

**COOPERATION AMONG INDUSTRY AND CITIES AS A TOOL
FOR SUSTAINABLE MANAGEMENT OF METROPOLISES****Mucha-Kuś K., Makiela Z.J., Kinelski G., Stuss M.M., Raczek M., Wrana K.,
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Abstract: Synergy embodies the harmonious interplay among socially engaged individuals, yielding an amplified collective impact surpassing what their individual efforts could achieve in isolation. At present, urban centers, in their ever-evolving state, grapple with the task of fostering innovation and, of utmost importance, executing strategies conducive to drawing and retaining entities that instigate intelligent progress within the city. Municipalities traversing the realm of intelligent growth encounter the additional hurdle of cultivating a novel standard of living across diverse social segments through the harnessing of synergistic forces. The present study delves into the 4T framework, spanning domains of technology, trust, talent, and tolerance, offering a theoretical lens to probe these potentials. The authors endeavor to pinpoint, through an exploration of local governance dynamics, the inventive capacity of a learning-oriented municipality, while also scrutinizing urban innovation within the context of entrepreneurial activity, the inventive spirit of residents, and the support mechanisms fostering innovation. This research endeavors to elucidate the outcomes derived from the integration of the 4T paradigm in select cities within the GZM Metropolis, with the aim of uncovering, procuring, and nurturing Smart City domains and, potentially, synergies. In illustrating instances, the author underscores the unpreparedness of the chosen municipalities' local administrations in capitalizing on the synergies inherent in the Smart City landscape, despite the array of opportunities that this milieu offers.

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Key words: smart city, sustainable development, metropolis, special economic zones

DOI: 10.17512/pjms.2023.28.1.13

Article history:

Received July 12, 2023; Revised August 24, 2023; Accepted September 12, 2023

Introduction

The idea of sustainable development was disseminated in 1987 in the report "Our Common Future" published by the World Commission on Environment and Development, in which it was defined quite casually as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs".

Scientists have noticed the destructive effects of human activities leading to the degradation of individual species, ecosystems and, as a result, the entire Earth. Sustainable development in the literature is understood in many aspects, however, the basic assumptions recognized by most scientists can be indicated (Ahvenniemi et al., 2017):

-It is a type of socio-economic development - carried out by man and for man - whose main feature is the pursuit of environmental and socio-economic egalitarianism.

-It is a process integrating human activity reduced to three dimensions, namely economic, social and environmental, less frequently extended by spatial and political dimensions

-Means a desirable living environment and a responsible society implementing the concept of intra- and inter-generational order (Goal 11, 2023).

Sustainable development of the city consists primarily in shaping appropriate relations between urban systems and within them (economic, social, natural systems) and relations between systems and the environment. The causative role in shaping these relationships is played by man e.g. decarbonisation (Konovalyuk et al., 2023; Drożdż et al., 2021; Wójcik-Jurkiewicz et al., 2021).

In the article, the authors focused on analyzing the impact of the functioning of Special Economic Zone on the development of the city where it operates. From the point of view of the competencies of SEZs, the technical, ecological, economic and social conditions are of particular importance. This is due to the objectives of the SEZ - accelerating the development of regions through, among others, attracting new investments, developing exports and creating new jobs. Competences are an important instrument for supporting innovativeness and competitiveness of entrepreneurs due to the form of support and the scale of public aid granted to them. The aim of the article is to define the role of the Katowice Special Economic Zone in shaping sustainable development, economic growth, development of the city's entrepreneurship, relational and innovative capital, social inclusivity in the GZM Metropolis (GZM). By juxtaposing the empirical achievements and the identified research gap, scientific exploration in this area confirms its validity and legitimacy, in particular in the context of the impact of special economic zones on the

development of cities and metropolises. This article contributes to filling the knowledge gap in terms of the benefits of the functioning of SEZs affecting the broadly understood development of cities/metropolises. The choice of the research field was not accidental. The subject of this article is the Katowice Special Economic Zone and the cities of the GZM Metropolis within which the zone operates (Kinelski et al., 2021).

Literature Review

Sustainable development is an attempt to formulate a program integrating various planes of human activity, often previously considered separate, based on moral reflection regarding man's responsibility for nature (expressed in principle, sustainable development is such development that guarantees meeting the needs of the present generations, without limiting the possibility of by future generations (Ossewaarde and Ossewaarde-Lowtoo, 2020; Wójcik-Jurkiewicz et al., 2021). This integration means achieving order on many levels. These include:

- The moral plane (the question of man's responsibility for nature) (Ahvenniemi et al., 2017; Wróblewski et al., 2019; Makiela et al., 2022).
- Ecological plane (nature and landscape protection) (Kinelski et al, 2022).
- Technical level (new technologies, saving raw materials. The economic plane (taxes, subsidies and other economic instruments) (Goal 11, 2023; Wójcik-Jurkiewicz et al., 2021).
- Legal level (environmental protection law) (Malec et al., 2021).
- Social aspect (interpersonal relations, and in Polish conditions, the extremely important problem of providing jobs adequate to qualifications) (Szczepańska-Woszczyzna, 2018; Szczepańska-Woszczyzna et al., 2020; Pudryk et al., 2023).
- Political plane (formulation of sustainable development strategies, their implementation and control) (Muangmee et al., 2021; Zastempowski and Cyfert, 2021; Dyduch et al., 2021).

