



## DETERMINANTS OF WAREHOUSE SPACE MARKET DEVELOPMENT IN POLAND

Ireneusz Fechner

The Poznan School of Logistics, Poznań, Poland

**ABSTRACT.** Logistic nodal infrastructure consists of four types of facilities: ports, transshipment terminals, warehousing centres and logistics centres. The models of development of logistics centres in Poland are different from those typically found in Western Europe. Since 1990 we have been observing an intensive growth of modern warehousing space. The resources of modern warehousing space in Poland are estimated at ca. 4.8 M m<sup>2</sup>. There are two decisive determinants involved in the process of selecting location for modern warehousing facilities: the agglomeration determinant and the infrastructural determinant. The former accounts for the impact of such determinants as population size and household income, retail sales volume and volume of sold production. The latter is related to the availability and quality of transport infrastructure. Having taken into consideration all above mentioned determinants, an evaluation method was developed in order to estimate the demand for modern warehousing space in the largest urban agglomerations in Poland. It was found out that the modern warehousing space market in Poland does not demonstrate saturation, however, the demand for this type of space is diverse. New investment projects will be implemented predominantly in those urban agglomerations which until recently did not attract much interest from investors.

**Key words:** logistic facilities, logistic infrastructure, logistic centres warehouse, urban agglomerations.

### INTRODUCTION

The demand for warehouse space concerns mainly the space of indoor warehouses. Accordingly, this article concentrates on indoor warehouse space. The logistics real estate market is dominated by warehouse lease. The majority of new warehouse construction projects are undertaken by developers. Therefore, a good insight into the warehouse space demand is a key to a successful investment project where the payback period is more than a dozen years.

The location of warehousing facilities is mainly determined by economic criteria, including GDP volume and growth, volume of sold production, trade turnover, the population's purchasing power and demographic factors.

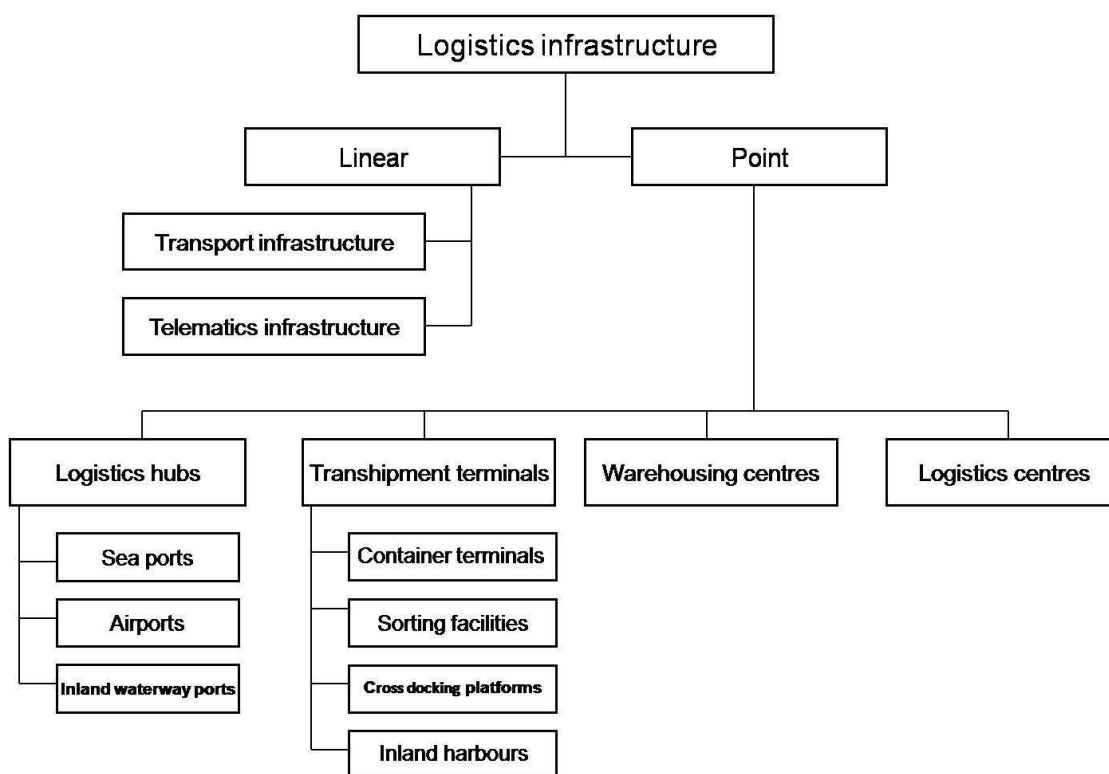
Selection of location for new warehousing facilities is also conditioned by such constraints as:

