Analysis of the Features of a Degraded Land in Terms of Revitalization – Case Study on the Example of a Post-Smelter Area

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INTRODUCTION

The spatial layout of cities where heavy industry is embedded in their history was shaped mainly by the needs of mining and metallurgical plants. However, the subordination of cities to industrial activities meant that they were affected by the negative effects of these activities: environmental degradation, chaotic spatial development. At present, the cities that grew up on the basis of mining and metallurgical activities are a conglomeration of operating, bankrupt or liquidated plants, storage and warehousing areas, settlement complexes of various character and origin – from the 19th century quarter workers' settlements, through multi-family multi-floor buildings to large-panel block of flats. Some of the parceled and sold out areas after the liquidated plants were entered by entities of different activity profile – production or service. The rest of the post-industrial areas are scattered throughout the city and undeveloped. The chaotic nature of urban spaces does not give a clear answer to the question about the direction of development of post-industrial areas. The analyzed area is located in the vicinity of a housing estate, as well as industrial, production and service areas. The lack of free space resulting from the compact urban layout of the city means that the analyzed area, despite being degraded, has the potential for re-development.

INTERNAL AND EXTERNAL CONDITIONS FOR THE REDEVELOPMENT OF DEGRADED LAND

The selection of land for future development should be preceded by an analysis focusing on two areas. The first is to diagnose the features that determine the suitability and susceptibility of the land to perform certain functions, the second are external factors, independent of the origin and condition of the land, allowing or preventing the transformation.

The first group includes issues such as: the land's size and dispersion in urban space, the nature of contaminants and their concentration in the soil as well as their impact on the environment and human health, the existence of buildings or their residues, under-surface structures and installations and other

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infrastructure. In the degraded area, a specific natural environment could have developed with sites of valuable plant species and animal habitats. This fact will definitely influence the direction of future development of such area.
External factors include, among others, the location of specific facilities or complexes of facilities in relation to the analyzed area (residential, service and production zones, green areas, distance from the center, etc.) and communication of the area with other parts of the city and the region (roads, tramways, railways, walking trails, bicycle paths).
External factors also include the degree of availability of utilities (water/sewage, gas, electricity, telecommunication network, etc.) and land ownership aspects. The divided area could be in the hands of many owners, and the forms of ownership could also be varied. This is a factor that makes it difficult to restore the area's functionality.
When revitalizing a given area, the social factor cannot be overlooked. Expectations of the local community as to the future use of the land may help or hinder the implementation of the development plan. The area may contain objects that over the years have become symbols of the place, the city, cultural identity and an attempt to remove them would face strong public opposition.

CHARACTERISTICS OF THE POST-SMELTER AREA UNDER ANALYSIS

The analyzed area is located in Chorzów II (Fig. 1).

Fig. 1 View of the Chorzów II post-smelter area:
1. Degraded post-smelter area, 2. Nowa Street, 3. Stacyjna Street. 4. Legnicka Street
Source: based on (Google Maps, 2020)

The past of the area is closely connected with one of the oldest ironworks in Poland, the Royal Ironworks, operating since 1797 in Chorzów (then the Royal Ironworks). After the Second World War it was renamed to the Kościuszko Ironworks. It closed down in 2012. Within the area under study, there were mainly landfills of solid waste generated in metallurgical processes. These landfills are currently removed. The area is large (over 53 ha), with height differences of several meters, faults. The ground plan is close to an equilateral triangle.

The approximate borders of the area are as follows:

- The western border partly runs along the Stacyjna Street,
- The southern border partly runs along the Nowa Street,
- The north-eastern border partly leads along the Legnicka Street.

The area is located in an urban, highly industrialized area. The surroundings are diverse. The south-western end is adjacent to a workers' housing estate, which was erected back in the 19th century. From the south, it is partly adjacent to the zone occupied by production plants, operating, among others, in the transport industry. The south-eastern part of the area is adjacent to the CHP Plant. From the north it is adjacent to the area that once belonged to the Barbara-Chorzów Hard Coal Mine.

Just beyond the western border of the area, there is a reservoir of standing water, the so-called Herman Pond, with an area of 3.54 ha. Until recently, this reservoir was part of the sewerage system – sewage passed through it. For this reason, the reservoir was a considerable nuisance for the people living in its vicinity. At present, after the modernization of the sewage system, the sewage bypasses the reservoir, and is led through pipes near the pond. The reservoir is no longer an element that reduces the inhabitants' life quality.