The technical conditions of sustainable development relate to the functioning of the industry. The concept of " industrial ecology ", which has been developed in recent years, should be mentioned here. Scientists points out that "it is based on an analogy with natural ecosystems. In nature, an ecosystem functions through a network of relationships through which " organisms live and eat each other ". The classic approach to production processes is linear, raw materials are used to produce products, which results in the generation of waste. In industrial ecology, it is proposed to create a closed system where waste is used as a source of energy or substrates for another product. An important challenge is that it is impossible to use the environment and obtain natural resources in such a way that these activities do not entail any negative changes. They can be direct or indirect, reversible or irreversible. Their scale will vary: from relatively minor consequences of a local event to global problems, e.g. problem with gas as fuel (Zych et al., 2023). However, this negative aspect will always be present. Environmental damage can be

minimized, which is a task for technical sciences and in particular for the currently developing environmental engineering e.g. from energy sector (Sołtysik et al., 2021). Awareness of the threats resulted in specific actions covering several levels: strict emission standards, introduction of new generations of purification devices (so-called "end-of-pipe solutions"), as well as - in the longer term - changes interfering with the technological process itself, including others promotion of the recently fashionable concept of cleaner production (Zych et al., 2021; Ossewaarde and Ossewaarde-Lowtoo, 2020; Muangmee et al., 2021), which is a direct reference to industrial ecology. The technical plane of sustainable development refers to all the above-mentioned aspects, but it is particularly important to emphasize the enormous possibilities associated with interference in the very essence of the technological process used. There are four main groups of strategies: limiting the flow of raw materials, releasing the flow of raw materials, closing the flow of raw materials flow replacement.

The integration of these strategies takes place through the introduction of the so-called "cleaner production". The overall goal of cleaner production is to improve quality, yield, reduce human risk and save costs (Lowitzsch, 2022).

The social plane is sensitive to degradation processes. The natural environment can be subject to degradation, and so can the social environment. This type of environment consists of many factors, including customs, culture, spirituality, as well as interpersonal relationships and living conditions (Kaszyński et al., 2021). Even the relationship between man and nature has its social dimension, because all human activity towards the environment always takes place through the mediation of existing socio-cultural patterns. The social environment should secure the foundations of an individual's existence, both in the material and spiritual dimensions. This is also how it is understood in the WHO Concept of Healthy and Smart Cities (Makiela et al., 2022; Kinelski, 2022a) where the issue of a clean environment and appropriate urban infrastructure is put on a par with social issues. There's a lot of truth to that. After all, what is the benefit of a clean environment when the people living in it will be a threat to each other? Interpenetration and integration of sustainable development planes, within the concept of sustainable development, the idea of the so-called "ecological footprint". It is an area that is necessary to provide raw materials and resources necessary for the life of an individual, society, or any population surveyed (Fischer and Kniely, 2020). It is estimated that even in the case of a medium-sized city, the ecological area can be from 500 to even 1000 times larger than the area occupied by the city itself. On a global scale, however, the situation is very diverse. According to the available estimates, taking into account the available land resources, there should be about 1.7 ha of "area" per one inhabitant of the Earth. There are areas (symbolic South) where people consume much less, but there are also areas (North) where the situation is completely different.

The topic of sustainable urban development is described in detail in the "2030 Sustainable Development Goals" published by the United Nations. They included,

among others “making cities and human settlements safe, stable, sustainable and inclusive”. These goals were adopted by each of the Member States in the agenda in 2015 and assume their implementation by 2030. However, they are of a general and universal nature, just like the set of ISO standards, they are not of a legal nature. Goal 11 is closely related to sustainable development and improving the standard of living in cities, which is at the heart of the concept of smart cities. It assumes, among others (Mainali et al. 2020):

- Ensuring access to adequate, safe and affordable housing and basic services.
- Improving living conditions in slums.
- Ensuring access to safe transport systems (with simultaneous improvement of road safety).
- Ensuring sustainable urbanization and participation.
- Integrated and sustainable planning and management of human settlements.
- Strengthening for the protection and protection of the world's cultural and natural heritage.
- Reduction of the city's negative impact on the environment per capita.
- Ensuring easy and safe access to green areas.
- Increasing the number of cities using studies and implementing integrated policies and plans seeking to increase inclusiveness and efficiency of resource use (Mucha-Kuś et al., 2019; Kinelski 2022b, Zamasz et al., 2020).

Looking at the special economic zones against this background, it can be said that it is a tool that can affect the socio-economic situation of cities and regions, but also - through a consciously shaped process of developing areas and facilities, including post-industrial ones - affecting the implementation of spatial and environmental policy. In Poland, SEZs turned out to be, first of all, an effective instrument for attracting foreign investors to selected regions. From the point of view of the central SEZ, they are a macroeconomic instrument of interregional policy. The role of the zones is noticeable at the macroeconomic, regional and local levels. It can be added here that real social feelings link the existence of the zone with the phenomena of socio-economic development, including structural transformations taking place mainly on a local scale, eg changes in the functional structure of the city. The main objective of incorporating new areas into special economic zones is to support new investments implementing the sustainable development policy understood as social and economic development, in which activities are integrated to increase the competitiveness of the Polish economy and create new jobs (Zastempowski and Cyfert, 2021).