- availability of large-size real properties fit for the purpose of constructing warehouse buildings and structures,
- legal regulations related to obtaining real property development conditions and building permits,
- quality of transport infrastructure in the area concerned,
- local labour market, including availability of warehouse workers.

Analysis of the domestic market for warehousing space shows its considerable growth dynamics, which raises the question of the target volume of demand for modern warehousing space. This article is an attempt at providing an answer to the question.

## LOGISTIC INFRASTRUCTURE AND ITS CLASSIFICATION

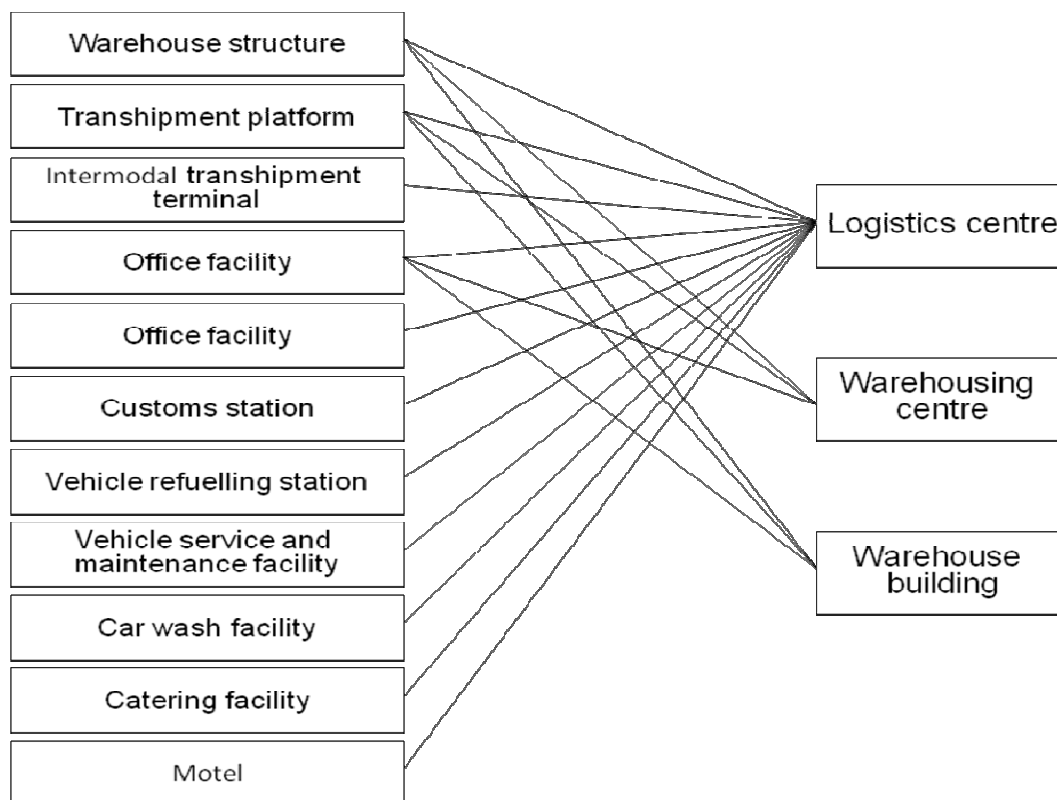
Logistic infrastructure is an indispensable element of logistics operations. Its quality has a deep impact on the form of logistic processes and relations between service quality and its cost. Warehousing facilities are included in the nodal infrastructure category (see Fig. 1). Ever since the time of political and economic transformations in Poland, the amount of modern warehousing space has been increasing rapidly in the commercial property market with regard to almost all elements of nodal infrastructure. Also, all types of ports are no longer places where goods are reloaded. Nowadays, any port area offers logistics services, such as short-term hire of warehouse space for goods that are to be further forwarded or distributed.



