

Planning of areas in the vicinity of large industrial plants

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Abstract

Planning space around large industrial plants affects urban development and significantly impacts the integration of industrial areas with a city's structure. Large industrial plants act as functional and spatial barriers within the urban fabric. Their immediate areas undergo transformation and are currently becoming sites of various uses. New manufacturing technologies limit the nuisance caused by industry and the siting of plants aids in using the areas around them. The objective of this paper is to present an analysis of the transformation of the existing function-spatial structure, transport layout and compositional relations in the vicinity of selected large industrial plants in Kraków and Skawina. The study covered areas around the north-eastern territory of the Metallurgy Plant in Kraków and selected industrial plants in Skawina.

This study was based on original analyses of the existing function-spatial structure, compositional relationships and transport accessibility. The form of development of areas adjacent to large industrial plants was found to be a product of local determinants. Compositional relationships and functional linkages affected the quality of the space and its visual reception, which in many cases is a natural urban development reserve.

Due to the specificity of industrial areas, concentrations of vehicular traffic and dominance within space, it may prove interesting to develop a dedicated form of development for areas near large industrial plants. This form would have to shield against possible nuisances while also offering the potential for a new, attractive and diverse function-spatial structure. The transformation of and the problems present in these areas are distinctive of many cities in Poland and around the world and require new, cohesive planning principles.

Keywords: function-spatial structure, urban planning, industrial areas

1. Introduction

In many cities, large industrial plants form integral parts of the development structure. Their placement significantly impacts a city's development, and most importantly, heavily affects nearby areas. This stems from the specificity of industrial areas, which are concentrations of pedestrian and vehicular traffic, and are a nuisance due to production processes affecting the immediate neighborhood. Exploring this subject is essential due to the processes of the transformation of the functio-spatial structure of contemporary urban complexes and their fragments, and the matter of planning areas close to large industrial plants requires dedicated and specific forms of development, one that blends with the urban or suburban tissue while ensuring a comfort of functioning within the zone of impact of industry. The objective of this paper is to present an analysis of the transformation of an existing functio-spatial structure, compositional relations and the transport network in the vicinity of large industrial plants in Krakow and Skawina, Poland. Investigating these areas is relevant and essential for the following reasons:

- ▶ Due to the real estate development pressure exerted within the city and its suburban zone, including in areas that accompany industrial plants,
- ▶ the continued limiting of the nuisance caused by production plants and the area they occupy,
- ▶ tendencies in the improvement of the quality of life and space, including in areas dominated and adversely affected by close proximity to industry.

The subject matter of broadly understood spatial transformation in urbanized areas, including those near industrial areas, is the object of interdisciplinary research. We can find them explored from the standpoint of architecture and urban planning, the social sciences and demographics. Spatial effects impact, among others, matters of economics and demographics. These problems were discussed by A. Hołuj (Hołuj, Luchter, Semczuk, Serafin, 2020). who focused on Krakow's suburban area. The authors analyzed the demographic changes of the years 1996–2018 and changes in land use in selected areas of Krakow's suburban zone in the years 1977–2019, highlighting the dynamism of urbanization processes, yet confined the scope of spatial research to transport-related areas and broadly understood development. Many papers concern the revitalization of post-industrial areas, especially within the city structure, due to their adaptive reuse and the disappearance or decline of previous branches of production. Transformations of the industrial structure were discussed by M. Miśkowiec on the example of Łódź, Manchester and Lyon (Miśkowiec, 2016).

The author noted the adaptive reuse of historical buildings associated with the declining textile industry and various models of revitalization efforts and their spatial outcomes in the urban fabric. Examples of revitalization models employed in postindustrial areas in reference to projects carried out in European countries were presented by M. Baborska-Narożny (2012). This author pointed to the complexity of revitalization processes and the economic consequences of the solutions introduced, stressing that every measure taken in these areas contributes to shaping urban tissue. New functions in postindustrial areas and their legal and environmental conditions were discussed by S. Krasuski (2020). The author, having analyzed the process of revitalizing postindustrial areas, refers to its social, economic and spatial outcomes, which affect the sustainable development of cities and the surroundings of former industrial areas. This study points to the complexity of problems arising from past industrial uses and difficulties in adapting these areas to present-day standards and new, preferred uses. Matters that concern the immediate vicinity of industrial plants within the city structure were within the field of interest of researchers due to the nuisance caused by industry and a lack of effective methods and technical means of limiting it. Thus, much of the literature from the 1980s and 90s focused on protective zones around industrial areas as a makeshift method of isolating industrial plants from surrounding urban tissue.

