LogForum

> Electronic Scientific Journal of Logistics <

http://www.logforum.net

ISSN 1734-459X
2010
Vol. 6
Issue 2
No 2

ROLE OF LOGISTICS CENTRES IN NATIONAL LOGISTICS SYSTEM

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The paper was prepared within the project "The model of logistic system for Poland as a way to the transport comodality in European Union". Warsaw University of Technology. Faculty of Transport. The Division of the Technology and Organisation of Transport. Warszawa 2009/2010.

ABSTRACT. This article presents a division of logistics centres according to various criteria and specifies their role in a national logistics system. It provides a classification of the main logistics network nodes. It also describes those features of logistics centres that have an impact on zoning development of towns and regions. The current situation in the national logistics system has been presented here against theoretical analyses and also a concept for the development of a logistics centre network in Poland has been formulated.

Key words: logistics centre, warehouse centre, Intermodal trans-shipment terminal, national logistics system, logistics network, nodes of the logistics network, Intermodal transport.

FOREWORD

A logistics infrastructure is an indispensable element of any logistics system. It should provide for the flexible configuration and reconfiguration of networks and supply chains and for a variety of and freedom in selecting transport solutions based on a multi-branch transport infrastructure and also for a technical and IT infrastructure necessary in respect of functionality and the saturation level of logistics networks.

The variety of the logistics system models is significant. This results from the level of complexity, scope of functioning and form of ownership of the business networks for which such models are intended and also from the purpose of their use (exclusively for business purposes or also for non-business purposes, for example, social ones). Taking into account the required variety of linear and nodal elements of the logistics infrastructure, the national logistics system should be characterised by a high level of standardisation. For linear elements, this relates to the quality and technical parameters of the transport infrastructure and the telecommunications and IT networks. For nodal elements, on the other hand, this primarily means the presence of essential elements, the similarity of technical solutions, the level of availability and the parameters of exploitation, etc. Furthermore, an even distribution of those elements in individual regions is also important. In this context, the logistics networks should comprise an appropriate number of nodes, which apart from warehouse facilities should also include the internal multi-branch transport infrastructure connecting nodes with a similar national infrastructure and a technical infrastructure allowing for intermodal transport solutions to be

Citation: Fechner I., 2010, Role of logistics centres in national logistics system. LogForum 6, 2, 2
URL: http://www.logforum.net/vol6/issue2/no2
Accepted: 12.05.2010, on-line: 31.05.2010.

established. Such nodes need a large number of users, who through their activities create sufficiently high demand for logistics services in order to ensure their profitability. Such nodes include logistics centres and seaports, inland water ports and airports.

The establishment, functioning and development of the national logistics system depend on the availability and condition of the logistics infrastructure defined as:

A system of land and water routes, airports, seaports and/or telecommunications networks located in a certain area. A system approach to logistics recognises linear and nodal infrastructure as components of the logistics infrastructure [Słownik terminologii logistycznej].

The logistics infrastructure network is often identified with the transport infrastructure referred to as the infrastructure network consisting of transport nodes and a linear infrastructure [Wojewódzka-Król, Rolbiecki 2008].

The nodal elements of the logistics infrastructure function as logistics network nodes, which form the 'tissue' of the logistics systems. Depending on the location, organisation, functionality and their technical infrastructure, the nodes constitute external entries/exits to the national logistics system and/ or locations between which internal goods flows are carried out and at which goods are subject to various activities related to their collection, storage and delivery.

The aim of this paper is to systematise knowledge regarding the nodal logistics infrastructure, which together with the linear infrastructure, comprises the logistics network used by business entities in their relations with suppliers and customers. The logistics networks influence the shape of the logistics processes and the configuration of supply chains and business networks. The elementary logistics nodes have been divided and described here according to the adopted classification. The specific function of the logistics centres as the main nodes of the national logistics network has been presented against the adopted division. The detailed criteria for the division of the logistics centres and their specific characteristics have also been provided.

DIVISION AND DESCRIPTION OF THE ELEMENTARY TYPES OF THE LOGISTICS NODES

In relation to the issue of the national logistics system, the main nodes play an essential role. They are locations between which large freight streams are transferred and in which the freights are combined and divided in order to provide for the optimisation of transport solutions and the use of resources that are appropriate for this purpose. The auxiliary role is played by the nodes in the form of warehouses and terminals functioning for the purpose of being used by individual enterprises acting as suppliers and customers of local freight streams (Figure 1).

