (Act of 20 March 2002 on Financial Support for Investments, hereinafter referred to as Act 2002). An *Industry park* is a set apart real estate complex, which includes at least one property where technical infrastructure after a restructured or liquidated company remains. Industrial parks are created on the basis of a civil contract with a unit of local government and create business possibilities, especially for small and medium-sized companies (Act 2002, Article 2.1.15). *A technology park*, on the other hand, is a group of separate buildings, including technical infrastructure, created in order to facilitate the exchange of knowledge and technology between scientific and business communities using modern technologies. The services offered to entrepreneurs include: consultancy in the establishment and development of enterprises, transfer of technology, converting the results of research and development into technological innovation, the creation of favorable business conditions by utilizing property and technical infrastructure on a contractual basis (Act 2002, Article 2.1.14).

Finally, the definition of an *industrial-technology park* was formulated by PAIiIZ. This is a group of separate buildings, together with the infrastructure remaining after restructured or liquidated companies, and other real estate connected with them, created with the participation of local authorities in order to enable economic activity on preferential terms, particularly for small and

medium-sized entrepreneurs (MATUSIAK 2011, pp. 111-114). The aim of an industrial-technology park is to fill the offered space with companies using modern technologies and create new jobs, which is to mitigate the effects of industrial restructuring. Undoubtedly, an industrial-technology park has features of both industry as well as technology parks.

The above definitions emphasize the technical and "incubative" nature of industrial-technological parks, while the international definition of *(science) parks*, which is shorter and more managerial, focuses on their purpose and effect, professionalism and cooperation. The definition according to the International Association of Science Parks (IASP) is: "a science park is an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated business and knowledge-based institutions" (IASP, accessed 2013-12-06). According to ISAP, the parks create new businesses, add value to companies, and create new knowledge-based jobs and, in consequence, promote the economic development and competitiveness of cities and regions. Both the "technical" and "managerial" concept are certainly reflected in practice.

Dynamic changes in the global economy have caused the evolution of parks. There are three generations of the development of park initiatives (HANSSON 2005, pp. 1047-8; BIGLIARDI et al. 2006, pp. 490-1; MATUSIAK 2011, p. 18-21). The parks of the first generation are for companies located within or close to universities and research institutions, in order to create the effect of a more commercial orientation of research. The offer of real estate includes specialized areas tailored to business needs based on new technologies. Their location near research entities is to reduce the gap between science and business by accelerating the processes of knowledge transfer and commercialization. Revenue from the infrastructure was to ensure the financial self-sufficiency of the park, and the dynamics of the business park were a sign of a modern university and region. Poznański Park Naukowo-Technologiczny is the first Polish park, established in 1995 within the framework of the statutory activity of the Foundation of the Economic University of Poznań. The second generation of parks are associated with the expanding of the idea of parks to include the wide availability of business-related services. The differentiation of the services led to the parks' specialization: ICT (Information and Communication Technology) parks (e.g. Małopolski Park Technologii Informacyjnych within the Krakowski Park Technologiczny), bio-parks (e.g. Gdański Park Naukowo–Technologiczny), or media-parks (e.g. MMC Brainville). Consequently, the services and facilities were adapted to the specific aims of the industry. Incubation programs and emphasis on the creation of new businesses, often in the context of the regional structural policy, were an important element of these parks. The concept behind third generation parks, on the other hand, is based on integration with the challenges faced by the development of cities and regions. They allow large post-industrial urban areas to be transformed into innovative and modern city districts. Parks are becoming the centers of specific cooperation networks and integrate regional innovation systems.

All Polish parks differ in terms of their structural characteristics (MATUSIAK 2010, p. 36, MAŻEWSKA, TÓRZ, 2012, p. 36), which also applies to industrial-technology parks. There are 63 identified parks, which are at different stages of development, in Poland. By the middle of 2012, more than 650 companies, which create 4,827 jobs, decided to rent out business facilities in the parks (MAŻEWSKA, TÓRZ, 2012, p. 36). The following requirements are taken into account in the selection of park residents: the innovative nature of the project, a realistic business plan and growth potential. The presented values are changing in most parks, practically from day to day. Polish parks are also diversified in terms of formal organization and legal structure. They operate as limited liability companies, joint-stock companies, public-private corporations, local government units, and university functional units. The typical shareholders of the most frequent limited liability and joint-stock companies are budgetary units of public administration, local authorities, large companies, research units and foundations. Administrative and public institutions are major shareholders (MAŻEWSKA, TÓRZ 2012, p. 28). In fact, parks are often established in cooperation with local authorities, i.e.: the city, gmina (municipality), poviat (county), or even voivodeship (province). As non-financial support of the local authority is not sufficient to launch and run the park, public sector subsidies explain much of their success (GOWER et al. 1996, p. 30). More than half of the investment expenditures in Polish parks were financed from European Union funds, while own contributions reached an average of 20% (MAŻEWSKA, TÓRZ 2012, p. 35). The management costs required an average annual budget of PLN 7.83 mln in 2011 (approximately 1.89 million euro). The level of self-financing at the current financial needs

is 53.3%. The remaining funds come from foreign grants and projects, national projects and other external sources. A decrease in revenues from rents paid by tenants has been recently observed. This may be due to the rotation of tenants and periodically lower rents. There has been also a significant reduction of income from the sale of "soft" services. These inflows have been replaced by European funds, which is, of course, a good sign, indicating that the parks have gained the skills to reach for such funding (MAŻEWSKA, TÓRZ 2012, pp. 35-36). The disadvantage of this situation is the resignation from payable activities.

3. The specificity of assessing the effectiveness of industrial-technology parks

3.1. Industrial-technology parks as public infrastructure projects

Infrastructure is defined as basic devices and service institutions necessary for the functioning of the economy and society. There are two types of infrastructure. Economic (or technical) infrastructure includes modes of transport, communications, energy, water, gas, and sewerage systems. Social infrastructure consists of devices (institutions) in education, science, health, culture, security, and law. The economic infrastructure enables the processes of production, trade and other forms of socio-economic activity. It meets the material needs of the people. Social infrastructure supports development organizationally and socially by fulfilling non-material needs, affecting economic development indirectly (KAMIŃSKA 1999, pp. 45-46). When infrastructure is effective and focused on meeting the needs of its users, it becomes a factor generating social prosperity as well as ensuring spatial links, creating opportunities for productive activity and generating jobs connected with designing, building and the exploitation of construction objects. Infrastructure has become an essential component of an efficient market economy.

Industrial-technology parks consist, among others, of roads and technical infrastructure. At the same time, due to their specific objectives and effects, they are public investments (DROBNIAK 2002, pp. 16-17). The public nature of such investments means that they are financed mainly by public funds as public projects. A public project is a set of actions characterized by attributes similar to those of a project in the classical sense, with the difference being that its initiators and coordinators are institutions of a public nature (DROBNIAK 2002, pp. 18-23). The role of the state, local authorities and the market when it comes to infrastructure has been discussed and is part of the dispute on the role of the state and the market in the economy (WĘGRZYN 2012, pp. 247-258), while public real estate management is, in itself, a complicated process (GROSS, ŹRÓBEK 2012, pp. 11-12; WOJEWNIK-FILIPKOWSKA, RYMARZAK 2013, pp. 16-29).

Public projects can be assessed in many different ways (DROBNIAK et al. 2008, pp. 36-39; WOJEWNIK-FILIPKOWSKA 2012, pp. 249-252). Evaluation methods include the financial evaluation of a project, the assessment of its environmental impact, and economic and social evaluation (using cost-benefit analysis, CBA). As external benefits (which are a characteristic of infrastructure) occur in the case of industrial-technology parks, cost-benefit analysis should be applied in their evaluation despite some limitations (DROBNIAK 2012, p. 63). The use of cost-benefit analysis to evaluate the projects stems from rational reasons, i.e. the occurrence of the defects of the market mechanism and defects in the mechanism of power in the economy (SAMUELSON, NORDHAUS, 1996, p. 233).

