Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego
Studies of the Industrial Geography Commission of the Polish Geographical Society

34(4) · 2020

ISSN 2080-1653
DOI 10.24917/20801653.344.2

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Industry in seaports in Poland

Abstract: The study aims to classify port cities in Poland in terms of the development of their industrial functions and those in their immediate surroundings. Industrial plants currently operating in the vicinity of seaports were identified in the area where the port and its industrial districts have developed. Data on the volume of transhipments in individual ports, the number of manufacturing entities in *gminas*, including ports themselves, and on employment in industry in *powiat*s where seaports are located, were used. The research includes both the industry directly related to the maritime economy, including shipbuilding and fish processing, as well as industrial enterprises located there for economic reasons following classical location theories. Seaports in Poland, due to the level of industrial development, can be divided into four groups: with a developed and diverse industry (Gdańsk and Szczecin), with one sector dominating (Gdynia, Police, Elbląg), with a small shipbuilding industry and factories operating for the needs of fisheries (Świnoujście, Kołobrzeg, Władysławowo, Ustka, Łeba), without any developed industry (others).

Keywords: industrial ports; port industry; seaports; shipbuilding

Received: 23 December 2019
Accepted: 11 May 2020

Suggested citation:
Bocheński, T. (2020). Industry in seaports in Poland. *Prace Komisji Geografii Przemysłu Polskiego Towarzystwa Geograficznego* [*Studies of the Industrial Geography Commission of the Polish Geographical Society*], *34*(4), 22–37. doi: 10.24917/20801653.344.2

Introduction

The industrialisation of seaports in Poland was the subject of numerous geographical studies at the turn of the 1980s, including Adrjanowska (1977), Łangowski (1982), Szwankowski (1982), Piskozub (1982), and Dutkowski (1983). After the political transformation, interest in this subject decreased. Several studies were written on issues of the revitalisation of post-shipyard areas, especially in Gdańsk and Gdynia (e.g. Czepczyński, 2001; Palmowski et al., 2001), on the shipbuilding industry and its restructuring (e.g. Bernacki, 2010; Dajczak, 2008; Palmowski, Tarkowski, 2016) or offshore industry (e.g. Czapliński, 2015; Witoński, 2013). The topic of fish processing in Poland was also present (Czapliński, 2011; Czapliński, 2018; Kapusta, 2014; Kieliszewska,

2016; Szostak, Dróżdż, 2017). Bocheński (2019) wrote about the connections between seaports and industry not directly related to the maritime economy in the Baltic Sea region. In contemporary foreign literature, the subject of the functioning of ports and industrial complexes was present and not limited to Wiegmans, Louw, 2011 and Boulos (2016). In this context, numerous publications on the evolution of the relationship between a port and a city/town are also thought-provoking (e.g. Bird, 1973; Norcliffe, Basset, Hoare, 1996; Hoyle, 1998). This article is primarily empirical; hence the literature review is brief.

The political and economic transformation, as well as Poland's accession to the European Union, has resulted in severe changes in the Polish maritime economy including its ownership and organisational structures. This reform of the political system completely shattered the state naval economy, and the shipyards initially found themselves in a tough situation, but then rebounded though some companies went bankrupt. However, ship repair yards continued to develop, although deep-sea fishing and related processing plants on land have completely collapsed (Dutkowski, 2017). According to Grzelakowski (2017: 165), there has been a significant strengthening of transportation through Polish ports along with their distribution functions (including warehousing, storage, processing and other operations both inward and outward). At the same time, the importance of their industrial role has decreased. This study will show contemporary connections between Polish seaports and industry.

To begin with, defining fundamental issues such as the port area and related industry is essential. A seaport can be understood in a narrower or broader sense, depending on whether and to what extent its surroundings are taken into account (Table 1). In this article, the study focuses on seaports in the functional sense as well as with the city/town and industrial districts.