In order to classify the logistics network nodes as elements of the national logistics system, the following definitions have been adopted:

Logistics centre means a zoning structure, including its own organisation and infrastructure enabling various independent enterprises to carry out goods-related activities related to their warehousing and transfer between suppliers and customers, including intermodal transport servicing and the carrying out of activities through the use of resources intended for this purpose [Kisperska-Moroń, Krzyżaniak 2009].

Warehouse centre means a zoning structure, including its own organisation and infrastructure enabling various independent enterprises to carry out goods-related activities related to their warehousing and transfer between suppliers and customers.

Warehouse facility means a closed structure, completely covered using partitions (external walls and a roof), intended for the warehousing of inventories [Słownik terminologii logistycznej].

Intermodal trans-shipment terminal means a zoning structure, including its organisation and infrastructure allowing for the intermodal transport units such as containers, swap bodies and vehicle trailers, to be trans-shipped by different means of transport and the activities related to their storage and use to be carried out [Kisperska-Moroń, Krzyżaniak 2009].

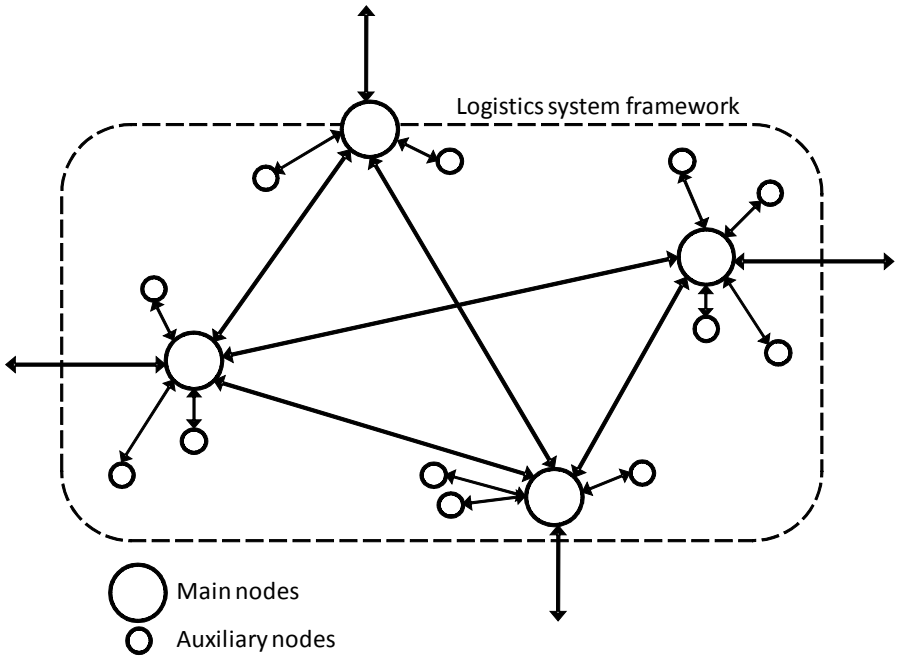

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Fig. 1. Logistics network nodes as elements of the national logistics system
Rys. 1. Węzły sieci logistycznej jako elementy krajowego systemu logistycznego

Table 1. Division and description of the nodes in the national logistics network
Tabela 1. Podział i opis węzłów w krajowej sieci logistycznej

Node	Type	Description	Significance
Seaport	Main	The logistics infrastructure's node of a functionality more complex than the functionality of a logistics centre	NLS* entry/exit
Airport	Main	Trans-shipment terminal with a limited warehousing function	NLS entry/exit
Inland port	Main	The logistics infrastructure's node of a functionality more complex than the functionality of a logistics centre	NLS entry/exit
Logistics centre	Main	Intermodal centre for logistics and additional services	NLS entry/exit and internal node
Warehouse centre	Main	Logistics centre with its functionality limited to warehousing, shipping and vehicle transport	NLS internal node
Trans-shipment terminal	Main	Trans-shipment location for load units in intermodal transport	NLS entry/exit and internal node
Package sorting facility	Main	Location for consolidation and division of itemised goods	Node redirecting freight streams
Inland water port	Auxiliary	Freight trans-shipment centre	NLS internal node
Warehouse facility	Auxiliary	Place for storing inventories, most often of one enterprise	NLS internal node

*NLS - National Logistics System

Source: Own materials

Logistics system is defined as a system of technical and organisational means and people necessary for the flow of goods and accompanying information, which is specifically organised and integrated within a given business area. It consists of the following subsystems: supply subsystem, production servicing subsystem, distribution subsystem, transport subsystem, warehouse subsystem and relations between them [Jacyna 2009].