The concept of economic zones as a tool for the sustainable development of metropolitan cities refers to the current of research, which indicates that the greatest resource conditioning the economic development of a city are the intellectual resources of human capital and the knowledge of the organization. An important resource of cities is innovation, which determines the pace of change and is the main driving force for economic development. The implementation of innovative solutions in enterprise management results in product, technological, organizational,

marketing and ecological innovations (Zavadsky et al., 2021; Xu et al., 2018). The use of innovations for the development of cities results in the formation of a smart, innovative and resident-friendly city (Kinelski 2022; Hospers and van Dalm, 2005; Szoltysek, 2020; Zygiaris, 2013; Toppeta, 2010). Innovations change the functional and spatial structure of cities; cities become more competitive than cities with traditional functions (Kaszyński et al., 2021). The literature review allowed for the formulation of the research question: what are the benefits of the functioning of SEZs affecting the broadly understood development of cities/metropolises.

Research Methodology

The first stage of the research began with a systematic review of the literature, the purpose of which is to identify and confirm the selected research topic and to contextualize research in the literature about e.g. economy, cities and climate (Morawski, 2021). Databases enabling access to current and important international journals and publications in full text versions were used, such as: Emis, ProQuest, Emerald, Scopus, Google Scholar. Then, a selection was made based on defined keywords and the criterion of the nature of the publication (narrowing down to the list of publications containing full reviewed texts). The searched terms were checked in databases due to its significance as a subscription-based online service for indexing scientific citations. Only scientific articles, monographs, chapters from monographs, and review papers were retained. The adopted methodology allowed for the collection of source materials relevant for further analyses. To minimize potential errors and biases in this study, data extraction methods were used for the systematic review, which required documentation of all diagnostic stages. Data extraction included general information such as the title, author or authors, and publication details. The prepared literature material was, in the next step of the literature review, extended to include Polish scientific publications, both monographs and reviewed articles in leading Polish journals. In the study based on a systematic literature review, a data extraction process was employed that included individual analyses of the collected references based on the adopted coding system. A systematic review of the literature identifies, evaluates and synthesizes existing research evidence, providing source material for designing empirical studies. Adopting a systematic review of the literature allows for the development of evidence-based methodology tailored to the needs of researchers, which can provide an important and effective means of creating practical knowledge. Based on the collected source materials, a cognitive gap was identified: the lack of a sufficiently described and diagnosed issue of the role of special economic zones as a tool for sustainable development of metropolitan cities, not only in Poland as a whole, but also in regional terms.

Based on the research methodology of J. Creswell (Creswell, 2013), research problems were formulated. The formulation of the research problem was based on the analysis of the literature on special economic zones as a tool for the sustainable

development of metropolitan cities. The importance of special economic zones as a tool for the sustainable development of metropolitan cities concerns:

-Effective allocation of resources and achieving an increase in production, but also determining the nature and conditions of socio-economic life that would allow for the convergence of the living standards of the population in local government structures (Štverková and Pohludka, 2018).

-Recognition of the existing development barriers, most often related to single factors of production, e.g. quality of residents' capital, innovative technologies, innovative organization management methods (Ahvenniemi et al., 2017; Florida et al., 2015; O'Connor et al., 2020; Giffinger et al., 2010).

-Launching the process of modernizing the economy and social institutions, supporting technological values, streamlining and improving the activities of social practice.

-Civilizational and cultural changes (technological and awareness), the transition of the economy from the traditional to the modern stage, to its more advanced forms, modern and postmodern.

-Economic modernization is a process of quantitative and qualitative changes taking place in the local and regional economy, enabling growth and economic development of the country (Petkovic et al., 2017; Knezevic et al., 2020).

The next stage of the research was the empirical verification of the adopted assumptions based on Creswell's principles of research design (Creswell, 2013). Questionnaire methods were used (by ordering the study and elaboration of results to a specialized and leading unit). The choice of the survey method is dictated by the arguments that questionnaire surveys enable a quantitative description of specific aspects of examining the competencies of the KSEZ and managing relations with the cities of the Metropolis GZM. In the selected research group of cities located in GZM, the research results can be generalized to other metropolises in the country. The questionnaire method also allows you to conduct research and obtain information that would otherwise be difficult to measure using observational techniques. The approach of both Creswell and Schwartz (Creswell, 2013) will be used in developing the questionnaires. The planning of the questionnaire was begun with establishing the procedure for the acquisition of the results. By assuming the propositions of P. Salant and D.A. Dillman as the starting point, the indicator of the responses and preferred level of the precision of the research were defined. The pilot project made it possible to test the research tools, make a precise diagnosis of whether the respondents understand the questions and instructions, and whether the meaning of the questions is the same for all respondents. The pilot also highlighted whether sufficient categories of answers were available and whether respondents systematically skipped any questions. Then, the planned quantitative and qualitative studies will be carried out (as part of an external order).

The intentional integration of different data collection methods and the triangulation of different data sources has overcome the weaknesses inherent in each study if it had been conducted alone. This also improved the reliability of the findings as

information from different data sources is convergent. The choice of the research field was not accidental. The subject of consideration is the Katowice Special Economic Zone and the GZM Metropolis, the only metropolis in Poland established under the Act on the metropolitan union in the Silesian Voivodeship. The study (survey) was addressed to enterprises located in the KSEZ, representatives of the Municipal Offices of GZM members and the Metropolitan Office of the GZM Metropolis (Kinelski et al. 2021).

The collected research results were subjected to inductive analysis using statistical methods, including a description of the structure and differentiation of the surveyed population. The accuracy of the data was checked (checking for errors and cohesion of the entries).

In terms of quantitative research, a synthetic indicator was also formulated (based on data characterizing the economic situation of communes in which a special economic zone operates) and the relationship between its value and the value of individual variables with the value of capital invested by entities operating in a special economic zone in the commune was determined.