The works of E. Niezabitowska (1987) and J. Klemens (1993) are some of the more interesting ones. They discuss the matters of the range and methods of determining protection zones and their limited effectiveness. Interesting materials on spatial structures that form around industrial areas and analyses of threats specific to given sectors were presented as a part of environmental impact assessment reports, which are legally required of a range of industrial projects. A report concerning an area close to Mikoszków (Szkudlarek, 2017) indicates the potential threats and presents an overview of urban and cultural tissue of the buffer zone as an essential element of the impact of mining a granite deposit. The specificity of industrial incidents that can significantly affect the safety of nearby areas and thus require relevant decisions during the planning document drafting stage, is a crucial factor in the planning of the surroundings of industrial areas. Guidelines concerning the methodology of identifying safe locations for such projects require individual analyses of technological processes and local conditions (Małaczyński, 2007). The subject of the immediate surroundings of large, actively operating industrial plants, is therefore a topical research problem. The review of the literature presented indicates that it has a multilayered and diverse character. It arises from the dynamic transformation of industrial areas, the decrease of the territory they occupy, and the use of new production technologies. The plants selected for analysis are key elements in the economic development of Krakow and Skawina, and their surroundings can be attractive in terms of placing new uses.

2. Research scope and method

This study focuses on the surroundings of the northeastern territory of the Metallurgy Plant in Krakow and selected industrial plants in Skawina. These include the power plant and the automotive plant in the eastern part of the city. The study was based on an analysis of the functio-spatial structure, compositional relations, transport accessibility and areas that abut the plants in question. The areas under study have been presented in figures 1, 2 and 3, suitably to their respective locations, and are lie within 1,0 km of the relevant industrial plant grounds' borders. A land use analysis was performed, accounting for selected elements of the functio-spatial structure, including housing (single- and multi-family), office, industrial and storage and service development, and green areas, including farmland and landscaped greenery. The analysis also focused on composition, including dominant buildings and elements, visual and compositional axes, and transport elements, including arterials, railway lines, public transport stops and parking lots. Available planning documents were also investigated, in reference to proposed development trajectories for the functio-spatial structure of these territories.

3. Overview of the development structure, functional and transport linkages

The analyzed surroundings of the Metallurgy Plant in Krakow Nowa Huta consist of single-family development that belonged to the historical villages of Grębatów, Lubocza, Łubczanowice, Wadów and Ruszcza (Fig. 1). The past settlement layouts were gradually erased due to the siting of new housing and service development along the existing and modernized transport system. Service, storage and manufacturing buildings supplement the single-family development. They consist of singular buildings without the clear zoning of a larger area for this function. The road system that connects the former villages was retained, and its modernized fragments were the result of ongoing development pressure in the area, which arose from limits placed on the output of the metallurgy plant and the resulting decrease in its nuisance. The surviving

railway lines that service the plant form a potential that can be used in public transport and providing access to presently developed areas and linkages with the city. There are two train stops in this area, in Lubocza and Ruszcza, which are planned for use by commuter rail.

The power plant in Skawina is located in the western part of the city and is surrounded by single-family housing development of the former suburban villages of Kopanki and Samborka, which have varying degrees of density (Fig. 2). At specific points, these areas are supplemented with services, natural greenery and agricultural uses. To the east and south of the plant, there are industrial areas that are varied in terms of what they produce and store. The area in the south has retained its former green protective zone, which separates the city from an inactive aluminum plant. The transport layout is based on past functional linkages, with the northern bypass that takes over some of the transit traffic through the city being a new addition. The railway line that crosses the area, despite there being a large number of plants, does not have a stop for local workers.