Nearly the entire discussed area is the property of the State Treasury with perpetual usufruct. Part of the plots of land, representing several percent of the area, belong to natural or legal persons.

CASE STUDY

Due to the volume limitations of the article, the analysis presented below is extremely simplified and random. Full analysis, apart from developing the issues indicated in this chapter (supported by deliberate research, e.g. substances contained in the soil and their impact on human health and the environment), should include an in-depth social query among the inhabitants, which would provide a picture of the situation – whether a given investment in this place would be supported by local communities, or what are the community's expectations of the future development of the area.

The analysis presented below is based on selected elements of the post-industrial area assessment procedure developed by M. Pierściński and B. Białecka (Pierściński and Białecka, 2014).

Tables 1 to 4 contain information related to the location of the site.

Table 1 Proper name or brief description of the area

Area after smelter heaps.

Table 2 Code and location

Area code	Place:	Municipality:	Poviat:	Post code:	Street, no.:
-	**Chorzów II**	**Chorzów**	**Chorzów**	**41-500**	**Nowa**

Table 3 GPS coordinates – outermost points

N 50° 31' 50,13" N 18° 95' 67,92" E	**E 50° 30' 97,56" N 18° 96' 55,51" E**	**S 50° 30' 76,75" N 18° 95' 86,21" E**	**W 50° 30' 88,96" N 18° 95' 25,98" E**

Source: Own study based on (Chorzów Geoportal, 2020)

Table 4 Size of the area

53.28 ha

Table 5 lists the registration plot numbers.

Table 5 Post-industrial area registration plot numbers

138, 139, 148, 158, 629/109, 2946/159, 799/177, 160, 674/179, 671/189, 1664/201, 1665/201, 1668/210, 1669/211, 1672/220, 221, 231, 232, 241, 242, 251, 261, 196/1, 201/6, 202/7, 202/12, 213/13, 218/18, 574/24, 371/125, 1271/30, 1274/31, 1275/36, 1278/37, 1282/43, 1290/47, 1295/49, 1301/51, 1302/54, 1307/55, 1308/56, 1313/57, 1733/59, 1737/61, 1739/64, 2932/128, 2931/128, 629/209, 702/135, 1896/124, 1899/129, 505/109, 586/110, 587/115, 588/116, 589/121, 590/124, 591/129, 2210/121, 2219/109, 2217/110, 2215/115, 2213/116, 2211/121, 1914/109, 1912/110, 1910/115, 1718/116, 1718/115, 1718/116, 2225/139, 127, 137, 140, 147, 150, 157, 782/162, 180, 187, 811/199, 190, 202, 209, 212, 219, 222, 1673/230, 1674/230, 233, 240, 243, 250, 1578/260, 1266/19, 1267/24, 27/126, 3159/136, 315/146, 262/164, 2659/181, 2662/191, 2914/223

Source: study based on (Chorzów Geoportal, 2020)

Table 6 and Table 7 show data on the legal status and forms of land ownership.

Table 6 Information on whether the legal status of the area is regulated

Yes	No	No data

Table 7 Ownership structure

Form of ownership	Share in ownership (in % of the land area)
State Treasury	**94.8%**
Local government unit (communal, county or voivodeship)	**0.2%**
Legal or natural persons	**5%**

The structure of ownership is illustrated in Figure 2.

In the case of property diversification, an important factor which may hinder comprehensive revitalization is the lack of agreement between individual property owners on the direction of land development, or reluctance to take any actions related to the area.

Fig. 2 Ownership structure of the post-smelter area. 1. Ownership by the State Treasury with perpetual usufruct, 2. Ownership by natural or legal persons, 3. Ownership by the City of Chorzów without perpetual usufruct

Source: Own study based on (Chorzów Geoportal, 2020)

Table 8 Requirement for immediate intervention

Yes	**No**

Table 9 Supply of the area with utilities (networks in the area)

Type	Yes	No
Electricity	**X**	
Water system		**X**
Sanitary sewage system		**X**
Combined sewage system		**X**
Storm water drainage		**X**
Gas	**X**	
Central heating		**X**
Telecommunications network		**X**
Other (specify)	**Unidentified residues of former installations**	

Source: Own study based on (Chorzów Geoportal, 2020)

Tables 10 to 13 relate to the state of building development on the site.