The survey research was supplemented by an analysis of source materials in the form of strategic and program documents of individual communes. In particular, urban development strategies were included as the main documents analyzed as well as local/municipal revitalization programs and programs of cooperation with non-governmental organizations as supplementary analytical documents. These documents were selected due to their comprehensive nature, long time horizon and, above all, central position in local planning systems.

The assumptions of this research, the process of understanding them (epistemology) and the research tools used are up-to-date and were understood by others during the analysis. This is important for the development of good theories and practices as a result of conducted research. The adopted criteria of methodological rigor are:

-The assessment and interpretation of the data was performed in a logical and impartial manner and the integrity of the findings was ensured by objectively establishing the relationship between the data and the findings.

-The truth about the conclusions came from cause-and-effect or causal relationships (so as to allow for an accurate explanation of research problems).

-The conducted survey research was verified by in-depth interviews and analysis of the collected source documents.

-The understanding of the results obtained in one study could be transferred to explain phenomena observed in other contexts through analytical generalization. A comprehensive understanding of one context warrants useful interpretations of similarities and differences in other contexts.

-Reliability, all stages of the research process - including data collection, coding and all other data preparation and analysis processes - have been described as accurately as possible to achieve a high degree of transparency.

Research Results

The Metropolis GZM consists of 41 member cities and communes, of which 16 communes are located within the area of operation of the KSEZ and are: Dąbrowa Górnicza, Bieruń, Bytom, Zabrze, Katowice, Sosnowiec, Rudziniec, Piekary Śląskie, Świętochłowice, Siemianowice Śląskie, Siewierz, Gliwice, Sławków, Knurów, Tychy, Łędziny. Twelve communes responded to the survey, while the last four mentioned did not participate in the survey. The survey was conducted using the CATI technique (computer-assisted telephone interviewing) and the tool used to conduct it was a questionnaire. The deadline for the survey was July 2022, and the respondents were mayors of cities or their deputies or substantive persons indicated by them.

Analysing the activity of territorial units in the field of supporting economic development, it can be seen that five out of twelve surveyed communes (Świętochłowice, Siemianowice Śląskie, Siewierz, Gliwice, Katowice) have an entrepreneurship development policy, and another four plan to create such a policy in the coming years. Currently, only three communes (Dąbrowa Górnicza, Siewierz and Rudziniec) have business incubators. Representatives of Siemianowice Śląskie, Gliwice and Zabrze declare that such incubators will be built in their communes in the near future. A permanent form of cooperation with entrepreneurs, e.g. in the form of an economic council, is currently functioning in Dąbrowa Górnicza, Gliwice, Zabrze and Katowice. In all these cases, representatives of companies operating in the KSEZ participate in its work (Table 1).

Table 1. The period of operation of the zone in the communes of the Metropolis GZM

	Name of the commune in GZM in which the area of the zone is located	date (year) of taking up the area in the KSEZ commune	date (year) of issuing 1 permit in the zone in the commune	total number of companies from the moment of the first location until the end of 2021
1	Bieruń	2005	2012	6
2	Bytom	2012	2017	10
3	Dąbrowa Górnicza	1996	1998	16
4	Gliwice	1996	1996	57
5	Katowice	2006	2006	18
6	Knurów	2012	2020	1
7	Piekary Śląskie	2014	2020	5
8	Siemianowice Śląskie	2005	2005	3
9	Sławków	2004	2011	2
10	Sosnowiec	1996	2000	18

11	Świętochłowice	2014	2019	1
12	Tychy	1996	1997	39
13	Zabrze	2002	2005	23
14	Lędziny	2016	2021	1
15	Rudziniec	2009	2010	1
16	Siewierz	2003	2004	1

Source: Own elaboration based on information from KSSE S.A. (date of availability 12/11/2022).

Four communes out of twelve surveyed (Siewierz, Siemianowice Śląskie, Rudziniec and Zabrze) achieved 100% use of land designated for investment purposes in the zone. Gliwice is slightly less occupied (95%). In this commune, however, there is the greatest variety of areas of investor activity. The lowest percentage of use of land intended for investment was declared in Katowice (1%) and Świętochłowice (5%) (Figure 1).

The above data show that the size and importance of the center in the agglomeration do not play a key role in making investment decisions. In the case of Katowice, it can be presumed that other areas in the city are a kind of competition for areas located in the zone. On the other hand, in the case of Świętochłowice, the development of investment areas is limited by the deficits in road infrastructure that allow connecting these areas with the main communication arteries on a regional and national scale.

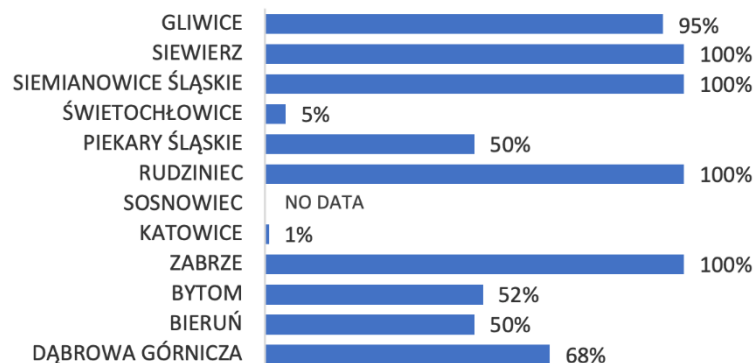


Figure 1: Degree of use of land for investment purposes in GZM communes

Source: own elaboration

The most frequently represented economic activity in the zone is the automotive industry; it is present in as many as six surveyed communes. Slightly less frequent are investments in the metal, construction and logistics industries (Figure 2).