According to a different definition, the **logistics system** is a flow of materials and products through subsequent configurations of nodes and paths, which is specifically organised and integrated within a given business system [Kisperska-Moroń, Szołtysek 1996].

Taking into account the aforementioned definitions, the following types of nodal elements of the logistics infrastructure, regarded as the nodes of the national logistics network, can be distinguished (Table 1).

LOGISTICS CENTRES AS MAIN LOGISTICS INFRASTRUCTURE NODES

Apart from the seaports, the logistics centres play a role of the main nodes in the logistics networks as the nodes of the highest functionality from the point of view of their logistics and technical infrastructure, including an infrastructure allowing for a transport solution to be selected in relation to the branch transport structure and for the means of transport and transport packaging to be selected, and also for the transport and shipping chains to be developed. Table 2 presents a division of the logistics centres according to various criteria.

The literature provides also for the classification of logistics centres according to the scope of their operations [Fechner 2004]. According to this criterion, logistics centres can be divided into international, regional and local. Taking into account the international nature of the business activities and global dimensions of the supply chains, to which the shipping and transport solutions are being adjusted, this division should be regarded as auxiliary.

Due to the variety of functions carried out in them in relation to business activities, the logistics centres have also a positive effect on the development of towns and regions and such an effect has the following attributes:

Urban attribute - the logistics centres enable decisions to be made that have a direct impact on the development of a zoning system. They allow for business activities to be concentrated in them, which are oriented towards logistics services, distribution and light production, which in turn need the properties for constructing building structures intended for such business activities and the diversified infrastructure. Therefore, they are favourable for creating a zoning system in connection with industrial investments and they enable local self-government entities to steer the development of business activities in accordance with the adopted environmental and zoning policy.

Development attribute - the existence of a logistics centre increases the investment attractiveness of a given location to production, trade and service companies and results in the them appealing to investors.

Social and economic attribute - the companies undertaking operations in the logistics centre or in its surroundings create jobs, provide funds in the form of local taxes to the budgets of self-government entities, stimulate the local economy, have an effect on the development of the local transport, service or professional development infrastructure, etc.

Reference attribute - business activities can be transferred to a logistics centre from city centres and urban agglomerations that are attractive to or indispensable for other urban functions (housing, culture, education, recreation, etc.). This function can be carried out, if an enterprise needs conditions for development or if the so-far carried out business activities are subject to liquidation and the properties can by developed in various ways.

Table 2. Classification and description of logistics centres
Tabela 2. Klasyfikacja i opis centrów logistycznych

Division criteria	Logistics centre	Description of the logistics centre
Zoning integrity	Concentrated	Infrastructure, buildings and structures belonging to a logistics centre or its individual users are located in one area subject to the management rules determined by the management board.
	Modular	A logistics centre in the area designated by its borders, which is divided functionally into separate modules subordinated to common operational rules determined by the purpose of its functioning; however, the ownership structure, organisation and management method of such modules may differ.
	Dispersed	Unified in term of organisation, but divided into parts spatially separated due to the following reasons: availability of properties, infrastructure, zoning and economic conditions, objectives of local economic and zoning policy, etc.
Ownership	Public and private	Logistics centres, as a rule, are initiated by the public sector, whose investment contributions include legal and administration actions enabling (facilitating) the investment, property, financial and tax decisions (zoning fee, local taxes, etc.) and investments in the development of the local infrastructure, including the transport infrastructure, etc. The private sector participates in the investment in a capital form. It finances the infrastructure and structures for its own use and, as a rule, carries out management functions in the logistics centre after its construction has been completed.
	Private	Built from own funds of an investor and oriented primarily towards market targets in terms of functionality and infrastructure.
Type of serviced goods	Universal	Enabling the collection of inventories without limitations in terms of their nature and physical form.
	Industrial	Limiting the collected goods to certain ranges due to the concentration of a given type of production in its environment (for example, industrial cluster solutions) rather than to self-limitations or legal/administration factors.
	Specialised	Specialisation may result from the nature of products or required additional authorisations for standard operating activities, for example, chemical products requiring specific procedures related to the requirements involving the compliance with special safety rules during warehousing and transport.