Table 10 Presence of buildings

Built-up area	**Non-built-up area**	No data

Table 11 General description of existing cubature facilities (names, cubic capacity, initial and current use, ownership)

Currently an undeveloped area, which contains brick remnants of the buildings that used to exist there

Table 12 General technical condition of the development

Good	Bad	Difficult to determine
Not applicable	**Not applicable**	**Not applicable**

Table 13 Do existing infrastructure structures require an expert opinion on their technical condition? If so, specify which structures

-

Table 14 sets out the distances of road and rail objects from the site.

Table 14 Local road and railway infrastructure

Road or railway facilities	Road/railway line number	Distance from the area
Nearest existing provincial, poviat or municipal road	**DK 79** **LK 132**	**200 m** **along the northern boundary of the area**

The location of transmission lines relative to the area is specified in the Table (15) below.

Table 15 Local industrial lines near the area

Type of infrastructure	Distance from the area
Water system	**runs at the Stacyjna Street along the western border**
Sanitary collector	**in the northern part of the area there are remains of old connections. Manifold accessibility from the Stacyjna Street and the Legnicka Street**
Power line	**in the northern part of the area, on the border with the Stacyjna Street there is a residue of a former installation Access from the Stacyjna Street and the Legnicka Street**
Gas pipeline	**There is a former gas pipeline installation in the area. Besides, access from the Stacyjna Street**
Telecommunication line	**Access from the Stacyjna Street and the Legnicka Street**

Source: Own study based on (Chorzów Geoportal, 2020)

Table 16 and Table 17 show the location of pollution emitters and landfills relative to the site.

Table 16 Local air pollution emitters

Emitter's vicinity	Yes	No
The area is adjacent to the sewage treatment plant – distance less than 500 m		**X**
The area is adjacent to a functioning point emitter of air pollution – distance less than 500 m	**from the south-western side the area is adjacent to the CEZ Chorzów S.A. CHP Plant.**	
Sewage treatment plant within the area		**X**
Point emitter of air pollution within the area		**X**

Table 17 Unused landfills

Facility	Distance (m)	Notes on nuisance
Unused municipal landfill	-	-
Unused industrial landfills	**The analyzed area is a demolished landfill site for metallurgical waste.**	**Negative environmental and health impacts due to substances in the soil. The nuisance as such is not perceptible.**

Table 18 provides an assessment of the internal communication system.

Table 18 General internal evaluation of the communication system

Type	General description (degree of development, technical condition)
Road network and car parks	**None**
Rail infrastructure	**None**
Other (footpaths, bicycle paths, horseback riding paths, lifts, etc.)	**Road residues within the site**

The Table (19, 20) below indicates the type of current land use.

Table 19 General types of current use of the area

	Yes	No
Production and services		**X**
Housing		**X**
Communication and transport		**X**
Recreation in the open air		**X**
Arranged greenery or nature conservation		**X**
Open waters		**X**
Agriculture		**X**
Unused area	**X**	

Table 20 A document specifying the directions of future use of the area

Local area development plan	**X**	Study of land management conditions and directions	

The following tables show the activities that caused land degradation (Table 21) and the types of waste on the site (Tables 22 to 24).

Table 21 Activity that caused degradation

Energy sector		Machinery industry		Industrial waste depository	**X**	Opencast mining	
Metal industry		Construction industry		Municipal waste management		Underground ore mining	
Chemical industry		Paper industry		Wastewater treatment		Aggregate extraction	
Coke industry		Textile industry		Cement factory		Sand extraction	
Iron industry	**X**	Wood industry		Transport business		Rock mining	
Metallurgy of non-ferrous metals		Food processing		Underground coal mining		Peat exploitation	

Table 22 Presence of waste in the area

Types of waste (classification according to Waste Act)	Present	Not present	No data
Hazardous	**X**		
Municipal		**X**	
Other than hazardous	**X**		
Neutral			**X**

Table 23 Is the area polluted?