In the opinion of commune representatives, the presence of KSSE areas increases the commune's attractiveness in the eyes of potential investors. To a lesser extent, this opinion is shared only by the representatives of Siemianowice and Siewierz. The

very presence of the KSEZ and the companies operating in it has a positive impact, especially on attracting new investors to the commune, professional activity of the inhabitants, the commune's income level and a decrease in unemployment.

Table 2. Areas of activity represented by investors

<i>Business area</i>	DĄBROWA GÓRNICZA	PEKARY ŚLĄSKIE	ŚWIETOCHLOWICE	SIEMIANOWICE	SIEWIERZ	GLIWICE	BIERUN	BYTOM	ZABRZE	KATOWICE	SOSNOWIEC	RUDZINIEC
<i>Machine manufacturing</i>												
<i>Electric</i>												
<i>Automotive</i>												
<i>Printing</i>												
<i>Plastics</i>												
<i>IT</i>												
<i>Metal</i>												
<i>Glassware</i>												
<i>Construction</i>												
<i>Housing</i>												
<i>Food</i>												
<i>Aviation</i>												
<i>Household appliances</i>												
<i>Electronic</i>												
<i>Chemical</i>												
<i>Accounting services</i>												
<i>Wood processing</i>												
<i>Transport</i>												
<i>Logistics</i>												
<i>Textile</i>												
<i>Laundry services</i>												
<i>Paper</i>												
<i>Telecommunications</i>												
<i>Education</i>												
<i>Scientific and Research</i>												

Source: Own elaboration

The above answers may indicate three general ways of influencing the image of investment attractiveness of communes. Firstly, KSSE has a brand that in its own way ennobles the commune where the zone operates. Secondly, the real quality of amenities offered by the zone is a significant value influencing investors' location decisions. And thirdly, the image of the commune is strengthened by the interest and brand of companies located in the zone operating in a given commune.

Among the specific benefits derived by communes from the functioning of the zone in their area, the following were indicated:

- Greater recognition of the commune, especially in the investment context.
- Creation of patronage classes, cooperation between companies and schools.
- Expanding the possibilities of developing projects not directly related to the SEZ.
- Easier acquisition of new investors.
- Promoting the attractiveness of the commune through joint promotion and substantive support in servicing investors, especially when it comes to tax reliefs or discounts.

Building new access roads to investment areas.

- Employment of commune residents by enterprises from the KSEZ.
- "pull effect" associated with locating next to well-known brands or companies from the same geographical area.
- Development of corporate social responsibility of companies from SEZ (companies want to engage in the life of the community of places where they are located, supporting cultural, sports, social and environmental activities, infrastructure development, influencing spatial order).

The general assessment of the impact of the functioning of the KSSE on local development is rated high or very high by the surveyed communes. Even communes where the percentage of land development in the zone is not high considered that the importance of the zone for shaping the attractiveness of the location is high. Only two communes (Siewierz and Siemianowice Śląskie) assessed the importance of the zone in this context as moderate or low) (Figure 2, Table 3).

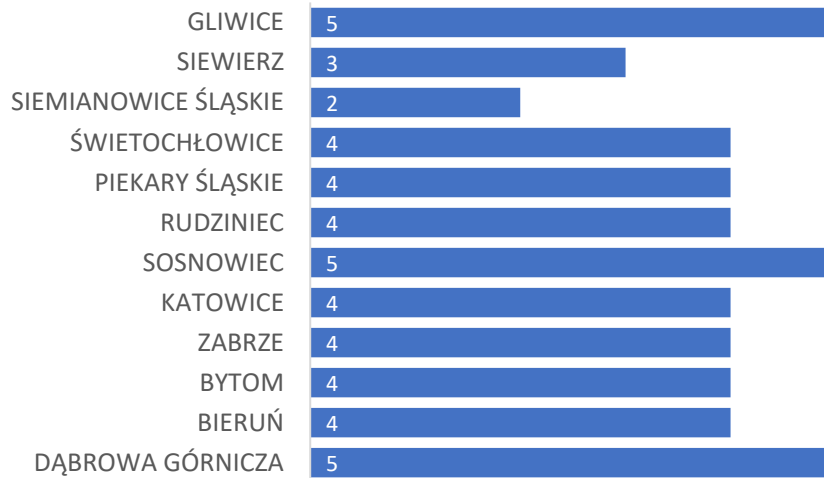


Figure 2: Impact of the functioning of the KSEZ in the commune on attractiveness on a scale of 1-5 (where: 1 not at all or very little, 5 very much)

Source: Own elaboration

Table 3. The degree of impact of the functioning of the KSEZ and the companies operating there in the commune (scale 1-5, where 1 is a very slight impact, 5 is a very large impact)

The degree of impact of the functioning of the KSEZ and the companies operating there in the commune (scale 1-5) on:	professional activity of the inhabitants	municipal income level	income level of residents	stimulating the level of entrepreneurship consisting in setting up enterprises and activities cooperating with enterprises in the zone	attracting new investors to the commune
Dąbrowa Górnicza	4	3	3	3	5
Bieruń	4	3	2	2	4
Bytom	2	2	2	1	4
Zabrze	4	4	4	4	4
Katowice	4	2	2	1	4
Sosnowiec	4	5	5	5	5
Rudzinek	5	5	4	2	4
Piekary Śląskie	4	5	5	4	4
Świętochłowice	4	4	3	4	5

Siemianowice Slaskie	3	3	3	1	2
Siewierz	3	3	2	1	1
Gliwice	4	4	3	3	4

Source: Own elaboration

In the course of the study, an initial attempt was also made to objectify the impact of the functioning of the KSSE on the economic situation of the GZM communes in which the areas of the zone are located. In the light of this research objective, a synthetic indicator was constructed on the basis of data available in the resources of public statistics. The indicator includes the following variables:

-Working per 1000 population.