3.2. The essence cost-benefit analysis

Cost-benefit analysis is a conceptual framework for the appraisal of a public or private project to determine the value of the project from a social perspective. CBA differs from straightforward financial appraisal as it includes all gains (benefits) and losses (costs) to social agents. Social agents are corporations, the government, society and people. Despite having different goals, abilities and constrains, they are all affected by the project. Therefore, especially public sector organizations should be guided not only by the results of financial analyses, but should also take into account other results, i.e. both the external (social) costs and benefits which are included in the economic analysis (WOJEWNIK-FILIPKOWSKA, RYMARZAK 2013, p. 27). CBA has the same meaning as economic analysis. It reflects values which the society would be willing to pay for goods or services which are not sold on the commercial market. Such aspects are characteristic mainly of public sector services (*Guide*… 2008, pp. 244-5).

Economic analysis is, therefore, wider ranging than financial analysis. External effects may relate to the social (e.g. prevention of unemployment), economic (e.g. creation of conditions for local development), environmental (e.g. protection of natural resources), and fiscal spheres (e.g. setting the

tax burden for companies), as well as the infrastructure (e.g. increasing the availability of communication). Some of these results can be expressed in monetary values (e.g. the creation of new jobs in the service sector), while others cannot, or are much more difficult to (e.g. improving the living conditions of inhabitants). For this reason, the evaluation of the effectiveness of investment in infrastructure is presented in two parts: quantitative (for results expressed in monetary value) and qualitative (called descriptive, for unmeasurable results).

DROBNIAK (2002, pp. 109-115) divides CBA into several stages: defining a set of alternatives, determining the participants based on their benefits and costs, calculating effects and choosing indicators, quantitative prediction of the effects during the project life cycle, introducing monetary values for each type of effect, discounting of costs and benefits in order to obtain the net present value (NPV, also referred to as FNPV - which stands for financial net present value) and internal rate of return (IRR, also referred to as FRR - which stands for financial rate of return), calculating economic net present value (ENPV) and economic rate of return (ERR) for each of the alternatives, carrying out sensitivity analysis, and making a recommendation. The relation of economic and financial effectiveness enable a number of recommendations for the public project Presented in Table 1 to be made. Projects are qualified to different levels of indicated effectiveness based on the above mentioned methods of measuring return on investment, such as FNPV and/or FRR in terms of financial effectiveness, and respectively ENPV and/or ERR in terms of economic effectiveness. Generally, a low level of effectiveness means that the project's FNPV (ENPV) is below zero and FRR (ERR) is below the expected rate of return. Medium and high levels of effectiveness are the result of the investor's subjective decision. Decisions depend on the type and scale of the investment, which, among others, determine capital and operational expenses and finally impact public project recommendation.

Table 1

Public project recommendation

<table>
<tr><td rowspan="3">Financial effectiveness</td><td>High</td><td rowspan="2">Reject/modify</td><td rowspan="2">Modify/accept</td><td>Accept</td></tr>
<tr><td>Medium</td><td rowspan="2">Modify/accept</td></tr>
<tr><td>Low</td><td>Reject</td></tr>
<tr><td></td><td></td><td>Low</td><td>Medium</td><td>High</td></tr>
<tr><td></td><td></td><td colspan="3">Economic effectiveness</td></tr>
</table>

Source: based on DROBNIAK (2012, p. 72).

The economic analysis of industrial-technology parks should take into account the characteristics of aspects connected with industry and technology, such as: the dissemination of knowledge and business skills in companies, benefiting from the new infrastructure, the establishment or relocation of new businesses and associated jobs, reputational effects, the overall reduction of costs associated with start-up, and savings on transportation costs. The major external costs are associated with traffic congestion connected with the implementation of infrastructure development (*Guide*… 2008, pp. 125-129).

4. Analysis of the effectiveness of industrial-technology parks

4.1. Data and survey

The survey process consisted of three phases, i.e.: identifying industry and technology parks, verifying the compatibility of the parks with their legal and practical definition, and economic analysis. The list of parks has been developed on the basis of the Polish Agency of Information and Foreign Investment (PAIiIZ). For the purposes of identifying industrial-technology parks, common characteristics have been identified based on the study of literature and according to the previously mentioned definitions. These common characteristics include the following services:

1) assistance in the establishment and development of enterprises,
2) transfer of technology (including foreign direct investment),
3) cooperation with research units, converting the results of research and development into technological innovation,
4) creation of favorable business conditions,

According to the definition of an industry park, the offer should include land property for investment with technical infrastructure. Moreover, the park should be established with local authorities being a part of the civil contract. The above mentioned characteristics are the criteria based on which the parks were verified. An overview of this step of research has been presented in Table 2. The participation of local authorities has been specified in Table 3.

In terms of regions, park initiatives are implemented in all voivodeships, as illustrated in Figure 1. Most of the parks are located in the Śląskie voivodeship.

Mazowieckie, the voivodeship in which the Polish capital is located, should be regarded as being under special circumstances. Despite the fact that this is the country's largest concentration of potential innovation and scientific research, there is only one relatively small park in Płock. This can be perceived as a significant deficiency, considering that Mazowieckie Voivodeship is also not the best equipped in terms of other institutions supporting innovative growing companies and researchers (MAŻEWSKA, TÓRZ 2012, p. 27). On the other hand, as the most developed voivodeship, Mazowieckie may not need institutional support in the form of parks.

Table 2

Identification and verification of the industrial and technology parks with their definition

No.	Park	Location (voivodeship)	Service				land with technical infrastructure
			(a)	(b)	(c)	(d)	
1	AURO Business Park Gliwice	Gliwice (Śląskie)	no	yes	no	yes	yes
2	Bełchatowsko Kleszczowski Park Przemysłowo Technologiczny	Bełchatów (Łódzkie)	yes	yes	yes	yes	yes
3	Białogardzki Park Inwestycyjny INVEST-PARK	Białogard (Zachodniopomorskie)	yes	yes	yes	yes	yes
4	Białostocki Park Naukowo-Technologiczny	Białystok (Podlaskie)	yes	yes	yes	N/A	yes
5	Bielski Park Technologiczny Lotnictwa, Przedsiębiorczości i Innowacji	Kaniów (Śląskie)	N/A	yes	yes	N/A	yes
6	Bydgoski Park Przemysłowo-Technologiczny	Bydgoszcz (Kujawsko-Pomorskie)	yes	yes	yes	yes	yes
7	Bytomski Park Przemysłowy	Bytom (Śląskie)	yes	yes	yes	N/A	yes
8	Częstochowski Park Przemysłowy	Częstochowa (Śląskie)	yes	no	no	N/A	yes
9	Dolnośląski Park Technologiczny „T-Park"	Szczawno-Zdrój (Dolnośląskie)	yes	yes	yes	yes	yes
10	Elbląski Park Technologiczny	Elbląg (Warmińsko-Mazurskie)	yes	yes	yes	N/A	no
11	Eureka Technology Park	Poznań (Wielkopolskie)	yes	yes	yes	N/A	no
12	Euro-Centrum Park Naukowo-Technologiczny	Katowice (Śląskie)	no	N/A	N/A	N/A	no
13	Euro-Centrum Park Przemysłowy	Katowice (Śląskie)	yes	N/A	N/A	N/A	no
14	Gdański Park Naukowo-Technologiczny	Gdańsk (Pomorskie)	yes	yes	yes	yes	no
15	Goleniowski Park Przemysłowy	Goleniów (Zachodniopomorskie)	no	yes	no	yes	yes
16	Górnośląski Park Przemysłowy	Katowice (Śląskie)	no	yes	no	yes	no
17	Grudziądzki Park Przemysłowy	Grudziądz (Kujawsko-Pomorskie)	yes	N/A	no	yes	yes
18	Kaliski Inkubator Przedsiębiorczości	Kalisz (Wielkopolskie)	yes	yes	yes	yes	no
19	KGHM LETIA Legnicki Park Technologiczny	Legnica (Dolnośląskie)	yes	yes	yes	yes	yes
20	Kielecki Park Technologiczny	Kielce (Świętokrzyskie)	yes	yes	yes	yes	yes
21	Krakowski Park Technologiczny	Kraków (Małopolskie)	yes	yes	yes	yes	yes
22	Kutnowski Park Agro-Przemysłowy	Kutno (Łódzkie)	no	yes	no	yes	yes