The vicinity of the automotive plant in Skawina, in its southern and eastern sections, consists of single-family detached houses and compact urban development (Fig. 3). They form enclaves that can be accessed via the transport system that services the industrial zone, which is expanding to the north. The green uses that have survived in this area are irregular and form potential buildable land reserve for developing industry and storage development. Services consist of free-standing buildings that supplement the existing development structure, without any clear tendencies to form interlinked centers that would compositionally integrate the space. The transport layout is illegible, and is connected to the city's northern bypass and a road that links up with Krakow.

4. Compositional relations

The metallurgy plant is a spatial barrier in the area. Its development and technical infrastructure dominates the area and is visible from various perspectives and distances (Fig. 1.). The Mound of Wanda is an interesting compositional element, and its location provides potential for vista openings and compositional axis directed towards Krakow and its remaining mounds. Local landmarks include the former church in Ruszcza, as well as areas of landscaped greenery associated with historical manorial complexes in Wadów, Ruszcza and Łuczanowica, as well as the fort in Grębałów.

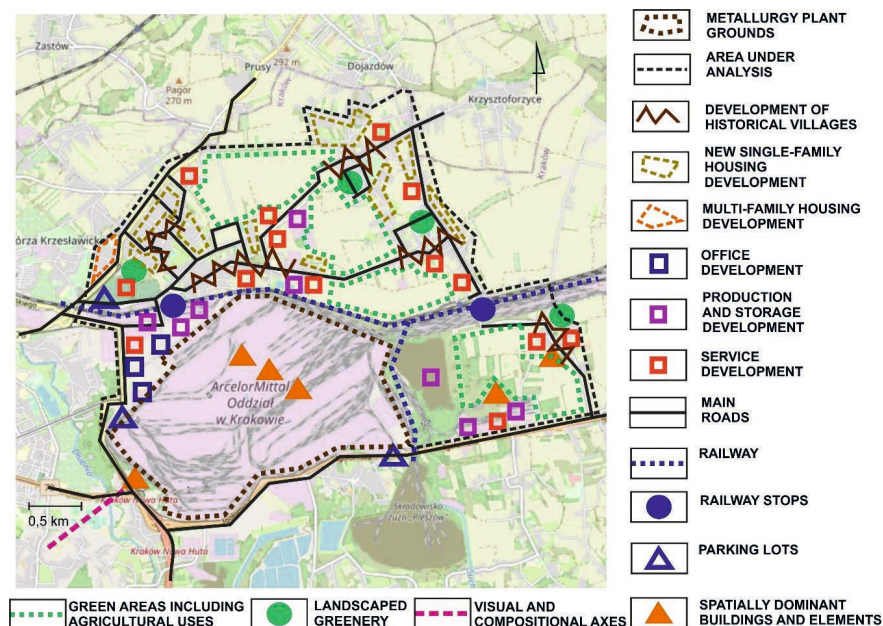
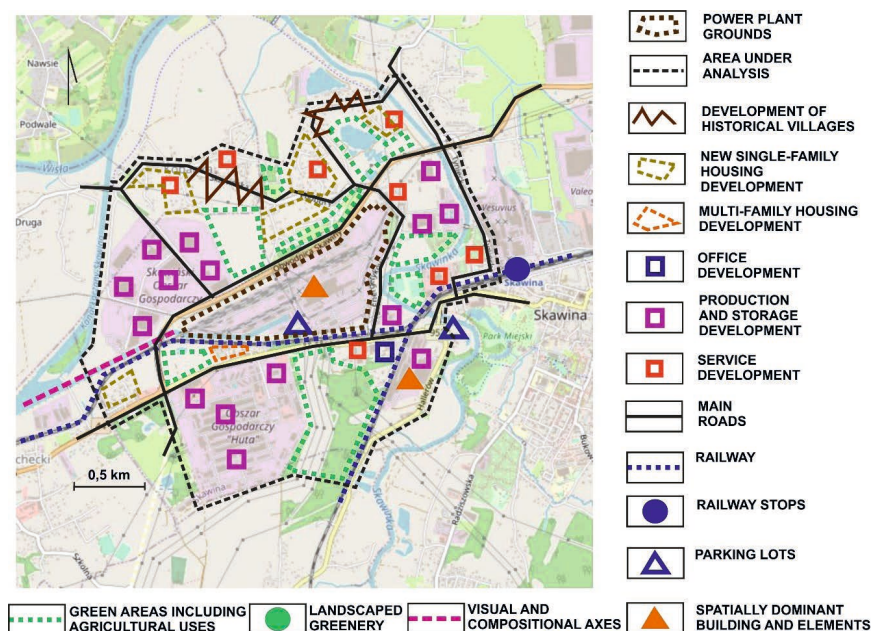