-Shares in taxes constituting state budget revenues - personal income tax per 1 inhabitant.

-Shares in taxes constituting state budget revenue - corporate income tax per 1 inhabitant.

-Average monthly gross salary.

-Entities entered in the REGON register per 1000 population.

Partial indicators have been unitarized. It is a normalization method leading to a constant, unit range of variability of normalized features. The value of the variable or its distance from one of the volatility limits is divided by the range and takes values from the range (0;1). Unitarization was carried out according to the following formula (all variables are stimulants):

$$y_{ij} = \frac{x_{ij} - \min\{x_{ij}\}}{\max\{x_{ij}\} - \min\{x_{ij}\}}$$

x_{ij} – value for the j -th feature and the i -th object

$\min\{x_{ij}\}$ – minimum value

$\max\{x_{ij}\}$ – maximum value

y and j - standardized value of the j -th feature for the i -th object.

After unitarization, the sub-indicator was calculated as the average of the standardized values of 5 groups of variables (Figure 3).

Correlation analysis between: selected values and the value of funds invested in the zone's communes, and the synthetic indicator is at the level of 0.51. The highest value for partial factors concerns the value of the share in taxes constituting state budget revenues (Table 4).

Table 4. Correlation between the value of invested funds per capita and the value of the synthetic indicator of the economic situation

Indicator	Correlation coefficient
Working per 1000 population	0.38
Shares in taxes constituting state budget revenues personal income tax per capita	0.43
Shares in taxes constituting state budget revenues corporate income tax per capita	0.54
Average monthly gross salary	0.36
Entities entered in the REGON register per 1000 population	0.23
synthetic for all GZM communes	0.51

Source: Own elaboration

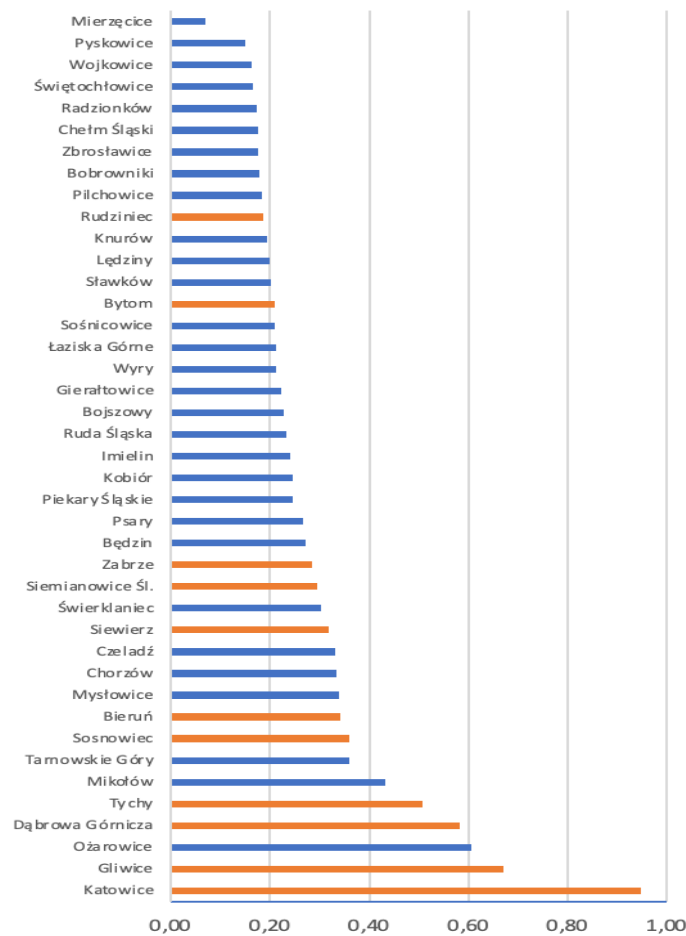


Figure 3: Synthetic indicator of the economic situation of GZM communes

Source: Own elaboration

The strongest relationship between the value of capital employed and the synthetic ratio was observed in communes where the largest value of capital was invested, i.e. in Gliwice, Tychy and Dąbrowa Górnicza (Figure 4).