Source: Own study

Fig. 1. Classification of the logistic infrastructure  
Rys. 1. Podział infrastruktury logistycznej

Indoor warehouse space mainly takes the form of indoor warehouse facilities such as self-contained warehouse facilities as well as groups of those facilities, e.g. logistics and warehousing centres (Fig. 2).



Source: Own study

Fig. 2. Elements of nodal infrastructure in the form of warehouse buildings as well as warehousing and logistics centres

Rys. 2. Elementy punktowej infrastruktury logistycznej występującej w postaci obiektów magazynowych oraz centrów magazynowych i logistycznych

The shares of particular types of warehousing facilities as shown in Fig. 2 in the total modern warehousing space are determined not only by the demand for this type of space, but also by some intermediate factors which affect decisions made by investors seeking locations suitable for constructing warehousing facilities, as well as by warehouse tenants. These include:

- the State's policy regarding the overall national logistic infrastructure and its instruments affecting investors' decisions,
- quality of transport infrastructure,
- inter-branch competition in transport,
- availability of large real properties zoned for construction purposes,
- local policy observed in areas with a demand for logistic services or a local policy which boosts demand by means of appropriate administrative decisions affecting local business growth.

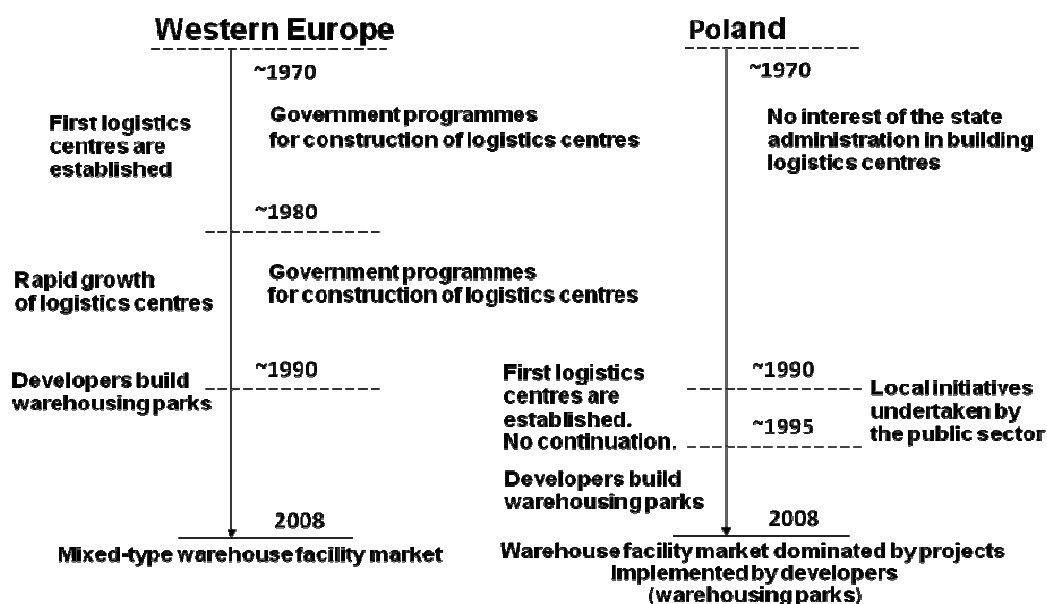
## **MODELS OF DEVELOPMENT OF LOGISTICS AND WAREHOUSING CENTRES IN EUROPE AND IN POLAND**

The model of development of logistic facilities being part of the nodal infrastructure is affected to a large extent by the state's transport policy which influences the shares of particular modes of transport in the overall haulage of goods, and - to a small extent - by the spatial development model which affects land use planning.