Fig. 1. Analysis of selected elements of the existing functio-spatial structure of the surroundings of the northeastern part of the Metallurgy Plant in the district of Nowa Huta in Krakow (Own elaboration)

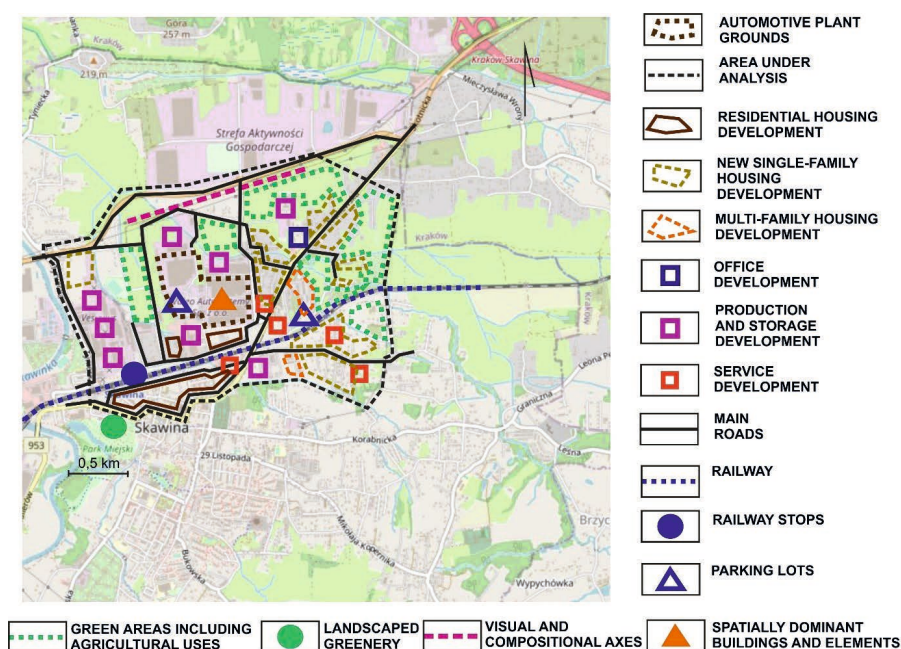
Fig. 2. Analysis of selected elements of the existing functio-spatial structure of the surroundings of the power plant in Skawina (Own elaboration)



The power plant in Skawina and the food processing plants in its vicinity are significant dominant elements in the area under study (Fig. 2). In the case of the power plant, long-distance overhead power lines interfere with the landscape. The visual and compositional axis along the nearby łączany water canal forms an interesting vista opening towards the west.

The automotive plant has the form of an extensive plant that blends into the remaining development of the industrial zone, that nevertheless dominates in terms of area (Fig. 3). In terms of composition, the nearby existing housing development is dominated by the proximity of industry. The lack of the delineation of these structures and a shared transport system are not conducive to the compositional legibility of the urban layout. A visual axis runs along a fragment of the city's northern bypass.