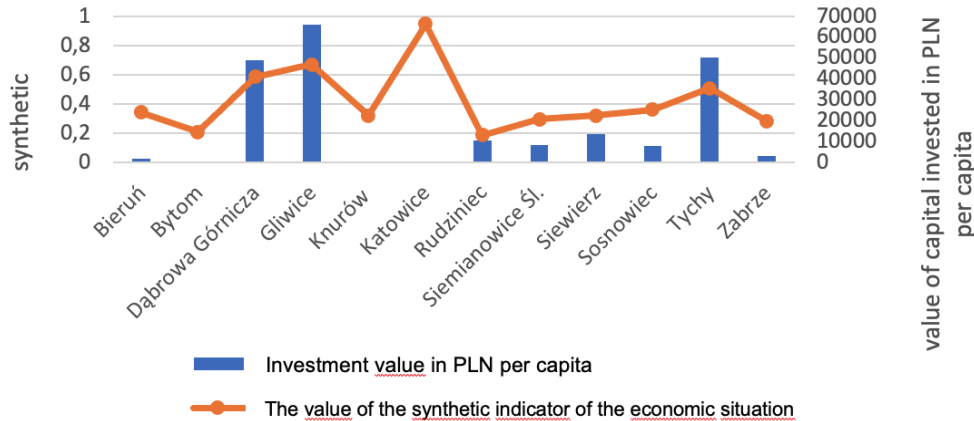


Figure 4: Relationship between the capital invested in a given commune per capita and the value of the synthetic index

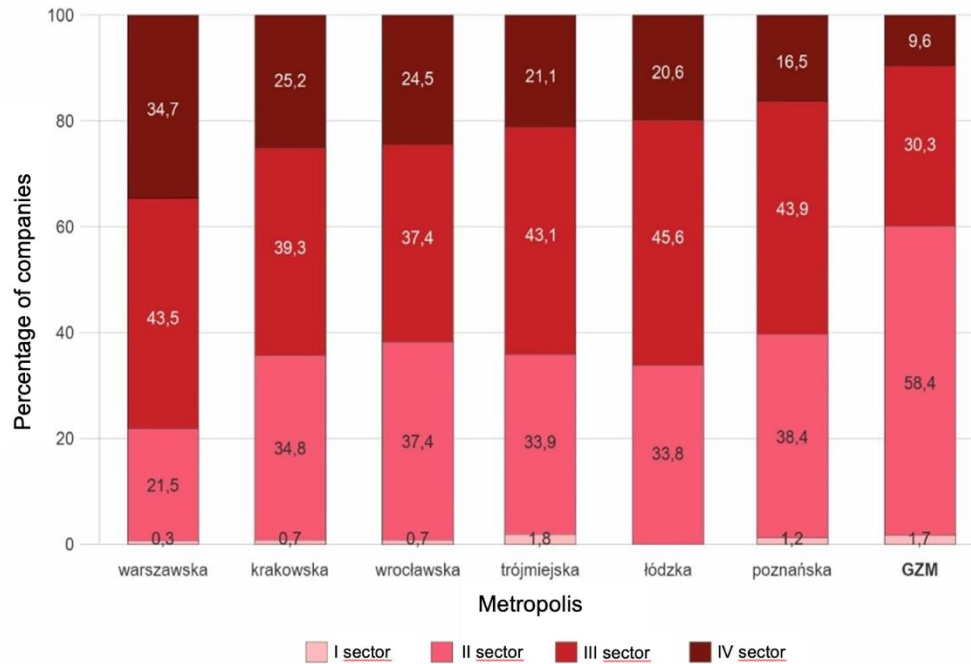
Source: Own elaboration

The long-term cooperation of KSSE enterprises with the cities of the Metropolis of Metropolis GZM is conducive to the development of entrepreneurship and innovativeness of cities, which is expressed, among others, in Modern infrastructure, access to new technologies, access to recreation and relaxation, efficient public transport.

In order to check the hypotheses put forward, residents' opinions on the innovativeness of the city in which they live were surveyed. The study was carried out using the CATI method, on a sample of N=600, the sample was of a quota-random nature. In the surveyed communes (Chart 5), the greatest expectations among the inhabitants concern access to places of rest and recreation (52%), efficient public transport (48%), access to bicycle paths (45%) contact with science (40%) and the possibility of improving qualifications (34%), access to electronic communication (32%). Research shows that the surveyed residents prefer access to innovative infrastructure, science and recreation, and these factors determine the perception of the city as an innovative city.

The strong position of metropolitan cities is the result of the location of the headquarters of industrial companies belonging to the KSEZ in its area. In no other supra-regional Polish metropolis, apart from the Metropolis, companies from the second sector of the economy (mining, processing industry, energy and construction) play such a role (Figure 5). Among them, industries traditional for the Silesian region still hold a strong position: coal mining, steelmaking and energy production. These

three account for 40% of the revenues generated by the largest companies located within the border of the metropolis.



Note: sector I - agriculture, forestry and fishing, mining, sector II - industry, energy, media supply, construction, sector III - less knowledge-based services, sector IV - knowledge-based services.

Figure 5: Share of economic sectors of the largest companies in Polish metropolises in 2019

Source: list based on: data from the Ministry of Finance

<https://www.gov.pl/web/finanse/2019-indywidualne-dane-podatnikow-CIT> [list version of August 1, 2020] (Dyduch et al., 2021).

Domestic headquarters of companies in the processing industry, in particular the automotive industry, have a strong presence - nearly 20% of the revenues of the largest companies in Metropolis GZM. In total, companies from the industrial sector (including construction), which have their headquarters in GZM, generated 60% of revenues in 2019, trading companies (mainly wholesale) accounted for 1/5 of revenues, and 1/8 for other services (table 5).