Source: Edited by Kisperska-Moroń, Krzyżaniak 2009.

Reduction attribute - concentration of distribution functions related to the servicing of a town or urban agglomeration in a logistics centre facilitates the management of supplies delivered to inhabitants or enterprises within the urban agglomeration. It also facilitates the planning and optimising of transport and the selection of the means of transport, etc. Simultaneously, it relieves the urban transport infrastructure from a large load of freight transport.

Notwithstanding the attributes specified above, by having at their disposal access to the multi-branch transport infrastructure and an infrastructure for intermodal trans-shipments of freight units, logistics centres are favourable for freight transport with the use of intermodal transport, and therefore they are used to increase the share of railway and inland water transport in the freight transport by land.

ROLE OF LOGISTICS CENTRES IN LOGISTICS PROCESSES IN THE NATIONAL LOGISTICS SYSTEM

The logistics centres and seaports (logistics centres with expanded functionality) play the following roles in the national logistics system:

System entries/exits - logistics centres having at their disposal the infrastructure for servicing intermodal transport activities are the connecting points of the logistics systems in different countries, as they use transport solutions allowing for the timely and cost effective transport of large freight batches over long distances (Figure 2).

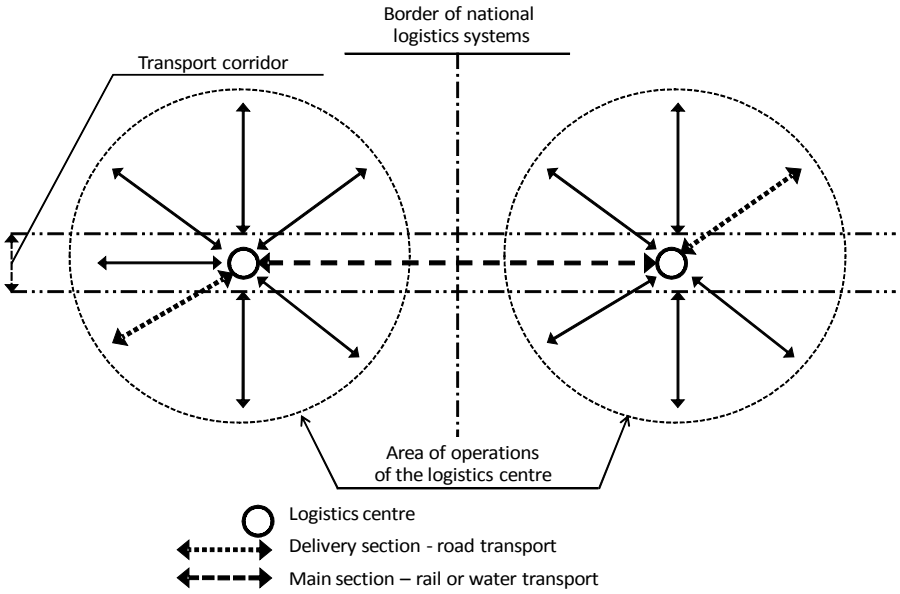

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Fig. 2. Connections between national transport systems using logistics centres and intermodal transport solutions
Rys. 2. Połączenia pomiędzy krajowym systemem transportu używającym centra logistycznego oraz rozwiązaniami transportu intermodalnego

Support for increase in intermodal freight transport - logistics centres have a positive effect increase in the railway and inland water transport of unit freight (in containers, swap bodies and trailers), which reduces the nuisance caused by the excessive road freight transport.

Integration of economic regions - by creating concentrated locations for various logistics services and transport solutions that suit them, cooperation relationships are established and economic potential is strengthened. This feature is visible, in particular, in the case of regular container transport operations (combined transport) in a form of block trains operating in accordance with a fixed timetable between the cooperating logistics centres.