Fig. 3. Analysis of selected elements of the existing functio-spatial structure of the surroundings of the automotive plant in Skawina (Own elaboration)



5. Planning determinants

The areas north of the metallurgy plant in Krakow, in the district of Nowa Huta, are covered by Krakow's Spatial Development Conditions and Directions Study (SUiKZP) from 2014. The area that borders on the metallurgy plant in this area is primarily assigned for single-family housing as the supplementation and continuation of the development of the historical villages of Grębatów, Lubocza, Wadów and Ruszcza. The possibility of placing services and industrial areas at specific points is allowed, as is the retention of the railway line with a train stop in Ruszcza, as the planned development of the city's commuter rail system. The Skawina power plant and the automotive plant and their respective surroundings are covered by the detailed provisions of the Local Spatial Development Plan for Skawina from 2013. The surroundings of the power plant from the west, south and east, are areas intended for the development and retention of previous industrial and service uses. From the north, there is to be a continuation of single-family housing with services, and sports and recreational areas. They are separated from the power plant grounds by the city's northern bypass and buffer greenery, which indicates an awareness of the predominance of the power plant in the space of this fragment of the city. The automotive plant is located in the north-eastern part of the city and is a part of a planned industrial zone. In their immediate vicinity, to the west and north, further industrial uses are planned, while from the south and east, the existing single-family development is to be retained, with possible supplementation via services. The transport layout shared by these uses connects with the bypass from the north and with the main arterial of the city that runs towards Krakow. No green areas that would separate enclaves of single-family development from industry were planned here.

6. Results and discussion

The form of the development of areas that abut large industrial plants is the effect of local determinants. The compositional relations and functional linkages affect the quality of space and the visual reception of the zone, which in many cases is a natural area of urban development. Similar themes were discussed by Liu H. et al. (2015), who analyzed changes in the land use of a city in the light of the dynamic development of industry over the past two decades in China. The transformation of urban structures, especially in the area of large industrial plants, require a suitable approach due to new threats to the natural and cultural environment, the freeing up of areas previously occupied by industry is a challenge for creating new space (Kaczmarek, 2004) as it is in the case of the northeastern section of the Metallurgy Plant in Krakow's Nowa Huta, which are the subject of a competition.

The urban and architectural design competition that concluded in 2012 can become the start of a new quality of space in this area and a continuation of the development of the previously also residential district of the city (Stangel, Drobnik, 2014). Its effects can be an indication for other areas with predominantly industrial uses, for the pursuit of alternative, attractive architectural and urban solutions and linking new creative branches of production with urban tissue. The southern area that was covered by the competition was not included in the study due to its current transformation and the open, staged decisions featured in competition solutions.

In the analyzed cases of the surrounding industrial plants, there are notable examples of a varied functional-spatial structure (Fig. 1, 2, 3). It consists of housing development with a predominance of single-family detached housing, production and storage uses, as well as service and office uses (table 1). A considerable portion was also found to be occupied by green areas, which included agricultural uses.

Table 1. Estimation of selected existing elements of the functio-spatial structure in the areas around industrial plants under analysis (Own elaboration, 2021)

Land use	Krakov metallurgy plant	Skawina power plant	Skawina automotive plant
Industrial plant	30.3%	11.9%	5.5%
Housing	13.3%	9.5%	22.2%
Services	2.8%	3.6%	6.6%
Office buildings	0.9%	0.6%	2.2%
Production and storage facilities	4.8%	28.5%	15.5%
Greenery, including agricultural use	28.5%	27.3%	22.2%
Other uses, including transport and technical infrastructure	19.4%	18.8%	25.8%

In the case of the metallurgy plant in Krakow and the power plant in Skawina, placement within the suburban zone abuts historical settlement layouts of villages and open greenery, including agricultural uses. All of the plants were found to be spatially dominant elements within their respective areas and acted as functional barriers in this area. The transport layouts were not legible. The surroundings of the plants under study was found to be a site of the placement of new industrial functions, especially in the case of Skawina. An absence of new landscaped greenery was observed within existing housing development enclaves, which is not conducive to the separation of industry from other types of development and the emergence of integrating public space networks. Services were found to be limited to essential functions, and their placement did not provide a continuity of linkages with the city center in the case of Skawina and local compositional relations in the case of the buffer zone of the metallurgy plant in Krakow.

