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LOCATION DETERMINANTS OF CITY LOGISTICS CENTRES IN THE CONCEPT OF SUSTAINABLE DEVELOPMENT

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ABSTRACT: The decision-making processes for planning an environmentally compatible infrastructure are extremely complex, as are the logistics processes themselves. The concepts for the location of urban logistics centres have been compared with the ecological danger zones in Poland. In this way, areas with a high degree of environmental degradation, particularly unfavourable from the point of view of the location of new logistics centres, were identified. The decision on the location of the planned project should be based on a previously developed, special procedure for assessing investment implementation and its impact on the natural environment. The study aims to indicate the infrastructure of city logistics centres as one of the necessary and most effective factors determining sustainable development. As a rule, infrastructure can be created in two ways. The first one recommends building the enterprise and then its infrastructure, while the second one recommends the opposite approach. From the point of view of the infrastructure of sustainable development, the second approach seems appropriate, allowing for the effective implementation of the sustainable development strategy. The first approach may only lead to a decline in the meaning of sustainable development in mentality and social awareness (Ratajczak, 2000). The variety of approaches in the literature on the subject defining the concept of sustainable development infrastructure covers both the area of economy, society and the environment. Significant from the point of view of future generations seems to be the environmental aspect related to the creation of urban logistics centres in the era of sustainable development. One of the essential properties of the natural environment is equilibrium, which occurs when the outflow and supply of energy and matter in nature are balanced. The natural environment is in constant interaction with humans; to prevent its gradation, measures are taken to prevent damage to the physical environment or natural resources. There are also activities to reduce the risk of losses or encourage the efficient use of natural resources, including measures to save energy and use renewable energy sources (Tokarski, 2020).

KEYWORDS: infrastructure and environment, logistics centres, sustainable development

Introduction

One of the leading development trends of logistics centres is the development of city logistics. The more common clusters of distribution centres can facilitate the management of supplies related directly to the supply of residents and enterprises, using the planning and optimisation of logistics processes. There is no uniform definition of City Logistic as it covers various economic, ecological or environmental aspects. The concept of City Logistic is understood as a collective concept for many concepts of urban freight transport; it describes all activities related to the creation, control and optimisation of the flow of goods and information in industrial zones. The objectives of all these concepts focus on relieving the internal urban infrastructure as well as increasing the cost-effectiveness of urban freight transport while maintaining the same quality of supply. The bundling of different freight channels is one concept that is being attempted in freight centres.

One of the modern solutions that use new organisational forms to improve processes is logistics centres. A logistics centre that is an independent business entity that provides logistic services (transport, reloading, storage, distribution and picking of loads) generally has:

- separate area and infrastructure (roads, squares, parking lots, engineering structures and buildings),
- technological equipment for movement and storage as well as management (control) devices,
- qualified personnel,
- an organisation appropriate to the type and size of the logistic task.

The main goal of building and organising logistic centres in the economy is to: dispose of specific material goods, in the necessary quantity, in the desired place, at the right time and at the lowest possible cost.

This goal is achieved by the following functions of logistics centres (Jędra, 2011):

- reloading of transfer goods from many suppliers,
- storage of goods from many suppliers and intended for many recipients,
- distribution and completion of loads intended for multiple recipients,
- transport of goods, usually small recipients,
- many auxiliary functions (processing, packaging, repair).

Due to various types of logistics centres in countries leading in economic development, the article focuses on those that fulfil distribution functions in the logistics chain. As there are no logistic centres of European significance in Poland yet, you can choose from the solutions developed in the European Union countries with greater freedom. It is necessary to establish not only centres of national importance but also to create 2-3 centres of European

importance, constituting the distribution base for many important products in the neighbouring countries (Skowron-Grabowska, 2010).

The concept of Polish logistics centres should be linked to what is happening in neighbouring countries. It should be closely related to the combined and multimodal transport system, the development of the express service network, and the optimisation of warehouse locations. It's time to depart from the current practice of organising local centres for individual branches, namely: creating combined transport terminals on railway areas, bases of road transport services on highways, specialised bases in sea or river ports. The future belongs to logistics systems based on centres located in one place. The best location is, of course, in places with easy access to various international communication arteries (road, rail, water, air) with high capacity (Lipińska-Słota, 2009).