23	Kwidzyński Park Przemysłowo-Technologiczny	Kwidzyn (Pomorskie)	yes	yes	yes	yes	yes
24	Lubuski Park Przemysłowo-Technologiczny	Zielona Góra (Lubuskie)	yes	yes	yes	yes	yes
25	Łódzki Regionalny Park Naukowo-Technologiczny	Łódź (Łódzkie)	yes	yes	yes	N/A	yes
26	Miejska Strefa Rozwoju Techno-Park w Ełku	Ełk (Warmińsko-Mazurskie)	yes	yes	yes	N/A	yes
27	Mielecki Park Przemysłowy	Mielec (Podkarpackie)	yes	yes	yes	yes	yes
28	MMC Brainville	Nowy Sącz (Małopolskie)	N/A	N/A	yes	no	no
29	Nickel Technology Park Poznań	Suchy Las (Wielkopolskie)	yes	N/A	yes	N/A	no
30	Noworudzki Park Przemysłowy	Nowa Ruda (Dolnośląskie)	yes	yes	yes	yes	yes
31	Opolski Park Naukowo-Technologiczny	Opole (Opolskie)	N/A	N/A	N/A	N/A	N/A
32	Park Lifescience Kraków	Kraków (Małopolskie)	yes	yes	yes	yes	no
33	Park Naukowo-Technologiczny "Technopark Gliwice"	Gliwice (Śląskie)	yes	yes	yes	N/A	no
34	Park Naukowo-Technologiczny Polska - Wschód	Suwałki (Podlaskie)	N/A	yes	yes	N/A	yes
35	Park Naukowo-Technologiczny Politechniki Koszalińskiej	Koszalin (Zachodniopomorskie)	yes	N/A	yes	N/A	no
36	Park Przemysłowo Technologiczny "Ekopark"	Piekary Śląskie (Śląskie)	yes	yes	N/A	yes	yes
37	Park Przemysłowo-Technologiczny "Maszynowa"	Gdańsk (Pomorskie)	yes	yes	yes	yes	yes
38	Park Przemysłowy Boruta Zgierz	Zgierz (Łódzkie)	N/A	yes	N/A	N/A	yes
39	Park Przemysłowy Bukowice	Bukowice (Dolnośląskie)	yes	yes	N/A	yes	yes
40	Park Przemysłowy Gminy Leżajsk	Leżajsk (Podkarpackie)	N/A	yes	N/A	yes	yes
41	Park Przemysłowy LUVENA	Luboń (Wielkopolskie)	yes	yes	yes	yes	no
42	Park Przemysłowy Nowoczesnych Technologii w Stargardzie Szczecińskim	Stargard Szczeciński (Zachodniopomorskie)	yes	N/A	N/A	yes	yes
43	Park Przemysłowy w Solcu Kujawskim	Solec Kujawski (Kujawsko-Pomorskie)	yes	yes	yes	yes	yes
44	Płocki Park Przemysłowo-Technologiczny	Płock (Mazowieckie)	yes	yes	yes	yes	yes
45	Podkarpacki Park Naukowo-Technologiczny AEROPOLIS	Rzeszów (Podkarpackie)	yes	yes	yes	yes	yes
46	Pomorski Park Naukowo-Technologiczny	Gdynia (Pomorskie)	yes	yes	yes	N/A	no
47	Poznański Park Naukowo-Technologiczny Fundacji Uniwersytetu im. A. Mickiewicza	Poznań (Wielkopolskie)	yes	yes	yes	N/A	no
48	Puławski Park Naukowo-Technologiczny	Puławy (Lubelskie)	yes	yes	yes	N/A	no
49	Puławski Park Przemysłowy	Puławy (Lubelskie)	N/A	yes	no	yes	yes
50	Rudzki Inkubator Przedsiębiorczości	Ruda Śląśka (Śląskie)	yes	N/A	N/A	N/A	no
51	Słupski Inkubator Technologiczny	Słupsk (Pomorskie)	yes	N/A	yes	yes	no
52	Sosnowiecki Park Naukowo-Technologiczny	Sosnowiec (Śląskie)	N/A	yes	N/A	N/A	no
53	Stargardzki Park Przemysłowy	Stargard Szczeciński (Zachodniopomorskie)	no	yes	no	yes	yes
54	Synergy Park	Gliwice (Śląskie)	no	yes	no	N/A	yes

55	Szczeciński Park Naukowo-Technologiczny	Szczecin (Zachodniopomorskie)	yes	yes	yes	N/A	no
56	Śląski Park Przemysłowy	Ruda Śląska (Śląskie)	yes	yes	yes	N/A	yes
57	Toruński Park Technologiczny	Toruń (Kujawsko-Pomorskie)	yes	yes	yes	N/A	yes
58	Turecki Inkubator Przedsiębiorczości	Turek (Wielkopolskie)	yes	yes	yes	N/A	no
59	Vistula Park	Świecie (Kujawsko-Pomorskie)	N/A	yes	N/A	yes	yes
60	Włocławska Strefa Rozwoju Gospodarczego - Park Przemysłowo-Technologiczny	Włocławek (Kujawsko-Pomorskie)	yes	yes	N/A	yes	yes
61	Wrocławski Park Przemysłowy	Wrocław (Dolnośląskie)	yes	yes	N/A	yes	yes
62	Zielony Park Przemysłowy w Tarnowie	Tarnów (Małopolskie)	N/A	yes	N/A	yes	yes
63	Żorski Park Przemysłowy	Żory (Śląskie)	yes	yes	yes	yes	yes

Legend: N/A – not available

Source: Own study.