Consolidation of freight flows in large freight streams - the logistics centres are locations that are intended for the concentration of products of the enterprises that require logistics and transport and freight services. Such a concentration of products allows for their consolidation and transport in the form of large freight streams directed to similar network nodes.

Provision of conditions for the increase in transport co-modality - the concentration of large freight batches to be transported and the availability of the varied transport infrastructure and the infrastructure for its servicing in the logistics centres allows for the means of transport to be selected and adjusted to the nature of a given product, type and quality of the transport infrastructure on the transport route. It also enables the use of the means of transport to be optimised and also transport technologies that are appropriate in given conditions to be applied, etc. The logistics centres also increase the chance for return freight to be provided for the means of transport.

Development of quality and parameters of a logistics system - logistics centres determine the ability of a logistics system to transfer goods. They have effect on the efficiency of transport solutions, the ability to shift burdens in conditions of demand volatility and the possibility for integration with

other logistics systems. They also have a positive impact on the costs of logistics and productivity of the resources used for the implementation of the logistics processes.

The efficiency of the logistics processes and the productivity of the resources used for their implementation also depend on the ownership form of the logistics centre. The highest effects, from the point of view of the entirety of the national logistics system, can be achieved if the logistics centre is of a public nature, that is if all the users have access to its resources such as properties for investment purposes, trans-shipping infrastructure (container terminal), telecommunications infrastructure, local transport infrastructure (the so-called access infrastructure) connecting the logistics centre with the national road system, railway lines, inland water routes and sea lanes. The public role of the logistics centre involves providing enterprises with equal access to resources and freedom in making decisions that affect their competitiveness and simultaneously not interfering in market mechanisms regarding the provision of logistics services.

LOGISTICS CENTRES AS NODES OF TRANSPORT CORRIDORS IN POLAND

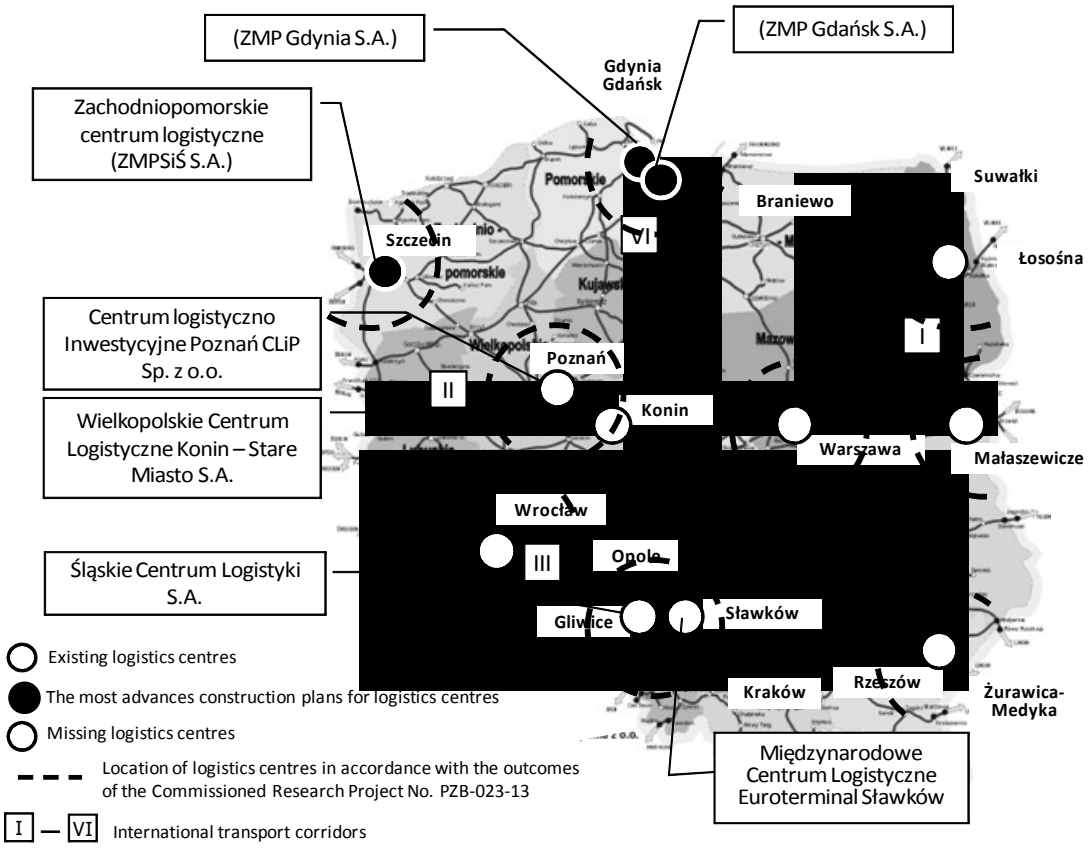
The following logistics centres operate within the national logistics system: three logistics centres complying with European standards (Śląskie Centrum Logistyki SA in Gliwice, Centrum Logistyczno-Inwestycyjne Poznań (CLIP) in Swarzędz-Jasin and Międzynardowe Centrum Logistyczne Euroterminal Sławków in Sławków) and the fourth logistics centre constructed in accordance with the dispersed logistics centre concept (Wielkopolskie Centrum Logistyczne Konin-Stare Miasto SA in Modła Królewska near Konin, which currently has no container terminal of its own).