Legal and environmental requirements for the implementation of the investment

Logistics centres, both during the construction phase and later during operation, will significantly impact the surrounding natural environment. Therefore, before making a construction decision, an indispensable part of the prepared project should be an ecological analysis performed on the same principles as economic, financial or technical analyses. Therefore, it is necessary to develop a procedure for checking each project in terms of its potential environmental impact. In the first stage, all data on the planned activity should be collected, including data on ecological aspects. They will be used in the next stage when classifying the planned project according to the lists of activities depending on the degree of an environmental hazard. During the next step, you should get answers to the following questions:

- What might the impacts be, and how significant?
- What measures could be proposed to reduce the negative effects of the impact?
- What are the possible recommendations?
- Does the planned project meet ecological standards resulting from national, international or other legal regulations?
- Are there any possibilities to reduce the harmful effects of the planned project?

It is an essential part of the procedure and should consequently lead to a document containing all the data relevant to the project. It must also answer whether the effects of the activity are acceptable or not. The next step is an ecological inspection to check whether the agreed conditions are met, leading to creating a compliance document. It also includes potential comments

and conclusions. This document is the basis for possible ecological monitoring after the facility is commissioned.

Such environmental impact assessment procedures, usually more extended, are required, for example, when concluding credit agreements with the European Bank for Reconstruction and Development, which “supports in all its activities environmentally friendly and sustainable development”. In addition, local authorities often request comprehensive research on the impact of new investments on the natural environment of areas earmarked for new infrastructure and various organisations, especially ecological ones, under the sign of “Greenpeace”. Accurate information on the environment and the effects of human activities is very important. It is the basis for creating, implementing, monitoring, and enforcing legal regulations and environmental policy. They also constitute the basis for public participation in the decision-making process on environmental protection and, consequently, strengthen democratic institutions.

The association of Poland with European Communities and their member states obliges the Polish side to adjust the law, including the law in environmental protection, to the EU requirements. The Union has published relevant legal acts in environmental protection in the so-called “White Book” in the form of directives, regulations and decisions (Ogonowska, 2003).

After the adoption of the first Act on the protection and shaping of the environment on January 30, 1980, there was a legal basis for a comprehensive assessment of the state of the environment throughout the country. The draft of the new economic plan for the years 1983-1985 and the spatial development plan of the country until 1995, which was prepared at that time, gave rise to the need for a comprehensive approach to this assessment in spatial terms. Work on the development of the spatial diagnosis of the state of the environment was undertaken by the Planning Commission at the Council of Ministers, and its contractor was the National Spatial Development Team (Kassenberg and Rolewicz, 1985).

The areas of ecological threat were introduced in Appendix No. 4 to Resolution No. 21/83 of the Council of Ministers on the draft of the National Social and Economic Plan for the years 1983-1985. Every year, until 1994, the validity of the then introduced delimitation was extended.

The purpose of designating such a category of areas was to distinguish areas with a high concentration of threats and to accurately recognise the state of the environment and the need for measures to protect it (due to limited resources) in order to contribute to stopping further degradation in these regions of the country, and then start the process of restoring them required environmental quality. The diagnosis included:

- state of water hazard and protection,

- state of protection of the earth's surface and its resources,
- state of danger and air protection,
- condition of forests,
- the state of conservation of nature and landscape.

The assessment was performed using the cartographic method, consisting of the mutual overlaying of state maps of individual elements of the environment and drawing conclusions for the spatial synthesis of the discussed phenomenon. The basic criterion for classifying an area as an endangered area was:

exceeding the permissible normative states of at least two elements of the environment, or

multiple or particularly troublesome (toxic) exceeding the permissible normative state of one element.