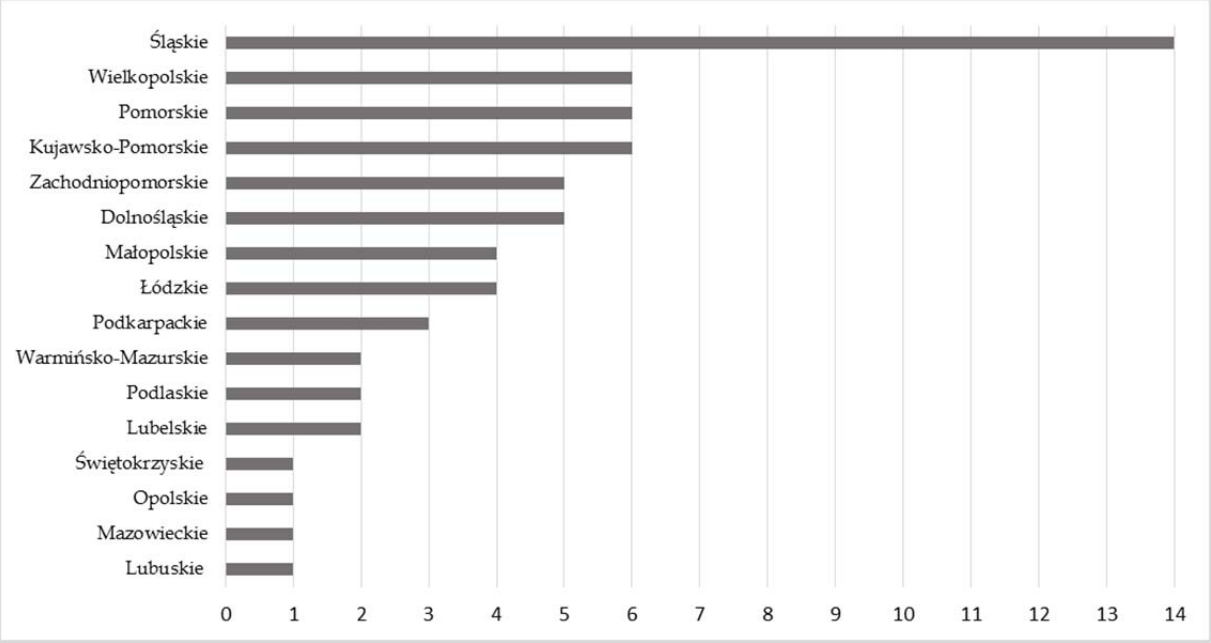

Fig. 1. Science parks in the individual voivodeships. *Source*: own study.

Table 3

The main characteristics and analysis assumptions of selected parks

No.	Park	Organizational form	Financing	Capital expenses for land (PLN thousand) [spending year]	Capital expenses for infrastructure, costs of documentation included (PLN thousand) [spending year]	Price (PLN thousand /ha)	Area with technical infrastructure for sale (ha)	OPEX (PLN thousand per year)	Management fee (PLN thousand /ha per year)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1	Bydgoski Park Przemysłowo-Technologiczny	Limited liability company	City of Bydgoszcz own resources (90%) and EU funds	195 650 [2007]	44 332.68 [2007]	800.00	279.50	480	13.50

2	Lubuski Park Przemysłowo-Technologiczny	Limited liability company	Own funds (province, municipality, city, local university, special investment zone), state budget, EU funds	33 050 [2010]	53 020 [2010]	810.00	123.80	12	20.00
3	Park Przemysłowo-Technologiczny "Maszynowa"	Limited liability company	Own resources (City of Gdańsk)	57 630 [2009]	1 920 [2009]; 20 000 [2010]	2 000.00	51.00	480	13.50
4	Park Przemysłowy w Solcu Kujawskim	Limited liability company	EU funds, own funds (Municipality)	18 150 [2004]; 9 300 [2012]	16 120 [2004]; 20 700 [2012]	980.00	67.30	285	13.50
5	Płocki Park Przemysłowo-Technologiczny	Joint-stock company	City of Płock, PKN Orlen, EU funds	78 000 [2006]	39 997.78 [2006]; 315 [2010]; 561 [2011]; 407 [2012]	775.00	130.00	480	13.50

Source: Own study.

Sixteen of the 63 identified parks (highlighted in Table 2) fulfil the criteria for classifying them as industrial-technology parks. Questionnaires were sent to their management boards. Other parks did not meet at least one of the five conditions or were not able to provide the necessary information. Due to the nature of the parks, and in consequence of difficulties or the inability to access data, as well as because of relatively small investment areas, the following parks were excluded:

- Kielecki Park Technologiczny – in a telephone interview, information on not meeting the criteria posed for the verification of parks was provided, despite the fact that different information had been gathered in indirect research;
- Krakowski Park Technologiczny – park belongs to a special economic zone and is managed on basis of contracts signed with the owners of the individual sites;
- Kwidzyński Park Przemysłowo-Technologiczny – is in the pre-development phase;
- Mielecki Park Przemysłowy – operates within the Local Development Agency;
- Żorski Park Przemysłowy – has a relatively small investment area of 3.6 hectares.

The questionnaire included questions about:

- the value of capital expenditures for land and infrastructure (CAPEX),
- the value of operating expenditures (OPEX) and the management fee,
- area with technical infrastructure for sale,
- area and price of sold area, as well as possible forecasts,
- number of created (current state) and forecasted workplaces.

Space was provided within the questionnaires in case the respondents wished to elaborate on their responses. Completed questionnaires were obtained from 5 parks, which have been listed along with their main characteristics and analysis assumptions in Table 3. The response rate was 31.25%. This compares favourably, given that the average response rates are approximately 20% for questionnaire surveys of this nature (OPPENHEIM 1992). Six other parks, despite telephone follow-up, did not respond.

4.2. Assumptions for analysis

The analysis of selected parks was based on data from the questionnaires, supplemented by data from the parks' official websites, payable reports and telephone interviews. Park Przemysłowo-Technologiczny "Maszynowa" was the most open to cooperation over the course of the research and presented the most detailed data. Therefore, detailed calculations were presented for this park (Table 6, Table 7). Thanks to the detailed information, this park also provided the base for detailed assumptions if other parks were unwilling to disclose the required information. This applies to the forecast of operating costs (parks No. 1 and 5 in Table 3) and management fees (parks No. 1, 4 and 5 in Table 3).

According to the CBA stages, financial analysis was performed during the first step. Financial analysis includes expenditures for land acquisition and its infrastructure (CAPEX), as well as operating costs, including costs of management (OPEX). There are revenues from the sale of developed areas and income from management fees - creating cash inflows. The detailed assumptions of financial analysis are:

- the period of analysis covers 20 years, starting in the year of initial capital expenses as indicated in Table 3 (column "d", initial year in brackets),
- financial discount rate was set at 5%,
- the analysis is based on fixed price,
- capital expenditures (Table 3, column "d" and "e"; Table 5 - CAPEX) include the values of land contributions of the public sector or land acquisition, and infrastructure expenses, as determined by the parks;
- the average price per m² (Table 3, column "f"; Table 5 – base as for calculations of inflow from sales) was determined by the parks (parks No. 2 and 4), when given as a range (park No. 3), the lower value was selected, or determined based on the market analysis conducted by authors (park No. 1 and 5),
- the areas with technical infrastructure for sale (Table 3, column "g") were determined by the parks, with detailed information about the sold areas and forecasted sales taken from the questionnaires (park No. 3) or PAZiZ (park No. 4); in the case of the other parks (No. 1, 2, 5), systematic (equal) future sales were assumed until the available area sold out at the end of the period under analysis, as the parks did not run such forecasts themselves; the inflow from sales is obtained by multiplying the price (base) and sales (sold area),
- operating costs (Table 3, column "h", Table 5 - OPEX) were constant at the level indicated in the questionnaires (parks No. 2, 3 and 4), while costs for parks which did not provide such information (parks No. 1 and 5) were calculated on the basis of "Maszynowa",
- rates of management fees (Table 3, column "i", Table 5 – base as for calculations of management fee) were constant at the level indicated in the questionnaires (parks No. 2 and 3), and in the absence of data, calculated on the basis of "Maszynowa" (for parks No. 1, 4 and 5); the management fee is calculated by multiplying the fee rate and cumulated sales.