Yes	**X**	No		no data	

Table 24 What types of substances cause contamination?

type of contaminant	Yes	No	no data (but contamination is highly probable)
metals	**X**		**tantalum, vanadium, molybdenum, lead, arsenic, cadmium, metal oxides**
organic compounds (other than pesticides)		**X**	
gas emissions		**X**	
pesticides		**X**	
other (specify)			**fluorides, sulphides**

Source: Own study based on (Lis, Nowacki and Łakomy 2018).

The so-called slag – a waste product of metallurgical processes – was stored in the landfill. Slag is an alloy containing impurities from ores, fluxes, deoxidants and metal oxides. Tantalum, vanadium, molybdenum and other ions could be flushed from the landfilled waste to the soil and then penetrate into the water (Adamczyk, Grzesik and Karat, 2017, Jonczy and Lata, 2013). Heaps are demolished, while the soil may contain compounds with negative environmental and health impacts.

Additional information about the terrain is shown in the table below (Table 25).

Table 25 Additional relevant area information (e.g. occurrence of slopes above 15%, ponds, ditches, shallow underground voids, especially large parking areas or storage yards, garages, extensive bushes, wild animals, etc.)

Despite the leveling, the area shows fluctuations in height, with faults reaching several meters. In the past it was occupied by heaps of solid waste from metallurgical processes.

Table 26 and Table 27 indicate the possible directions of re-developing the area.

Table 26 Suggested preferences for development directions in the light of the origin of the area

Production sites	Service building sites	Residential buildings	Communication and transport sites	Sport and recreation in the open air	Greenery, nature
	X	**X**			**X**

Table 27 Possibility of multifunctional development (work-housing-rest) in the light of the origin of the area and its size (only areas over 20 ha)

Yes, after eliminating the risks associated with the activities carried out in this area	No.

Information on whether there are groundwater intakes near the described area is given in Table 28.

Table 28 Main groundwater reservoirs and intakes

Criterion	Yes/No
Presence of groundwater intake	**Not present**
Location in a protection zone of the groundwater intake	**No**
Location within main groundwater reservoirs	**No**

Tables 29 and 30 contain data on distances from the terrain to roads and objects of supra-local importance.

Table 29 Road facilities of supra-local importance

Road facilities	Road no.	Distance
Nearest motorway or expressway	**DTŚ 902 A1**	**3.8 km 4 km**
Nearest national road	**DK 94**	**200 m**
Nearest motorway junction	**A1 and A4**	**24 km**

Source: own study based on (Google Maps, 2020)

Table 30 Other facilities related to transport of supra-local importance

Facility	Name	Distance
Road border crossing point	**Chałupki**	**74 km**

Source: own study based on (Google Maps, 2020)

THE IMPORTANCE OF A SOCIAL FACTOR IN THE SUCCESS OF REVITALIZATION OF A DEGRADED AREA

The transition from an industrial to a post-industrial city was associated with the economic restructuring process, which also affected the social factor in a negative way. A change in plant owners, a change in the business profile or liquidation of plants has resulted in an increase in the number of unemployed, migration or a sense of exclusion. The technical resources of the liquidated companies were degraded. Such factors do not favor a positive perception of post-industrial areas by communities once related to the plants operating on their territory. Such a state of affairs may result in low interest or lack of support for potential investments giving new functions to these areas.

The key to the investment's success may be to give supra-local significance to the revitalized area.

Therefore, determination of the direction of future development of the analyzed post-smelter area should be preceded not only by activities documenting the analyzed area in detail in the environmental, legal or economic aspect. The

social factor, on which the success of the revitalization process may depend, should also be included.

CONCLUSION

Restoring functionality to degraded areas has positive effects on many levels. Depending on the direction of future development, it may be: strengthening the economic potential of the city, creating new jobs, activating the community, improving the environmental potential and using it for the leisure of the inhabitants. The choice of an appropriate direction of revitalization is based, among others, on the collection of comprehensive information on the area. The collection and handling of data is supported by various types of solutions: information platforms, cluster solutions (Tereny Poprzemysłowe i Zagradowane jako integralna…, 2020, Bondaruk and Pilch, 2013, Michalski and Szczęśniak, 2015, Szczęśniak, et al., 2018). As mentioned in point 4, the above article only indicates issues that should be elaborated in detail in order to create a complete picture of the area under analysis.