Based on the analysis at that time, the following were distinguished:

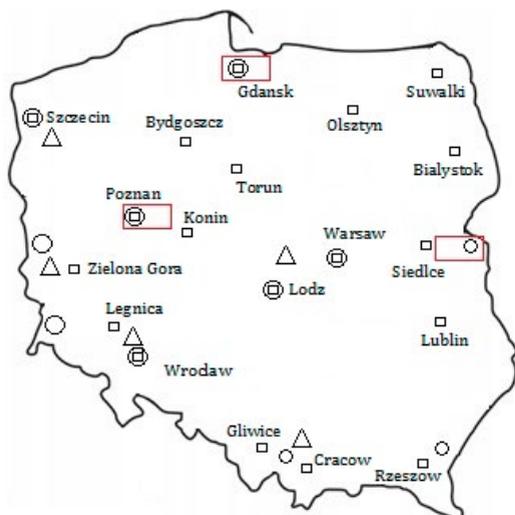
1. Ecological threat areas (OEZ), that is 27 areas of threatened ecological balance.
2. Areas of conservation nature and landscape protection with a disturbed natural balance – 23 National Parks.
3. Health resorts in danger of losing their medicinal values due to the disturbance of the natural balance – 23 Spas.

The result of classifying an area as ecological threat areas were clear restrictions formulated in the NPSG 1986-1990 Project as prohibitions:

- localisation of new and extension of the existing environmentally noxious facilities of the Agricultural Plant and in protected areas;
- locating new and expanding large industrial investments (employing over 200 people) in the distinguished agglomerations (Gdansk-Gdynia, Warsaw, Lodz, Katowice, Cracow);
- location of new water-absorbing facilities and facilities that discharge onerous sewage in the southern and central part of the country.

After environmental threats are placed on the map of Poland, there is clear zoning of the distribution of the endangered areas (Prystrom, 2013).

- Zone 1. The zone of integration of ecological danger zones, located in the southwest and south of the country, where the different areas are or overlap. The strategy of operation in this zone should be based on total protection of the environment, to which all socio-economic decisions must be subordinated.
- Zone 2. Bipolar coastal and sea risk zone, from Szczecin to Gdansk. The strategy for the operation of this zone should be based on the activities of the entire country to protect the Baltic Sea, as a significant amount of pollution comes from the country's interior.



City logistics centers:
 □ - International according to the concept of I
 △ - Regional according to the concept of I
 ○ - according to the concept of II

Figure 1. Regions of the location of logistics centres in Poland

Source: author's work.

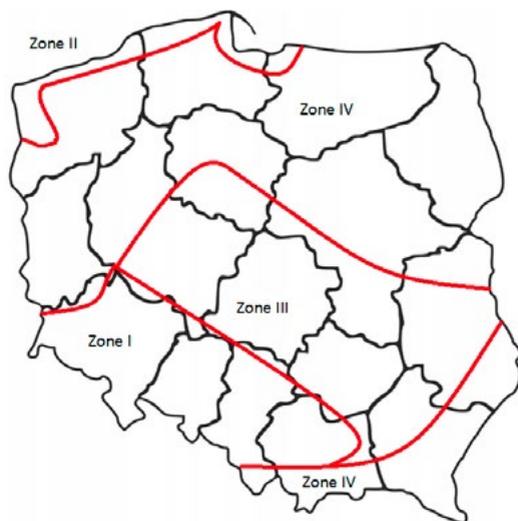


Figure 2. Ecological danger zones in Poland

Source: author's work.

- Zone 3. Dispersed OEZ in Western, Central and Eastern Poland. As threats are local, actions may consist in overcoming local threats and barriers to development.
- Zone 4. No OEZ, covering the north, north-east and south-east of the country. This zone requires, first of all, protection against the spread of pollution and threats to this area.

In 2018, the areas of ecological threat covered 35,208 km² (a total of 11.3% of the country's area), and 13.3 million people lived there, i.e. 34.5% of the country's population. Out of these 27 areas, 4 were considered to be extremely degraded areas; they are Upper Silesian Industrial District, Legnica Industrial District, Cracow City Complex, Bay of Gdansk and Zatoka Pucka (Czarnecki et al., 2020).

For several years, the largest program financed by the Funds, the Infrastructure and Environment program 2014-2020, has been implemented in Poland and the European Union. The areas of support and the types of projects that can be implemented relate to low-emission economy, environmental protection, counteracting and adapting to climate change, transport and

energy security, and protection of health and cultural heritage (Infrastructure and Environment Program, 2021). Thanks to the balance between investment activities in infrastructure and support aimed at selected areas of the economy, the program is to effectively implement the assumptions of the Europe 2020 strategy, with which its main goal is related – supporting the economy that uses resources efficiently and is environmentally friendly, and fosters territorial and social cohesion (Zalewska, Świetlikowski, 2017).