According to PAIiIZ, industrial-technology parks focus primarily on filling the space with commercially efficient companies using modern technologies, attracting investment and creating jobs. These factors are the fundamental external benefits (gains) to third parties not directly involved in the implementation of the project (compared to directly engaged park residents) and are taken into account in economic analysis. Benefits might thus be defined as socio-economic gains to social agents (stakeholders) (DROBNIAK 2002; *Guide…* 2008). In this research, analysis of economic effectiveness takes into account the following benefits:

- benefits from new workplaces (individuals) during their operation, due to the time required for the organization and construction of the workplaces, occur two years after the sale of the plots (as projected in financial analysis); benefits were calculated by multiplying the base, which is the average salary in the industry and the average salary for administration and support services (50% share) (Table 4) and the number of new workplaces created (Table 6, (I)),
- the number of new workplaces created was based on questionnaires: parks No. 1 and No. 4 made projections up to the year 2020, while No. 2 and No. 5 – only until 2014; in the case of park No. 3, the respondent declared 10 new workplaces on every sold hectare two years after the sale, and this assumption was accepted in all cases beyond the projection period made by the parks;
- an additional stream of money for construction companies is considered during the construction of the facility; the additional income is assumed to be 15% of the investment expenditures (CAPEX) (Table 6, (II)(a)),
- an additional stream of money comes also from operating costs (OPEX), of which 25% is assumed as income (Table 6, (II)(b);
- revenues to local budgets from a share of personal tax (39.34%) and corporate tax (6.71%) have been included (Table 6, (III)(c),(d)); fiscal benefits from personal income tax were calculated by multiplying the benefit from a new workplace (I) by the tax rate (18%); fiscal benefits from

corporate income tax were calculated by multiplying the additional stream of money for companies (II) by the tax rate (19%).

The assumption of an additional stream of money at 15% of the investment expenditures and 25% of operating costs comes from author's similar analysis (WOJEWNIK-FILIPKOWSKA). Corporate tax benefits are calculated only in respect to companies (relating to CAPEX and OPEX) from outside the park, as companies from the park (park residents) might have favorable tax conditions or not pay income taxes due to high amortization reflecting investment. Average salaries for selected voivodeships, along with the national comparator, used to calculate the benefits from workplaces have been presented in Table 4.

Table 4

Average salary for selected provinces

No.	Unit	Park	Average salary (PLN/month)		Average salay for calculations (PLN thousand/year)
			Industry	Administration and support service	
	Poland		*3 600*	*2 462*	*36.38*
1	Kujawsko-Pomorskie	Bydgoski Park Przemysłowo-Technologiczny, Park Przemysłowy w Solcu Kujawskim	3 035	2 131	*30.99*
2	Lubuskie	Lubuski Park Przemysłowo-Technologiczny	3 125	2 016	*30.84*
3	Pomorskie	Park Przemysłowo-Technologiczny "Maszynowa"	3 506	2 470	*35.86*
4	Mazowieckie	Płocki Park Przemysłowo-Technologiczny	4 059	2 931	*41.94*

Source: own study based on data from the Central Statistical Office, www.stat.gov.pl.

The benefit from the creation of new workplaces is one of the main aims of creating parks, and the analysis considers the long-term benefits connected with new employment during the operation phase of the parks. Transfers connected with social insurance and VAT on the construction of infrastructure were not taken into account as they are the income of the state budget or other national units, whereas the analyses were performed from a local perspective. The social discount rate is 5%.

4.3. Cost-benefit analysis

The analysis was performed according to the methodology of the Guide to Cost-Benefit Analysis of Investment Projects (2008) and Drobniak's studies (2002, 2012). First, FNPV and FRR calculations were carried out, followed by ENPV and ERR. The detailed analysis for Park Przemysłowo-Technologiczny "Maszynowa" according to the above assumptions has been presented in tables 5 and 6. Other parks were analyzed in the same way.

Table 5

Financial analysis of Park Przemysłowo-Technologiczny "Maszynowa"

Item	*Base (PLN thousand/ha)*	2009	2010	2011	2012	2013	2014
Sales [ha]		0.00	3.00	19.10	2.50	2.00	7.80
Cumulated sales [ha]		0.00	3.00	22.10	24.60	26.60	34.40
Inflow from sales *(sales*base)*	*2 000.00*	0.00	6 000.00	38 200.00	5 000.00	4 000.00	15 600.00
Management fee *(base*cumulated sales)*	*13.50*	0.00	40.50	298.35	332.10	359.10	464.40
Total inflows *(sales+management fee)*		**0.00**	**6 040.50**	**38 498.35**	**5 332.10**	**4 359.10**	**16 064.40**
OPEX (*operational expences)*		**0.00**	**0.00**	**0.00**	**480.00**	**480.00**	**480.00**
Expenses for land		57 630.00	0.00	0.00	0.00	0.00	0.00
Expenses for infrastructure		1 920.00	20 000.00	0.00	0.00	0.00	0.00
CAPEX *(capital expences; land+infrastructure)*		**59 550.00**	**20 000.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total outflows *(OPEX+CAPEX)*		**59 550.00**	**20 000.00**	**0.00**	**480.00**	**480.00**	**480.00**
Net cash flow *(total inflows-total outflows)*		**-59 550.00**	**-13 959.50**	**38 498.35**	**4 852.10**	**3 879.10**	**15 584.40**
FNPV		3 591.18	5.00%	discount rate			
FRR		6.29%					

Item	2015	2016	2017	2018	2019	2020	2021
Sales [ha]	2.90	7.50	4.20	0.00	0.00	0.00	0.00
Cumulated sales [ha]	37.30	44.80	49.00	49.00	49.00	49.00	49.00
Inflow from sales *(sales*base)*	5 800.00	15 000.00	8 400.00	0.00	0.00	0.00	0.00
Management fee *(base*cumulated sales)*	503.55	604.80	661.50	661.50	661.50	661.50	661.50
Total inflows *(sales+management fee)*	**6 303.55**	**15 604.80**	**9 061.50**	**661.50**	**661.50**	**661.50**	**661.50**
OPEX (*operational expences)*	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**
Expenses for land	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Expenses for infrastructure	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAPEX *(lcapital expences; land+infrastructure)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total outflows *(OPEX+CAPEX)*	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**
Net cash flow *(total inflows-total outflows)*	**5 823.55**	**15 124.80**	**8 581.50**	**181.50**	**181.50**	**181.50**	**181.50**

Item	2022	2023	2024	2025	2026	2027	2028
Sales [ha]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cumulated sales [ha]	49.00	49.00	49.00	49.00	49.00	49.00	49.00
Inflow from sales *(sales*base)*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Management fee *(base*cumulated sales)*	661.50	661.50	661.50	661.50	661.50	661.50	661.50
Total inflows *(sales+management fee)*	**661.50**	**661.50**	**661.50**	**661.50**	**661.50**	**661.50**	**661.50**
OPEX (*operational expences)*	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**
Expenses for land	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Expenses for infrastructure	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAPEX *(lcapital expences; land+infrastructure)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total outflows *(OPEX+CAPEX)*	**480.00**	**480.00**	**480.00**	**480.00**	**480.00**	**480**	**480**
Net cash flow *(total inflows-total outflows)*	**181.50**	**181.50**	**181.50**	**181.50**	**181.50**	**182**	**182**

Source: own calculations.