There are plans to decrease the growth of road haulage by increasing the share of railway haulage and inland water transport in the overall transportation of goods. There are attempts to implement the plans by means of decisions that support the development of combined transport. As these transport solutions are not cost-effective, there is a need for various kinds of administrative support. One of the measures taken to bring about expected changes is aiding the construction of container terminals, and one of its effects - the development of the nodal logistic infrastructure around them, which becomes an intermodal logistics centre.

As the State is not taking any active steps to modify the structure of cargo haulage, both logistic services providers and users are free to use their preferable transport solutions and so they use road haulage which is a faster, more punctual and price-competitive mode of transport as compared to railway or inland water transport. In this case, investors selecting a location for new warehouse facility construction concentrate predominantly on good access to the road infrastructure. The resulting warehouse space takes the form of monomodal warehouse centres [Fechner 2008] or of self-contained warehouse facilities.

In the second half of the previous century the majority of western European countries focused on the development of intermodal transport solutions. Regardless of the policy effectiveness, one of the results was the development of a network of intermodal logistics centres that changed into national networks of logistic centres. The warehousing space markets in those countries were also complemented with projects financed by private investors who did not benefit from the state's assistance. Consequently, the markets are a mixture of intermodal logistic centres networks, and monomodal warehouse centres networks whose location was affected purely by market mechanisms (Fig. 3).



Source: Own study

Fig. 3. Models of development of warehousing space in Europe and Poland  
 Rys. 3. Modele rozwoju powierzchni magazynowej w Europie i Polsce

In Poland, where there was neither a policy for the development of a national network of logistics centres, nor any forms of support for any local initiatives relating to the establishment of logistics centres, a different model of nodal infrastructure emerged. The warehousing space market was dominated by investment projects implemented by developers. Due to market conditions, mainly connected with selecting the transport solutions, newly built warehousing facilities were monomodal transport warehousing centres located in major transport corridors. However, no attention was paid to access to the railway infrastructure from warehousing facilities.

## MODERN WAREHOUSING SPACE MARKET IN POLAND

The term "modern warehousing space" is construed as a warehouse of the net height of minimum 10 m, with a floor loading capacity of 5 t/m<sup>2</sup>, equipped with smoke control dampers and sprinklers and with minimum one dock with a swing ramp per each 1000 m<sup>2</sup> of storage space.

The total indoor warehousing space in Poland is estimated at ca. 63 million m<sup>2</sup>; no precise data are available. According to surveys conducted by the Central Statistics Office of Poland, trade companies have at their disposal a total indoor warehousing area of ca. 17.5 million m<sup>2</sup> [Krzysztofik 2007]. As at the end of June 2008, the modern warehousing space amounted to ca. 4.8 million m<sup>2</sup> (own unpublished study of the Institute of Logistics and Warehousing 2008. According to the report "Logistyka w Polsce. Raport 2007" ILiM Poznań 2008, it was 4.5 million m<sup>2</sup> in 2007). Table 1 shows the amount of modern warehousing space in Poland broken down by provinces and investor types.

Table 1. Modern warehousing space in Poland - June 2008  
 Tabela 1. Nowoczesna powierzchnia magazynowa w Polsce - czerwiec 2008

s/n	Province	Developers /m <sup>2</sup> /	Owners and logistic operators /m <sup>2</sup> /	TOTAL /m <sup>2</sup> /
1	mazowieckie	1 690 000	323 400	2 013 400
2	śląskie	609 500	227 700	837 200
3	wielkopolskie	430 000	294 000	724 000
4	łódzkie	330 000	360 000	690 000
5	dolnośląskie	185 000	29 500	214 500
6	małopolskie	18 000	64 500	82 500
7	kujawsko-pomorskie	31 000	51 000	82 000
8	pomorskie	45 000	21 000	66 000
9	zachodniopomorskie	0	34 700	34 700
10	lubelskie	0	17 800	17 800
11	lubuskie	0	13 800	13 800
12	podkarpackie	0	4 500	4 500
13	warmińsko-mazurskie	0	2 000	2 000
14	podlaskie	-	1 400	1 400
Total		3 338 500	1 445 300	4 783 800

Source: Own study by ILiM 2008

The spectrum of modern warehouse facility users is very broad. However, Table 1 does not account for specialised warehouse facilities used for the purpose of selected production and distribution processes, e.g. automated high-stacking warehouses, often equipped with temperature and atmosphere control systems, as well as distribution warehouses characterised by similar storage conditions requirements.