Concepts for the location of urban logistics centres in Poland and risk areas

Choosing the right location for a logistics investment should be preceded by a detailed analysis of a given region's potential. The construction plan is always associated with access to strategic road routes that connect the largest agglomerations in the country. City logistics centres enable the creation of optimal warehouse facilities in the supply chain of potential contractors, near industrial centres, with access to experienced employees, in the immediate vicinity of the most important communication nodes.

The location of logistics centres for the territory of Poland is closely related to the existing and planned transport corridors, which are connected with international transit routes located in Poland, running towards Eastern Europe and Asia. The construction of highways without suitable distribution sites would only create channels for the transfer of goods from abroad, thus not including Poland in the economic network of Europe, with transport directed primarily at its eastern partners. The location of logistics centres also depends on the development area and the radius of the cooperation.

Concerning Polish conditions, we can distinguish Logistics Distribution Centres (Kott, 2012):

- international (with an area of 100-150 ha and a range of 500-800 km),
- regional (with an area of 20-50 ha, range 50-80 km),
- local (with a development area of 10 ha and a range of 5-8 km),
- industry,
- indirect.

In the proposed concept (a concept I), the necessary minimum seems to be the establishment of 4 centres of the highest rank in Poland, International Logistic Distribution Centres in the vicinity of Poznan, Gdansk, Siedlce and Rzeszow. However, it must be admitted that their construction will require a lot of effort on the part of the central authorities of the country and the clear help of the EU partners. In addition, Regional Logistics Distribution Centres are needed in the region of Szczecin, Zielona Gora, Wroclaw, Cracow and Lodz (Jędra, Borowiak, 2010). The presented proposal for the location of logistics

distribution centres in Poland (figure 1) does not have to be treated as the only concept, but it is supported by Poland's new tasks that appeared when opening the trade borders between Western and Eastern Europe.

A similar concept (concept II) lists 11 areas (figure 1) where logistics centres of prime importance should be located, without indicating regional and broader international. As they require huge investments (over US \$ 7 billion), one experimental region should be selected as a testing ground where the construction of a logistics centre could be started with the prospect of including it in the European network of logistics centres. Due to its location near important communication routes and economic activity, the Poznan agglomeration seems to be such a region. Simultaneously with the creation of this main centre, sub-centres of the lower level could be created in other regions (Budner, Pawlicka, 2020). As mentioned before, 2 or 3 centres of international importance should be created. When comparing the two concepts, it can be seen that opinions are divided when it comes to the number of logistic centres of the highest rank in Poland.

The concept of urban logistics centres was created in conjunction with the development of urban logistics, which is a tool for solving problems of the functioning of highly urbanised areas – microregions such as urban agglomerations. It consists of taking a comprehensive look at freight traffic in cities. It covers considerations related to supply, waste disposal, as well as problems arising from air pollution, noise, accidents and traffic jams. Its aim is to reduce traffic congestion in city centres with unchanged transport efficiency. The partners of this concept are, on the one hand, retail companies and logistics service companies, and, on the other hand, municipalities (districts) that define the framework conditions. Such urban logistics centre concepts can be realised by creating a distribution centre on the outskirts of cities with convenient access. They are supplied by various producers whose products are intended for individual recipients. Merchandise distribution centres can also cooperate with a larger number of service providers. Due to the concentration, commercial enterprises located in city centres are efficiently supplied by a smaller number of vehicles, thanks to which, at the same time, environmental relief is achieved (Kryś, 2019).

The location and shaping of logistics centres require in-depth pre-design studies and considering many criteria related to location, spatial and functional development, infrastructure, information flow, and financial possibilities. It should be emphasised that the overriding criterion in relation to the above-mentioned ones is in compliance with ecological requirements.