Table 6

Economic analysis of Park Przemysłowo-Technologiczny "Maszynowa"

Item	*Base (PLN thousand)*	2009	2010	2011	2012	2013	2014
Net cash flows		**-59 550.00**	**-13 959.50**	**38 498.35**	**4 852.10**	**3 879.10**	**15 584.40**
Social-economic corrections *(I+II+III)*		**291.67**	**3 038.25**	**0.00**	**1 273.55**	**14 137.78**	**19 321.87**
(I) Benefit from the new workplaces *(number of new workplaces*base)*	**35.86**	0.00	0.00	0.00	**1 075.84**	**13 089.37**	**17 930.64**
Number of new workplaces		0.00	0.00	0.00	30.00	335.00	135.00
(II) Additional stream of money for companies *(a)+(b)*		**288.00**	**3 000.00**	**0.00**	**120.00**	**120.00**	**120.00**
(a) income as 15% investment expenditures	15.00%	288.00	3 000.00	0.00	0.00	0.00	0.00
(b) income as 25% operating costs	25.00%	0.00	0.00	0.00	120.00	120.00	120.00
(III) Fical benefits *(c)+(d)*		**3.67**	**38.25**	**0.00**	**77.71**	**928.41**	**1 271.23**
corporate income tax (CIT)	19.00%	54.72	570.00	0.00	22.80	22.80	22.80
(c) local government participation in CIT	6.71%	3.67	38.25	0.00	1.53	1.53	1.53
personal income tax	18.00%	0.00	0.00	0.00	193.65	2 356.09	3 227.52
(d) local government participation in PIT	39.34%	0.00	0.00	0.00	76.18	926.88	1 269.70
Corrected net cash flow *(net cash flow+social-economic corrections)*		**-59 258.33**	**-10 921.25**	**38 498.35**	**6 125.65**	**18 016.88**	**34 906.27**
ENPV		275 452.32	5.00%	discount rate			
ERR		31.33%					

Table 6 cont.

Item	2015	2016	2017	2018	2019	2020	2021
Net cash flows	**5 823.55**	**15 124.80**	**8 581.50**	**181.50**	**181.50**	**181.50**	**181.50**
Social-economic corrections *(I+II+III)*	**24 313.96**	**27 309.22**	**28 422.84**	**31 302.89**	**32 915.72**	**32 915.72**	**32 915.72**
(I) Benefit from the new workplaces *(number of new workplaces*base)*	**22 592.61**	**25 389.79**	**26 429.76**	**29 119.36**	**30 625.53**	**30 625.53**	**30 625.53**
Number of new workplaces	130.00	78.00	29.00	75.00	42.00	0.00	0.00
(II) Additional stream of money for companies *(a)+(b)*	**120.00**	**120.00**	**120.00**	**120.00**	**120.00**	**120.00**	**120.00**
(a) income as 15% investment expenditures	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) income as 25% operating costs	120.00	120.00	120.00	120.00	120.00	120.00	120.00
(III) Fical benefits *(c)+(d)*	**1 601.36**	**1 799.43**	**1 873.07**	**2 063.53**	**2 170.19**	**2 170.19**	**2 170.19**
corporate income tax (CIT)	22.80	22.80	22.80	22.80	22.80	22.80	22.80
(c) local government participation in CIT	1.53	1.53	1.53	1.53	1.53	1.53	1.53
personal income tax	4 066.67	4 570.16	4 757.36	5 241.48	5 512.60	5 512.60	5 512.60
(d) local government participation in PIT	1 599.83	1 797.90	1 871.54	2 062.00	2 168.66	2 168.66	2 168.66
Corrected net cash flow *(net cash flow+social-economic corrections)*	**30 137.51**	**42 434.02**	**37 004.34**	**31 484.39**	**33 097.22**	**33 097.22**	**33 097.22**

Table 6 cont.

Item	2022	2023	2024	2025	2026	2027	2028
Net cash flows	**181.50**	**181.50**	**181.50**	**181.50**	**181.50**	**181.50**	**181.50**
Social-economic corrections *(I+II+III)*	**32 915.72**	**32 915.72**	**32 915.72**	**32 915.72**	**32 915.72**	**32 915.72**	**32 915.72**
(I) Benefit from the new workplaces *(number of new workplaces*base)*	**30 625.53**	**30 625.53**	**30 625.53**	**30 625.53**	**30 625.53**	**30 625.53**	**30 625.53**
Number of new workplaces	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(II) Additional stream of money for companies *(a)+(b)*	**120.00**	**120.00**	**120.00**	**120.00**	**120.00**	**120.00**	**120.00**
(a) income as 15% investment expenditures	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(b) income as 25% operating costs	120.00	120.00	120.00	120.00	120.00	120.00	120.00
(III) Fical benefits *(c)+(d)*	**2 170.19**	**2 170.19**	**2 170.19**	**2 170.19**	**2 170.19**	**2 170.19**	**2 170.19**
corporate income tax (CIT)	22.80	22.80	22.80	22.80	22.80	22.80	22.80
(c) local government participation in CIT	1.53	1.53	1.53	1.53	1.53	1.53	1.53
personal income tax	5 512.60	5 512.60	5 512.60	5 512.60	5 512.60	5 512.60	5 512.60
(d) local government participation in PIT	2 168.66	2 168.66	2 168.66	2 168.66	2 168.66	2 168.66	2 168.66
Corrected net cash flow *(net cash flow+social-economic corrections)*	**33 097.22**	**33 097.22**	**33 097.22**	**33 097.22**	**33 097.22**	**33 097.22**	**33 097.22**

Source: own calculations.

The results of the financial and economic analysis for the five selected parks have been presented in Table 7.

Based on these assumptions, from the point of view of financial analysis, only investment in parks No. 3 and No. 4 is effective. One of the reasons behind this might be that the value of the parcel contribution of the public sector was included in the financial analysis while in Drobniak's analysis, it is treated as sunk costs and appears on the cost side but only in economic analysis (2012, p. 77). The performed financial analysis is consistent with the rule of the alternative cost of capital, which requires the value of assets already possessed to be included in the expenses (SZCZEPANIAK 2011, pp.

89-90). The second reason behind poor financial effectiveness is the relatively slow process of commercialization (sale or rent). Economic effectiveness confirms the benefits of all of the analyzed parks to the local authority (city, gmina). Taking into account the additional workplaces during the 20-year operational period, an additional stream of money, and related taxes which will contribute to the local budget, all the analyzed parks bring a quantifiable benefit. At the same time, parks attract investors and cooperate with local scientific research centers, thus resulting in qualitative, but also quantitative benefits. The number of scientific cooperators is based on the organization as a whole, while the actual cooperation may relate to several units within a given organization (such as the departments or institutes of a cooperating university).

Table 7

Financial and economic effectiveness of selected parks (FNPV and ENPV in PLN thousand)

No.	Park	FNPV	FRR	ENPV	ERR	Total number of workplaces on the basis of predictions for 20-year period of operation	Number of residents (companies) (as for 2013)	Number of scientific cooperators (organizations) (as for 2013)
1	Bydgoski Park Przemysłowo-Technologiczny	- 82 684	0.49%	755 786	22.55%	3 600	51	2
2	Lubuski Park Przemysłowo-Technologiczny	- 4 577	4.36%	233 223	19.81%	1 337	2	2
3	Park Przemysłowo-Technologiczny "Maszynowa"	3 591	6.29%	275 452	31.33%	854	10	2
4	Park Przemysłowy w Solcu Kujawskim	1 307	6.10%	324 004	75.67%	1 200	16	1
5	Płocki Park Przemysłowo-Technologiczny	- 63 732	-1.04%	191 693	13.57%	1 396	13	2

Source: Own study.

4. Conclusions

Parks are created in various parts of the world. They are the most comprehensive as well as organizationally and conceptually developed types of innovation and entrepreneurship centers and, therefore, are considered to be synonymous to a knowledge-based economy. Undoubtedly, they support and are sign of local development. Looking at the selected data on municipalities where the analyzed parks are located (tables 8 and 9), it seems that the municipalities of Gdańsk and Solec Kujawski, the homes of financially effective parks (No. 3 and No. 4, respectively), have the greatest share of income from assets in their total income (respectively 10.07% and 17.05%). More importantly, however, both of these local units also have the highest share of capital investment in the total outcome (respectively 38.22% and 41.65%). Similar observations can be made when data is analyzed per capita. Income from assets for Gdańsk is PLN 322 per capita, and PLN 427 per capita for Solec Kujawski. Capital investment per capita is respectively PLN 2,466 and PLN 1,948. The population of Gdańsk and Solec Kujawski is 460,427 and 16,805 inhabitants, respectively. This considered, it is difficult to agree that a pro-investment policy and the actions of local authorities play an important role only in smaller communities (e.g. Solec Kujawski), while in metropolitan areas (e.g. Gdańsk) pro-investment policy is less important.