Despite the fact that the need for constructing a network of national logistics centres and designating locations of such centres was formulated by academics [Commissioned Research Project], the governmental programme, which would lead to their construction, has never been developed. In such circumstances, the demand for warehouse areas was satisfied by industrial developers, who built warehouse centres in such a way as to meet the needs of their lessees, which are serviced exclusively by road transport and have access to main transport corridors exclusively through the local road transport infrastructure. The warehouse investments have been and are being implemented in an uncoordinated way and, from the point of view of the future intermodal national logistics network, their locations are often of an accidental nature.

The same method was applied and is still used for the construction of railway container terminals, which, from the point of view of the national logistics system, fail to constitute a logical network of the intermodal transport nodes. Furthermore, they are, at least, twice as small as similar terminals in other Western European countries and, with a small number of exceptions, they have no spare properties enabling them to develop if demand for the trans-shipment of containers increases.

Therefore, during the planning of the national network of logistics centres, the following limitations should be taken into account:

- New logistics centres should be planned only in those regions in which the supply of a modern warehouse area capable of meeting current and future needs is not sufficient and in which the supply of services related to the shipping and storage of containers in the existing container terminals is neither sufficient (Figure 3).
- The national intermodal logistics network cannot exclusively consist of logistics centres, because they will be forced to compete with the existing warehouse centres and container terminals that currently service most of the demand for logistics services.
- The long-term construction period of the logistics centres will be exposed to a high investment risk, because the current demand for warehouse areas and container trans-shipment is satisfied by the developers and shipping agencies that organise container transport using their own terminals and whose operations on the market are of an aggressive nature. Therefore, the investment in the newly designed logistics centres will be a long-term one.



Source: Own materials

Fig. 3. Logistics centres in Poland in 2010
Rys. 3. Centra logistyczne w Polsce w 2010

Table 3 presents the existing nodal elements of the logistics infrastructure in Polish provinces.

The information presented in Table 3 demonstrates that in the Mazowieckie Province, Łódzkie Province, Śląskie Province, Wielkopolskie Province and Dolnośląskie Province, the location of a new logistics centre is to no purpose, because these provinces have at their disposal a warehouse area exceeding the size of warehouse areas in typical Western European logistics centres (in the Western European logistics centres, the area of closed warehouses constitutes approximately 30 percent of the total area of 100 to 200 ha) and also at least two container terminals that have spare trans-shipment capacities. Furthermore, it is possible that demand for new warehouse areas in the following years will be balanced by the supply of such areas provided by developers, who have large properties intended for the construction of warehouse facilities located in these provinces and who will offer investment projects to be completed (with the acceptance for use issued) within 10 months.

In addition, in the next 2 or 3 years demand for new warehouse areas will be met by the existing spare properties (vacancies) amounting to approximately 1.5 million square meters.

The construction of the logistics centres in provinces that have a small modern warehouse area and that have no container terminals may turn out to be successful. Such provinces include the Kujawsko-pomorskie Province, Lubelskie Province, Lubuskie Province, Opolskie Province, Świętokrzyskie Province and Warmińsko-mazurskie Province.