The analysis of locations based on data presented in Table 1 leads to the conclusion that the selection of warehousing facility location is affected mainly by two determinants: the agglomeration determinant and the infrastructural determinant.

The agglomeration determinant pertains to the size of the urban agglomeration which plays the role of the region's centre. Urban agglomeration size, accompanied by such determinants as household

income, retail sales volume, volume of sold production, affects the type and volume of merchandise stocks and, consequently, the demand for logistic services.

The infrastructural determinant pertains to the availability and quality of transport infrastructure. As for transport infrastructure accessibility, location decisions account for the ability to cater for the logistic needs of agglomerations as well as the possibility to serve other agglomerations or regions. Therefore, the majority of modern warehousing facilities have been built around the cities of Warszawa, Poznań, Katowice and Wrocław (dominant influence of the agglomeration determinant) and Łódź (joint impact of both determinants).

Table 2 presents ten largest Polish urban agglomerations along with the values of the criterial factors assumed for the purposes of analysis and evaluation of the possibility of future increase in the demand for modern warehousing space.

Table 2. Ten largest urban agglomerations in Poland and criterial factors assumed for the analysis  
 Tabela 2. Dziesięć największych krajowych aglomeracji miejskich i czynniki kryterialne przyjęte do analiz

Urban agglomeration	Population /'000/	GDP per one inhabitant /PLN '000/	Household income per one inhabitant /PLN '000/	Retail sales per one inhabitant /PLN '000/	Sold production per one inhabitant /PLN '000/
Warszawa	2 800	40.8	21.8	27.3	32.2
Katowice	2 700	28.0	19.1	7.9	30.1
Łódź	1 100	23.7	17.2	9.5	15.6
Kraków	1 000	22.0	15.3	13.4	15.6
Gdańsk	940	25.3	16.2	10.0	22.2
Wrocław	910	26.6	17.5	9.7	23.2
Poznań	860	27.6	17.9	15.2	26.4
Bydgoszcz-Toruń	820	22.5	16.1	8.0	16.0
Szczecin	670	23.9	17.3	9.4	13.1
Lublin	570	17.6	13.8	8.2	8.3

Source: Own study based on: Krzysztofik 2007, GUS Rocznik statystyczny RP 2007.

Based on data listed in Table 1, the investment absorption rate F1 was calculated, which describes the potential demand of individual urban agglomerations for modern warehousing space.

$$F1 = \frac{\sum_{i=1}^n (K_i w_i)}{100}$$

where: K - criterial factor

w - weight

Table 3. Weight adopted for criterial factors  
 Tabela 3. Wagi dla przyjętych czynników kryterialnych

Population	GDP per one inhabitant	Household income per one inhabitant	Retail sales per one inhabitant	Sold production per one inhabitant
0.15	0.1	0.1	0.35	0.3

Source: Own study

Table 4. Investment absorption rate F1 for urban agglomerations as per Table 2  
 Tabela 4. Wskaźnik chłonności inwestycji F1 dla aglomeracji miejskich wg tabeli 2

Agglomeration	Existing modern warehousing space /'000 m <sup>2</sup> /	Investment absorption rate F1
Warszawa	2 013	4.5
Katowice	837	4.2
Łódź	690	1.8
Kraków	83	1.6
Gdańsk	66	1.6
Wrocław	215	1.5
Poznań	724	1.5
Bydgoszcz-Toruń	82	1.3
Szczecin	35	1.1
Lublin	18	0.9