7. Summary and conclusions

The planning of the areas that surround large industrial plans requires an individual form of development. It is the result of the need to protect against nuisance that accompanies the functioning of industry. Such development should provide a new, attractive, diverse structure, that could form enclaves that spatially deal away with the predominance of industry. We should also account for developers intending to use the areas which, despite being located close to industrial uses, are attractively placed and are often the natural development trajectories of urban development. In the cases analyzed, industrial plants were built on the outskirts of Skawina and Krakow, surrounded by former villages. Over time, the areas close to them began to attract new industrial functions, as well as housing and service development, constructed as their supplementation or the development of existing and new structures. This findings of this study can be used to formulate the following general conclusions:

The surroundings of large industrial plants are attractive areas for development. However, this requires formulating a new urban layout proposal based on the precepts of composition and the analysis of local environmental and cultural determinants.

New development enclaves, especially those that feature housing, should provide a new quality of space in architectural and urban design terms, and be supplemented by essential services and recreational areas.

The continuation of industrial uses requires separation from housing and establishing a legible layout in terms of transport and space.

Existing railway lines that could be used for public transport need to be modernized, and any new stops must become spaces that integrate new urban tissue.

It appears beneficial to maintain old and existing green areas around the plants or in fragments that naturally separate other areas from industry, and reduce the impression of its predominance in space, especially at the point of contact with housing development.

References

- Baborska-Narożny, M. (2012). Rewitalizacja terenów poprzemysłowych- modele przekształceń na wybranych przykładach. *Czasopismo Techniczne* 3-A, 275–279.
- Hołuj, A., Luchter, B., Semczuk, M., Serafin, P. (2020). *Zmiany użytkowania ziemi i ich skutki ekonomiczne i pozaekonomiczne w strefie podmiejskiej na tle przemian demograficznych*. Kraków: Wydawnictwo UE.
- Kaczmarek, S. (2004). Tereny poprzemysłowe w miastach – problem czy wyzwanie. [In:] *Przemiany struktury przestrzennej miast w sferze funkcjonalnej i społecznej* (pp. 155–163). ed. J. Stodczyk. Opole: Wyd. Uniwersytetu Opolskiego.
- Klemens, J. (1993). Przestrzenne i prawne uwarunkowania stref ochronnych. *Zeszyty Naukowe PŚ. Seria Architektura*, 20, 83–90.
- Krasuski, S. (2020). Zagospodarowanie i rewitalizacja terenów przemysłowych. *Economic and Regional Studies*, Vol. 13, Issue 4, 452–460.
- Liu, H., Silva, E., Wang, Q. (2015). *Creative Industries and Urban Spatial Structure*, Springer 2015, <http://doi.org/10.1007/978-3-319-16610-0>
- Małaczyński, M. (2007). *Metodologia określania bezpiecznych lokalizacji zakładów mogących powodować poważne awarie*. Warszawa: Główny Inspektorat Ochrony Środowiska.
- Miśkowiec, M. (2016). Przemiany terenów poprzemysłowych w miejscach dziedzictwa przemysłu włókienniczego na przykładzie Manchesteru, Lyonu i Łodzi. *Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego*, 30(3), 199–212.
- MPZP miasta Skawina (2013). Uchwała nr XIIN/456/13 Rady Miasta Skawina dnia 12.12.2013. Retrieved from: <http://www.gminaskawina.pl> (access: 16.08.2021).
- Niezabitowska, E. (1987). Infrastruktura społeczna i przyrodnicza przemysłu- stan istniejący prognozy rozwoju. *Zeszyty Naukowe PŚ. Seria Architektura*, 6, 101–112.
- Szkudlarek, Ł. (2017). *Raport o oddziaływaniu na środowisko przedsięwzięcia pn: Odnowienie koncesji eksploatacyjnej dla złoża Mikoszków*. Wrocław: Ekovert, 34.
- Stangel, M., Drobnia, A. (2014). Koncepcja zrównoważonego rozwoju dzielnicy Nowa Huta Przyszłości. *Przegląd Urbanistyczny*, VIII, Year VI, TUP publication series, 55–61.
- SUiKZP Krakowa (2014). Uchwała nr CXII/1700/14 Rady Miasta Krakowa z dnia 9.07.2014. Retrieved from: <http://www.bip.krakow.pl> (access: 16.08.2021).