Table 8

Selected data on municipalities where the analyzed parks are located

No.	Unit (park no,)	Total income	Personal income tax		Corporate tax		Income from assets		Income from rent and lease of assets and other similar contracts		Total outcome	Capital investment	
		(pln)	(pln)	(%)	(pln)	(%)	(pln)	(%)	(pln)	(%)	(pln)	(pln)	(%)
1	Bydgoszcz (1)	832 606 020	332 735 527	39.96%	27 577 135	3.31%	41 547 123	4.99%	8 917 051	1.07%	1 464 775 785	257 919 601	17.61%
2	Zielona Góra (2)	272 231 010	127 633 278	46.88%	9 003 438	3.31%	14 786 300	5.43%	6 336 680	2.33%	513 175 186	61 190 567	11.92%
3	Gdańsk (3)	1 470 196 583	525 718 302	35.76%	44 995 871	3.06%	148 079 224	10.07%	31 892 742	2.17%	2 970 739 641	1 135 399 074	38.22%
4	Solec Kujawski (4)	42 123 498	10 486 930	24.90%	453 536	1.08%	7 182 707	17.05%	3 564 490	8.46%	78 606 371	32 735 812	41.65%
5	Płock (5)	467 791 964	137 555 973	29.41%	74 710 037	15.97%	13 844 073	2.96%	2 783 138	0.59%	769 457 619	124 423 847	16.17%

Source: own study based on data from the Central Statistical Office, www.stat.gov.pl.

Table 9

Selected data on municipalities where the analyzed parks are located (per capita)

No.	Unit (park no.)	Total income	Personal income tax	Corporate tax	Income from assets	Income from rent and lease of assets and other similar contracts	Total outcome	Capital investment
		(pln)	(pln)	(pln)	(pln)	(pln)	(pln)	(pln)
1	Bydgoszcz (1)	2 305	921	76	115	25	4 055	714
2	Zielona Góra (2)	2 287	1 072	76	124	53	4 312	514
3	Gdańsk (3)	3 193	1 142	98	322	69	6 452	2 466
4	Solec Kujawski (4)	2 507	624	27	427	212	4 678	1 948
5	Płock (5)	3 784	1 113	604	112	23	6 224	1 006

Source: own study based on data from the Central Statistical Office, www.stat.gov.pl.

Evaluating the performance of science parks has become very important to their stakeholders, however it appears that due to the various outcomes of the parks, it is difficult to achieve homogeneity in these evaluations. The present research provides interesting results. The proposed methodology can rationalize costs associated with the planning and establishment of industrial-technology parks as public projects, and provide rationalization for the decision on the allocation of public funds. Rationalization based on selected benefits (employment and taxes) is both a limitation as well as an advantage of the present research based on these unquestionable factors. Other limitations of this research are essentially the small number of cases and the narrow typological context (industrial-technology parks). Still, it seems that all the parks are suitable for confirming the proposed approach, as selected benefits can be generalized to all types of science parks offering work space and creating new places of work.

The effectiveness of selected parks in financial and economic terms is characterized by different levels. It can be expected that, due to their low financial viability, operational activities of the parks will require financial support. At the same time, economic efficiency is at a medium level, despite quantifying only the key benefits.

5. References

AWANG A. H., HUSSAIN M. Y., MALEK J. A., 2013, *Knowledge Transfer and the Tole of Local Absorptive Capability at Science and Technology Parks*, Learning Organization, Vol. 20, Issue 4/5, pp. 291 – 307.

BIGLIARDI B., DORMIO A. I., NOSELLA A., PETRONI G., 2006, *Assessing Science Parks' Performances: Directions from Selected Italian Case Studies*, Technovation, Vol. 26, Issue 4, pp. 489-505.

COLOMBO M., DELMASTRO M., 2002, *How Effective are Technology Incubators? Evidence from Italy*, Research Policy, 31, pp. 1103-1122.

CUMMING D., JOHAN S., 2013, *Technology Parks and Entrepreneurial Outcomes Around the World*, International Journal of Managerial Finance, Vol. 9, Issue 4, pp. 279 – 293.

DĄBROWSKA J., 2011, *Measuring the Success of Science Parks: Performance Monitoring and Evaluation*, XXVIII IASP World Conference on Science and Technology Parks, http://portal.pmf.sc.gov.br/arquivos/arquivos/pdf/08_07_2011_16.28.06.346a693b4baaca30ad620164d8186c1d.pdf, pp. 1-23 (accessed 2014-01-06).

DROBNIAK A., 2002, *Zastosowanie analizy kosztów i korzyści w ocenie projektów publicznych (The Use of Cost-Benefit Analysis in the Evaluation of Public Projects)*, Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice.

DROBNIAK A., 2012, *Efektywność i skuteczność projektów publicznych – koncepcje i przykłady oceny projektów miejskich (Effectiveness and Efficiency of Public Projects - Ideas and Examples of Assessing Urban Projects)*, in: Ewaluacja i audyt w projektach, organizacjach i politykach publicznych, J. Kołodziejczyk (ed.), Instytut Spraw Publicznych Uniwersytetu Jagiellońskiego w Krakowie, Kraków, pp. 59-84.

DROBNIAK A., CZORNIK M., GIBAS P., 2008, *Ewaluacja programów rozwoju regionalnego. Weryfikacja metod oceny (Evaluation of Regional Development Programs. Verification of Methods of Assessment)*, in: Monitorowanie rozwoju regionu – wymiar społeczny, gospodarczy i środowiskowy. Tom 1. Wyd. Politechniki Opolskiej, Opole, pp. 32-44.

FUKUGAWA N., 2006, *Science Parks in Japan and Their Value-Added Contributions to New Technology-Based Firms*, International Journal of Industrial Organization, Vol. 24, Issue 2, March, pp. 381-400.

GOWER S. M., HARRIS F. C., COOPER P. A., 1996, *Assessing the Management of Science Parks in the UK*, Property Management, Vol. 14 Issue 1, pp. 30 – 38.

GOWER S., HARRIS F., 1996, *Evaluating British Science Parks as Property Investment Opportunities*, Journal of Property Valuation and Investment, Vol. 14 Issue 2, pp. 24 – 37.

GROSS M., ŹRÓBEK R., 2013, *Public Real Estate Management in Post-Socialist Countries*, Real Estate Management and Valuation, Vol. 21, No. 4, pp. 11-16.

Guide to Cost-Benefit Analysis of Investment Projects, 2008, Directorate General Regional Policy, European Commission.

HANSSON F., HUSTED K., VESTERGAARD J., 2005, *Second Generation Science Parks: From Structural Holes Jockeys to Social Capital Catalysts of the Knowledge Society*, Technovation, Vol. 25, Issue 9, pp. 1039-1049.

HUCULAK M., 2011, *Strefy inwestycyjne i obszary aktywności gospodarczej w Polsce (Investment Zones and Areas of Economic Activity in Poland)*, in: Sukces polityki proinwestycyjnej NIEPOŁOMICE 1990-2010. Wnioski dla władz lokalnych, W. Jarczewski, M. Huculak (ed.), Instytut Rozwoju Miast, Kraków, pp. 25-34.