The logistics centres will significantly impact the environment during the construction phase and during future operations. The main risks will be air pollution, noise, vibration and waste. An important area with a significant

impact on environmental pollution is the transport system and road and air transport. It consumes non-renewable energy and causes more pollution than industry. Internal combustion engines emit many substances harmful to the environment, such as carbon monoxide, hydrocarbons, nitrogen oxides, soot, sulfur dioxide, lead compounds, etc. Transport, especially road transport, is also one of the most onerous noises and vibration sources. Despite causing noise at higher levels, air and rail transport are assessed as less burdensome than road traffic because their impact affects a relatively smaller number of people living near airports or in areas along railway lines. However, the vicinity of logistics centres will become very onerous areas in this respect due to the increase in traffic intensity and its continuity (round-the-clock transport). The functioning of logistics centres can be compared to the functioning of small towns. Therefore, there is the problem of waste as well as the problem of wastewater treatment. Some centres, especially those with hazardous materials or larger amounts of various fuels, will pose an environmental problem. All these factors, as well as many others, must be taken into account and are very important elements in the design of logistics centres, as well as arguments “for” and “against” when designating sites for their construction.

The comparison of the concept of the location of centres (figure 1) with the ecological threat areas (figure 2) made it possible to distinguish those places on the map of Poland where the degradation of the natural environment is far-reaching and which are particularly unfavourable from the point of view of the location of logistics centres. These are mainly the vicinity of Cracow and Wroclaw located in the first danger zone, then Gdansk and Szczecin from the second zone, and then the vicinity of Lodz and Poznan lying in the third zone. Therefore, when deciding on the location and shaping of the centres, the situation should not worsen and be in line with the European Union’s environmental protection requirements.

Conclusions

The concept of sustainable infrastructure is developing. While traditionally, it has been associated with environmentally friendly or green infrastructure, it is becoming more noticeable and obvious in other, non-environmental dimensions. To summarise the considerations on the effective creation of sustainable development infrastructure, it should be shaped in harmony with nature, in order to ensure the continuity of the biosphere’s most important processes and to maintain the environment in a state that provides optimal conditions for human existence. The degree of infrastructure development determines whether a given economy will retain or attract new foreign

capital and whether a qualified workforce capable of generating technical progress will remain in a given country or seek more favourable work and development conditions in other countries. The basic goal of the development of each area is to provide its inhabitants with the highest possible standard of living. This is related to the pursuit of infrastructure investments, new economic entities and jobs, as well as goods and services that meet the needs of members of the local community while preventing or counteracting the harmful effects of human activity on the natural environment (Burchard-Dziubińska et al., 2014).

The role of logistics centres is to create conditions for the efficient flow of materials, mitigate and eliminate the disadvantages that logistics activities have on its environment, and support and initiate positive trends and tendencies in the development of business activities, elementary (but not only) in the area of logistics. Currently, the location and development of logistic investments of the City Logistic type is considered a tool that allows to increase the efficiency of logistics processes, the level of customer service, create quality in supply chains and reduce logistics costs. Logistics centres are also considered to be a significantly effective way to restructure areas in the downturn phase – they are treated as investments reviving the local economy and attracting new businesses. One of the most characteristic development trends of logistics centres is the development of city logistics – concentration of distribution resources in one place will in principle facilitate the management of supplies related to the supply of individuals, as well as companies within these agglomerations – by planning and optimising logistics processes.

Choosing the right location for a logistics investment should be preceded by a detailed analysis of a given region's potential. The construction plan is always associated with access to strategic road routes that connect the largest agglomerations in the country. Panattoni logistics centres enable the creation of optimal warehouse facilities in the supply chain of potential contractors, near industrial centres, with access to experienced employees, near the most important communication nodes.

The location of logistics centres for the territory of Poland is closely related to the existing and planned transport corridors, which are connected with international transit routes located in Poland, running towards Eastern Europe and Asia. The construction of highways without suitable distribution sites would only create channels for the transfer of goods from abroad, thus not including Poland in the economic network of Europe, with transport directed primarily at its eastern partners. The location of logistics centres also depends on the development area and the radius of the cooperation. The ability of transport companies to provide high-quality services is of signifi-

cant importance in the case of decisions regarding the location of a new transport and warehouse investment in Poland.

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