**Table 5. Branch structure of the largest copanies
based in the cities of the Metropolis of Metropolis GZM in 2019**

Industry	PKD section	Number of companies	Share (GZM=100)	Revenue in billion PLN	Share (GZM=100)	Poland = 100
Agriculture	a	0	0.0	0.0	0.0	0.0
Mining	b	3	1.7	10.9	7.0	37.9
Processing industry	c	86	48.3	83.5	54.2	8.3
Power engineering	d	4	2.2	3.9	2.5	4.0
Media delivery	e	5	2.8	1.8	1.1	19.0
Construction	f	9	5.1	3.0	1.9	2.1
Trade	g	44	24.7	32.2	20.9	4.2
Transport and logistics	h	8	4.5	9.3	6.0	8.8
Hotels and restaurants	i	0	0.0	0.0	0.0	0.0
ICT	J	4	2.2	1.2	0.8	1.3
Finance and insurance	k	3	1.7	–	–	–
Real estate services	l	1	0.6	0.4	0.2	2.4
Professional, scientific and technical activities	m	0	0.0	0.0	0.0	0.0
Administration services	n	1	0.6	2.0	1.3	4.3
Public administration	o	0	0.0	0.0	0.0	0.0
Education	p	3	1.7	1.4	0.9	7.5
Healthcare	q	5	2.8	1.4	0.9	5.0
Culture and entertainment	r	2	1.1	3.3	2.2	13.4
Other services	s,t,u	0	0.0	0.0	0.0	0.0
TOGETHER	–	178	100.0	154.2	100.0	3.7

Source: Own elaboration based on data from the Ministry of Finance

Metropolis cities are characterized by a clear tendency to increase the growth rate of medium-tech and high-tech industry entities, which indicates the direction of evolution of industry advancement. This trend is more clearly visible if we assess the technological advancement of large enterprises located in the KSEZ. The analysis shows a clear tendency of concentration in the KSEZ of companies with advanced technologies, which significantly determine the change in the functional structure of metropolitan cities.

Conclusion

Awareness of the innovative potential of special economic zones and their importance in implementing the process of sustainable development means that cities care about the development of entrepreneurial activity of their inhabitants, create attractive locations for companies and institutions, and as a result become centers of growth. They will also contribute to optimizing the use of the city's resources, improving the quality of life in the city, making the city more tolerant and

comfortable, more friendly to learning and the development of schools and willingness to learn. To create a city friendly to all residents and stakeholders of the city as an organism in which inter-organizational relations are based on trust.

The conducted study is the basis for further in-depth analyzes in the field of forms and durability of cooperation between local government units and the functioning of the zone area in communes, as well as the assessment of the objective impact of the value of invested capital on the economic and social sphere and situation of a given area.

The main recommendations should be the use of qualitative analyzes in diagnostic processes, allowing for a better definition of the existing potentials and stakeholders of development processes, which will increase the level of effectiveness of the implementation of development policies.

An important element of the recommendation is the commencement of the reconstruction and compatibility of local planning systems, so that operational documents are consistent with the objectives and directions set out in the strategy and constitute a real tool for implementing local development policy in the areas indicated in the strategy. Compatibility of the system of implementation and coordination of development policy and sectoral policies, and basing it on the principles of partnership and participation with the use of network open ICT tools, in the perspective of the metropolitan information system.

Another element in the area of recommendations is supporting the process of innovative management of metropolitan cities. As part of the strategic arrangements, attention should be paid to: adaptation to climate change, innovation, resilience, mobility and accessibility, space and social cohesion, metropolitan character and innovation, cooperation and openness, shaping and implementing spatial policy. Involving a wide range of stakeholders representing government and local government authorities, state institutions, academic, business, non-governmental communities and residents to cooperate.

The limitation to this study may be attributed to a selective case study presentation. This study does not have exhaustive ambitions, but, in turn, it might be biased by the omission of many theoretical and empirical works. While those reasons suggest a prudent use of findings, their formulation remains straightforward.

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WSPÓŁPRACA PRZEMYSŁU I MIAST JAKO NARZĘDZIE ZRÓWNOWAŻONEGO ZARZĄDZANIA METROPOLIAMI

Streszczenie: Synergia dopełnia harmonijną interakcję pomiędzy zaangażowanymi społecznie organizacjami, dając wzmacnione zbiorowe efekty niemożliwe do osiągnięcia indywidualnie. Obecnie, stale rozwijające się ośrodki miejskie stoją przed wyzwaniem i koniecznością wspierania innowacyjności i, co najważniejsze, realizacji strategii sprzyjających przyciągnięciu i zatrzymaniu podmiotów inicjujących inteligentny rozwój w mieście. Gminy wkraczające w sferę inteligentnego wzrostu napotykają dodatkową przeszkodę w postaci nowego standardu życia w różnych segmentach społecznych poprzez wykorzystanie sił synergicznych. Niniejsze badanie zagłębia się w ramy koncepcji 4T, obejmującej aspekty technologii, zaufania, talentu i tolerancji, oferując teoretyczną perspektywę do badania tych potencjałów. Autorzy wskazują, poprzez badanie dynamiki samorządu lokalnego, potencjał wynalazczy gminy zorientowanej na uczenie się, jednocześnie przyglądając się innowacjom miejskim w kontekście aktywności przedsiębiorczej, wynalazczości mieszkańców i mechanizmów wsparcia sprzyjających innowacjom. Celem badania jest wskazanie integracji paradygmatu 4T w wybranych miastach Metropolii GZM w kontekście identyfikacji, pozyskania i pielęgnowania domen Smart City oraz, potencjalnie, synergii z tym związanych. Autorzy dostrzegli nieprzygotowanie samorządów lokalnych wybranych gmin do wykorzystania synergii wynikających ze Smart City, pomimo szeregu możliwości, jakie oferuje ten koncept.

Słowa kluczowe: smart city, zrównoważony rozwój, metropolie, specjalne strefy ekonomiczne