IASP (International Association of Science Parks), http://www.iasp2012tln.com/en/Conference/theme.

Innowacje i transfer technologii, Słownik pojęć (Innovation and Technology Transfer, Glossary), Matusiak K. B. (ed.), 2011, Polska Agencja Rozwoju Przedsiębiorczości, pp. 184-190

KACZMARSKA B., GIERULSKI W., 2012, *Technological Parks as an Element of Innovation Systems Infrastructure,* in: Innovations in Management and Production Engineering, Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją, pp. 81-93.

KAMIŃSKA T., 1999, *Makroekonomiczna ocena efektywności inwestycji infrastrukturalnych na przykładzie transportu (Macroeconomic Assessment of the Effectiveness of Infrastructure Investments on the Example of Transport),* Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk

KAPLAN R. S., NORTON D. P., 1992, *The Balanced Scorecard and Measures that Drive Performance*, Harvard Business Review, pp. 71-9.

LINDELÖF P., LÖFSTEN H., 2002a, *Growth, Management and Financing of New Technology-Based Firms – Assessing Value-Added Contributions of Firms Located on and off Science Parks*, Omega – International Journal of management Science, Vol. 30, Issue 3, pp. 143-154.

LINDELÖF P., LÖFSTEN H., 2002b, *Science Parks and the Growth of New Technology-Based Firms – Academic-Industry Links, Innovation and Markets*, Research Policy, Vol. 31, Issue 6, pp. 859-876.

LINDELÖF, P., &, LÖFSTEN, H., 2005, *R&D Networks and Product Innovation Patterns – Academic and Non-Academic New Technology-Based Firms on Science Parks*, Technovation, 25, pp. 1025-1037.

LINK A. N. , SIEGEL D. S., 2005, *University-Based Technology Initiatives: Quantitative and Qualitative Evidence*, Research Policy, Vol. 34, Issue 3, pp. 253-257.

LINK A. N., SCOTT J. T., 2003, *U.S. Science Parks: the Diffusion of an Innovation and its Effects on the Academic Missions of Universities*, International Journal of Industrial Organization, Vol. 21, Issue 9, pp. 1323-1356.

MAŁECKA K., 2012, *Rewitalizacja obszarów zdegradowanych jako czynnik rozwoju lokalnego (Revitalization of Demoted Areas as a Local Development Factor),* Studia i Materiały Towarzystwa Naukowego Nieruchomości/Journal of the Polish Real Estate Scientific Society, Vol. 20 No. 2, pp. 225-257.

MATUSIAK K. B., 2010, *Parki technologiczne (Technological Parks),* in: Ośrodki innowacji i przedsiębiorczości w Polsce, Raport 2010, K. B. Matusiak (ed.), PARP, Warszawa, pp. 33-48.

MATUSIAK K. B., 2011, *Wyzwania strategiczne rozwoju parków technologicznych (Strategic Challenges of the Development of Technology Parks),* in: Strategiczne obszary rozwoju parków technologicznych, PARP, Warszawa, pp. 15-34.

MAŻEWSKA M., TÓRZ A., 2012, *Parki technologiczne (Technological Parks)*, in: Ośrodki innowacji i przedsiębiorczości w Polsce, Raport 2012, A. Bąkowski, M. Mażewska (ed.), PARP, Warszawa, pp. 25-42.

MONCK C., PETERS K., 2009, *Science Parks as an Instrument of Regional Competitiveness: Measuring Success and Impact*, IASP 2009 annual conference proceedings http://www.sqw.co.uk/files/8113/8712/8061/57.pdf, pp. 1-19 (accessed 2014-01-06).

OGRYZEK P., 2014, *Symulator Przetargów Nieruchomości instrumentem racjonalnego zagospodarowania przestrzennego i zrównoważonego rozwoju (Real Estate Tender Simulator as an Instrument of Rational Land-Use Planning and Sustainable Development),* in: Współczesne trendy na rynku nieruchomości, Cicharska M. (red.), Texter, Warszawa, pp. 7-22.

OPPENHEIM A., 1992, *Questionnaire Design, Interviewing and Attitude Measurement*, Pinter Publishers.

PELLE D., BOBER M., LIS M., 2008, *Parki technologiczne jako instrument polityki wspierania innowacji i dyfuzji wiedzy (Technology Parks as an Instrument of the Policy of Promoting Innovation and Diffusing Knowledge),* Instytut Badań Strukturalnych, Warszawa.

PHAN P. H., SIEGEL D. S. , WRIGHT M., 2005, *Science Parks and Incubators: Observations, Synthesis and Future Eesearch*, Journal of Business Venturing, Vol. 20, Issue 2, pp. 165-182.

RAGUZ M. J., LETNIC S., BUDIMIR V., 2012, *Assesing Science Parks' Performance: Selected European and Croatian Case Studies*, Journal of International Scientific Publication, Economy & Business, Vol. 6, Part 3, pp. 5-21.

RATINHO T., HENRIQUES E., 2010, *The role of science parks and business incubators in converging countries: Evidence from Portugal*, Technovation, Vol. 30, Issue 4, pp. 278-290.

SAMUELSON P. A., NORDHAUS W. D., 1996, *Ekonomia 2*, PWN, Warszawa.

SAMUELSON P. A., NORDHAUS W. D., 1999, *Ekonomia 1*, PWN, Warszawa.

SIEGEL D. S., WESTHEAD P., WRIGHT M., 2003, *Assessing the Impact of University Science Parks on Research Productivity: Exploratory Firm-Level Evidence from the United Kingdom*, International Journal of Industrial Organization, 21, pp. 1357–1369.

SRIMAI S., RADFORD J., WRIGHT C., 2011, *Evolutionary Paths of Performance Measurement: An Overview of its Recent Development*, International Journal of Productivity and Performance Management, Vol. 60 Issue 7, pp. 662 – 687.

SZCZEPANIAK K., 2011, *Ocena efektywności projektów inwestycyjnych (Evaluation of the Effectiveness of Investment Projects)*, in: Zarzadzanie inwestycjami I nieruchomościami, M. Rymarzak (ed.), FRUG, Gdańsk, pp. 85-112

TATICCHI P., BALACHANDRAN K., BOTARELLI M., CAGNAZZO L., 2008, *Performance Measurement and Management for Small and Medium Enterprises: an Integrated Approach*, Journal of Applied Management and Accounting Research, Vol. 5, No. 2, pp. 57-72.

Ustawa z dn. 20 marca 2002 r. o finansowym wspieraniu inwestycje (Act of 20 March 2002 on the Financial Support for Investments), Dz. U. z 2002 Nr 41, poz. 363, z poźniejszymi zmianami (Journal of Laws, 2002, No. 41, item 363, as amended).

WĘGRZYN J., 2012, *Rola władz lokalnych w sferze infrastruktury (The Role of Local Authorities in the Infrastructure Sector)*, Studia i Materiały Towarzystwa Naukowego Nieruchomości (Journal of the Polish Real Estate Scientific Society), Vol. 20 No. 2, pp. 247-258

WOJEWNIK-FILIPKOWSKA A., 2012, *Inwestycje w procesie odnowy miast - koncepcja oceny efektywności projektów (Investment in the Process of Urban Regeneration – Concept of Evaluating Project Effectiveness)*, Studia i Materiały Towarzystwa Naukowego Nieruchomości/Journal of the Polish Real Estate Scientific Society, Vol. 20 No. 3, Olsztyn, pp. 247-259.

WOJEWNIK-FILIPKOWSKA A., RYMARZAK M., 2013, *Decision-Making in Corporate and Municipal Asset Management (Literature Review)*, International Journal of Real Estate Studies, Vol. 8, No. 1, pp.16-29.