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REFERENCES

Adamczyk Z., Grzesik B., Harat A. (2017). Środowiskowe skutki stosowania żuzla hutniczego jako składnika kruszyw. In: Zeszyty Naukowe Politechniki Częstochowskiej. Budownictwo Z. 23 (173). Częstochowa: Wydawnictwo Politechniki Częstochowskiej.

Bondaruk J, Pilch A. Ogólnodostępna Platforma Informacji – Tereny Poprzemysłowe i Zdegradowane jako przykład systemowego podejścia do zarządzania danymi w zakresie zagadnień przestrzennych i środowiskowych. Aviailable at: http://www.e-slask.pl/files/zalaczniki/2013/12/17/1387286507/1387286747.pdf.

Gorgoń J., Bronder J., Starzewska-Sikora A., Owczarska I., Heffner K., Gibas P., Polko A. (2014). Lokalny program rewitalizacji Chorzowa do 2030 roku. Instytut Ekologii Terenów Uprzemysłowionych. Available at: http://miasto3.com/uploads/docs/Program_Rewitalizacji_Chorzowa_do_2030_roku.pdf [Accessed 20 May 2020].

Google maps, (2020). Aviailable at: https://mapy.google.pl/ [Accessed 19 May 2020].

Jonczy I., Lata L. (2013). Charakterystyka składu chemicznego żużli konwertorowych i wielkopiecowych. In: Górnictwo i Geologia, tom 8, zeszyt 1, Gliwice: Wydawnictwo Politechniki Śląskiej.

Lis T., Nowacki K., Łakomy K. (2018). Ekologiczne aspekty składowania odpadów hutniczych zawierających żelazo. In: R. Knosala (Ed.). Innowacje w zarządzaniu i inżynierii produkcji. Tom 2. Opole: Oficyna Wydaw. Polskiego Towarzystwa Zarządzania Produkcją.

Michalski K., Szczęśniak B (2015). Concept of a model database enabling data storage for purposes of investment attractiveness assessment of degraded post-mining areas. In: 15th International Multidisciplinary Scientific GeoConference SGEM 2015. Informatics, geoinformatics and remote sensing, pp. 18-24, June, 2015, Albena, Bulgaria. Conference proceedings. Book 2. Vol. 1. Sofia: STEF92 Technology.

Ogólnodostępna Platforma Informacji – Tereny Poprzemysłowe i Zdegradowane jako integralna część Regionalnego Systemu Informacji Przestrzennej (RSIP). Available at: http://opitpp.gig.eu/celerezultaty.html [Accessed 20 May 2020].

Pierściński M., Białecka. B. (2014). Wspomaganie procesu wyboru kierunku zagospodarowania terenów poprzemysłowych. In: B. Białecka (Ed.), Zrównoważona rewitalizacja terenów zdegradowanych – dobre praktyki. Katowice: Główny Instytut Górnictwa.

Szczęśniak B, Midor K, Zasadzień M. (2018). A concept of an IT tool for supporting knowledge transfer among facility maintenance employees as part of intelligent organization. In: Intelligent systems in production engineering and maintenance. Proceedings of the First International Conference on Intelligent Systems in Production Engineering and Maintenance, ISPEM 2017, Wroclaw, Poland, 28-29 September 2017. Ed. Anna Burduk, Dariusz Mazurkiewicz. Cham: Springer Verlag.

Abstract: The process of transformation in the Polish economy, transforming it from a planned economy into a market economy, has resulted, among others, in the liquidation of many heavy industry plants in the Upper Silesian Industrial Region (GOP). GOP cities, which grew up on the basis of heavy industry, were spatially planned according to the needs of mining and metallurgical plants. Liquidation of the plants resulted in the creation of degraded, unused post-industrial areas, scattered over various city districts. Their location is often very attractive, but with many drawbacks, such as degradation, contamination by harmful substances or unclear legal status, potential investors are reluctant to take interest in them. Detailed documentation of the land's characteristics, the effects of the activity previously carried out here, the community's expectations regarding the use and development of such land, will make it easier for the investor to take a decision on the re-development of the area. The article is an example of a preliminary analysis of a selected post-industrial area, which helps to outline the direction of its revitalization.

Keywords: degraded area, post-industrial management, revitalization