The Management Board of Morskie Porty Szczecin and Świnoujście SA decided to open a logistics centre in the Zachodniopomorskie Province. A similar situation can be seen in the Pomorskie Province, where a logistics centre is to be established in Gdynia on the initiative of the Management

Board of Morski Port Gdynia SA, and a logistics centre in Gdańsk is to be opened by Gdańsk City Office.

Table 3. Nodal logistics infrastructure in Poland (December 2009)
Tabela 3. Węzłowa infrastruktura logistyczna w Polsce (grudzień 2009)

Item	Province	Logistics centres /existing/	Logistics centres /planned/	Modern warehouse area /in '000 sq. m./	Container terminals existing outside the logistics centres
1	Dolnośląskie	None	None	616.4	2
2	Kujawsko-pomorskie	None	None	82.0	None
3	Lubelskie	None	None	17.8	None
4	Lubuskie	None	None	13.8	None
5	Łódzkie	None	None	1,134.0	2
6	Małopolskie	None	None	127.4	1
7	Mazowieckie	None	None	3,248.6	4
8	Opolskie	None	None	0.0	None
9	Podkarpackie	None	None	20.0	1
10	Podlaskie	None	None	0.0	1
11	Pomorskie	None	2	111.7	4
12	Śląskie	2	None	1,369.6	5
13	Świętokrzyskie	None	None	15.0	None
14	Warmińsko-mazurskie	None	None	2.0	None
15	Wielkopolskie	2	None	937.7	2
16	Zachodniopomorskie	None	1	107.3	1

Source: ILiM research materials 2009

CONCLUSIONS

- The national logistics system is formed by uncoordinated investments in the nodal elements of the logistics infrastructure, whose form and location is determined by market conditions and is not supported by zoning system solutions.
- The national intermodal logistics network that constitutes an element of the national logistics system should consist of the intermodal transport nodes in the form of seaports and logistics centres as the main nodes of the transport corridors and of the individual container terminals cooperating with warehouse centres located in their surroundings.
- The regions in which the logistics centres exist, include the Śląskie Province and the Wielkopolskie Province.
- The regions in which the logistics centres will probably be established, include the Pomorskie Province and the Zachodniopomorskie Province.
- The regions in which the locations of the logistics centres can be planned, include such provinces as the Kujawsko-pomorskie Province, Lubelskie Province, Lubuskie Province, Opolskie Province, Świętokrzyskie Province and Warmińsko-mazurskie Province.

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ROLA CENTRÓW LOGISTYCZNYCH W KRAJOWYM SYSTEMIE LOGISTYCZNYM

STRESZCZENIE. W artykule przedstawiono podział centrów logistycznych według różnych kryteriów oraz wskazano ich rolę w krajowym systemie logistycznym. Sklasyfikowano główne węzły sieci logistycznych. Wskazano także na cechy centrów logistycznych, które oddziaływają na rozwój przestrzenny miast i regionów. Na tle rozważań teoretycznych przedstawiono aktualną sytuację w krajowym systemie logistycznym oraz sformułowano diagnozę rozwoju sieci centrów logistycznych w Polsce.

Słowa kluczowe: centrum logistyczne centrum magazynowe terminal przeładunkowy krajowy system logistyczny sieć logistyczna węzeł sieci logistycznej transport intermodalny.

DIE ROLLE DER LOGISTIK-ZENTREN IN DEM INLÄNDISCHE LOGISTIK-SYSTEM

ZUSAMMENFASSUNG. Im vorliegenden Beitrag hat man die Aufteilung von Logistik-Zentren nach unterschiedlichen Kriterien dargestellt und auf deren Rolle im inländischen Logistik-System hingewiesen. Es wurden dabei Hauptknoten logistischer Netze klassifiziert. Außerdem hat man die Eigenschaften der Logistik-Zentren, welche die räumliche Entwicklung von Städten und Regionen beeinflussen, aufgezeigt. Auf Grund der theoretischen Erwägungen projizierte man die aktuelle Situation innerhalb des inländischen Logistik-Systems und formulierte man eine Diagnose für die Entwicklung von logistischen Zentren in Polen.

Codewörter: Logistik-Zentrum, Lagerzentrum, Umlade-Terminal, das inländische Logistik-System, logistisches Netz, Knotenpunkt für logistisches Netz, intermodaler Transport.

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