Source: Own study

The obtained F1 values indicate that investment absorption rates vary in the analysed agglomerations and that some of the regions are underinvested with regard to the amount of existing modern warehousing space. The underinvestment results from the impact of the latter criterial factor, i.e. the infrastructural determinant. In the period under analysis, the location of new warehousing facilities was to a large extent affected by varied accessibility and quality of transport infrastructure. Lack of evenly distributed network of dual carriageways led to the concentration of the logistic investment projects in the centre of Poland, for this ensures optimum distance to most of major cities and industrial centres all over the country. The development and modernisation of transport infrastructure begins to weaken the impact of the infrastructural determinant on selecting project location. Investors have been noted to be more and more attracted to regions which, until now, were outside their interests when seeking locations for new warehousing projects.

Analysing the infrastructural determinant, it is possible to notice the investors' preferences regarding the availability of road transport infrastructure. In the process of selecting warehouse facilities locations the factor of railway transport infrastructure availability was usually ignored. This

is due to the perception of bad quality of railway transport services in Poland, in particular with regard to haulage speed and punctuality, as well as high costs of accessing railway infrastructure.

The analysis of the investment absorption rate F1 poses a question relating to the potential volume of deficit of modern warehousing space in the analysed urban agglomerations. Table 5 presents calculation results showing the value of the shortage rate F3 being the quotient of the F1 rate value and the size of the modern warehousing space already existing in a given area. The value  $F=0.23$  is the mean calculated on the basis of values obtained for the agglomerations of Warszawa, Łódź and Poznań, which have the largest amount of modern warehousing space and have similar shortage rates. The value  $F3=0.12$  was adopted based on empirical studies on the size of modern warehousing space which has been constructed or is being constructed in the three aforementioned agglomerations. This value has been assumed to be the target value. The analysis excluded the impact of the infrastructural determinant, as it was presumed that the target saturation rate and quality of the transport infrastructure in any particular regions in Poland will make it possible to render haulage services on a comparable level.

Table 5. Shortage rate F3  
 Tabela 5. Wskaźnik niedopełnienia F3

Agglomeration	Existing modern warehousing space /'000 m <sup>2</sup> /	Shortage rate F3	Modern warehousing space deficit at F3 equalling 0.23 /'000 m <sup>2</sup> /	Modern warehousing space deficit at F3 equalling 0.12 /'000 m <sup>2</sup> /
Warszawa	2 013	0.22	-76	1 699
Katowice	837	0.50	996	2 676
Łódź	690	0.26	80	786
Kraków	83	1.97	626	1 276
Gdańsk	66	2.35	609	1 228
Wrocław	215	0.70	443	989
Poznań	724	0.20	-86	499
Bydgoszcz-Toruń	82	1.64	503	1 039
Szczecin	35	3.20	451	897
Lublin	18	5.22	391	765

Source: Own study

Results presented in Table 4 indicate that the greatest shortage of modern warehousing space occurs in the agglomeration of Katowice, Poland's second largest after Warsaw. Also, it is possible to notice the big potential of the so far underestimated agglomerations of Kraków, Gdańsk, Bydgoszcz and Toruń, Wrocław, Szczecin and Lublin. Assuming the shortage rate at a level of  $F3=0.23$ , the potential of Warszawa, Poznań and Łódź has already been exhausted, while at the target level of  $F3=0.12$  the highest growth rate can be expected of the agglomerations of Gdańsk, Kraków, Bydgoszcz and Toruń, Szczecin and Lublin.

## CONCLUSIONS

This article presents a method for analysis and evaluation of the modern warehousing space market, and it may be applied to forecast the warehousing space growth in particular regions of Poland. Its application in relation to the Polish market of modern warehousing space leads to the following conclusions:

1. Demand for modern warehousing space is determined by a combination of economic and demographic factors.
2. The modern warehousing space market in Poland does not show any signs of saturation. Assuming the criterial factors values at the levels presented in this study, the amount of modern warehousing space in Poland should double in several years. The warehousing space market growth rate will be determined by economic factors: the value and growth dynamics of GDP, volume of sold production, trade turnover and purchasing power of the population.
3. The development and improvement of the transport infrastructure quality in Poland will gradually result in more warehousing facilities being constructed by investors in the regions showing the biggest deficit of modern warehousing space.

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## UWARUNKOWANIA ROZWOJU RYNKU POWIERZCHNI MAGAZYNOWYCH W POLSCE

**STRESZCZENIE.** Punktowa infrastruktura logistyczna składa się z czterech rodzajów obiektów: portów, terminali przeładunkowych, centrów magazynowych i centrów logistycznych. Istnieją odrębne dla Polski i Europy Zachodniej modele rozwoju centrów logistycznych. Rozwój nowoczesnych obiektów magazynowych w Polsce po 1990 roku jest intensywny. Zasoby nowoczesnej powierzchni magazynowej oceniane są na ok. 4,8 mln m<sup>2</sup>. O lokalizacji nowoczesnych budowli magazynowych decydują dwa rodzaje czynników: aglomeracyjny i infrastrukturalny. Pierwszy z nich uwzględnia wpływ takich wielkości jak: liczba ludności i jej dochody, wielkość sprzedaży handlu oraz wielkość produkcji sprzedanej przemysłu. Drugi odnosi się do dostępności i jakości infrastruktury transportu. Biorąc pod uwagę powyższe czynniki opracowano metodę oceny popytu na nowoczesną powierzchnię magazynową w największych aglomeracjach miejskich w Polsce. Stwierdzono, że rynek nowoczesnej powierzchni magazynowej nie wykazuje oznak nasycenia, ale popyt na tego rodzaju powierzchnię jest zróżnicowany. Nowe inwestycje będą realizowane głównie w tych aglomeracjach miejskich, w których dotąd zainteresowanie inwestorów było niewielkie.

**Słowa kluczowe:** obiekty logistyczne, infrastruktura logistyczna, magazyn, centra logistyczne, aglomeracje miejskie.

## VORAUSSETZUNGEN DER ENTWICKLUNG DES MARKTES FÜR LAGERFLÄCHEN IN POLEN

**ZUSAMMENFASSUNG.** Die Punktinfrastruktur setzt sich aus vier Arten der Objekte zusammen: Häfen, KV-Terminals, Lagerzentren und Logistikzentren. Die Logistikzentren-Entwicklungsmodelle in Polen und in Westeuropa sind

unterschiedlich. Die Entwicklung moderner Lagerobjekte in Polen nach 1990 ist intensiv. Das Volumen moderner Lagerflächen wird auf ca. 4,8 Mio. m<sup>2</sup> geschätzt. Über die Standortplanung moderner Lagerobjekte entscheiden zwei Einflussfaktoren: Ballungszentren und Infrastruktur. Die erste Einflußgröße berücksichtigt solche Gruppen wie: die Einwohnerzahl und Einnahmen der Einwohner, Handelsvolumen, Produktionsvolumen. Die zweite betrifft die Zugänglichkeit zur Transportinfrastruktur und deren Qualität. Berücksichtigend diese Faktoren wurde eine Methode zur Beurteilung der Nachfrage nach modernen Lagerflächen in den größten Ballungszentren in Polen entwickelt. Es wurde festgestellt, dass der Markt für moderne Lagerflächen keine Symptome der Sättigung aufzeigt, aber die Nachfrage nach Flächen solcher Art unterschiedlich ist. Neue Investitionen werden vor allem in diesen Ballungszentren geplant, das Interesse der Investoren bis jetzt gering war.

**Codewörter:** Logistikobjekte, Logistikinfrastruktur, Logistikzentren, Lagerhaus, Ballungszentren.

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Ireneusz Fechner, PhD. Eng.  
The Poznan School of Logistics  
The Institute of Logistics and Warehousing  
ul. Estkowskiego 6  
61-755 Poznań, Poland  
e-mail: [Ireneusz.fechner@wsl.com.pl](mailto:Ireneusz.fechner@wsl.com.pl), [Ireneusz.fechner@ilim.poznan.pl](mailto:Ireneusz.fechner@ilim.poznan.pl)