Table 1. The seaport and its surroundings

Area	Characteristics
port in a dominant sense	the area under the seaport management, regardless of the function currently performed
port in a functional sense	all quays, terminals or piers with transhipping equipment and warehousing or storage facilities – function counts, not the area owner
port and industrial district	an area where transhipping, warehouse and storage, and industrial functions are located, including the entire logistic base of the port serving land transport, such as railways and facilities for servicing rolling stock along with road haulage
port and industrial agglomeration	covers the entire administrative unit (*gmina* – municipality) where the seaport is located. In case of an urban complex, other units (*gminas*) within the agglomeration are included as well.

Source: author's study

Following the division of industry located in seaports by Koselnik (1960) and Zaremba (1962), there are five groups of industrial plants operating in ports and their immediate vicinities (cf. Piskozub, 1982). The division respects two essential criteria, i.e. the type of activity and its relationship with the maritime economy (Table 2).

The shipbuilding industry and some plants of the near-port industry can create a kind of maritime cluster, for instance in the Polish People's Republic, *Zrzeszenie Przemysłu Okrętowego* (Shipbuilding Industry Association) performed this function (Dutkowski, 2017). Contemporary concepts of maritime clusters in Poland assume an

association of entities directly related to the maritime economy. Apart from the shipbuilding industry, they include shipowners and managers of seaports, etc. Currently, there are two cluster initiatives of this type in Poland: the Baltic Sea & Space Cluster (Bałtycki Klaster Morski i Kosmiczny) based in Gdynia (*Bałtycki Klaster*..., 2020), and the Klaster Morski Pomorza Zachodniego based in Szczecin (*Klaster Morski*..., 2020).

Table 2. Industries in seaports

Criterion	Type of industry	Characteristics
Type of activity	shipyard (shipbuilding)	includes the construction and renovation of ships and boats as well as the infrastructure of the maritime industry
	fish processing	directly related to sea fishing. Mainly preliminary processing plants (i.e. gutting, filleting, freezing) are located in the port, while processing and/or preservation takes place more often inland. Fish processing can also take place at sea (deep-sea trawlers).
	others	various sectors, which some plants cooperate with
Links between the port and maritime economy	port industry	includes offshore and shipbuilding as well as the industry associated with the port as a transport node where the supply chain is broken – transhipment of raw materials, semi-finished products, components and finished products, e.g. metallurgical, chemical, cellulose, food industry.
	near-port industry	existing production links with the shipbuilding industry, fish processing and the port itself, located in a port or nearby industrial district, e.g. metal and machinery industry.
	non-port industry	not related to port activities – location in a port and industrial district for other reasons than proximity or with any port industry.

Source: author's study

STUDY ASSUMPTIONS

The study aims to classify ports in Poland in terms of the development of industrial functions and those in their immediate vicinity. For this purpose, industrial plants currently operating were identified, and the areas where the ports and industrial districts have developed were indicated. When assessing the level of industrial development, the number of manufacturing industries in the *gmina* of the port and industrial plants in its immediate vicinity were taken into account, including those with access to the quays or infrastructure linked to the port terminal (internal transport system, e.g. conveyor belt, pipeline).

The analysis was based on data published by the Central Statistical Office (*GUS*) on the number of manufacturing entities in the *gminas* of ports and on employment in industry located in an administrative unit called a *powiat*[1].

Geoportal (2019) and Google Maps (2019) were used to define industrial and port districts. Information about industrial entities in the ports was collected with the use of the Maritime Economy Guide (Informator gospodarki morskiej, 2019), National Register

[1] The data published by the Central Statistical Office (GUS) are not fully reliable. The number of entities in the REGON register database is far greater than those actually active – confirmed by comparison with the data of the Ministry of Finance from 2018, made by P. Śleszyński (unpublished materials). However, it mainly concerned the service sector. Whereas, the data on the number of employees do not include those working in plants with fewer than 10 employees. For the purpose of this study, it was decided to include them to show the economic environment in which individual port centres operate. They do not have a decisive impact on the result of the analysis.

(Krajowy Rejestr Sądowy, 2019), and information published by individual companies. The use of several sources enabled the continued operation of a given enterprise to be checked and to assign it to an appropriate sector. The boundaries of industrial and port districts were determined by land-use planning documents for industrial and storage functions, and industrial land ownership.

Industry in ports in Poland

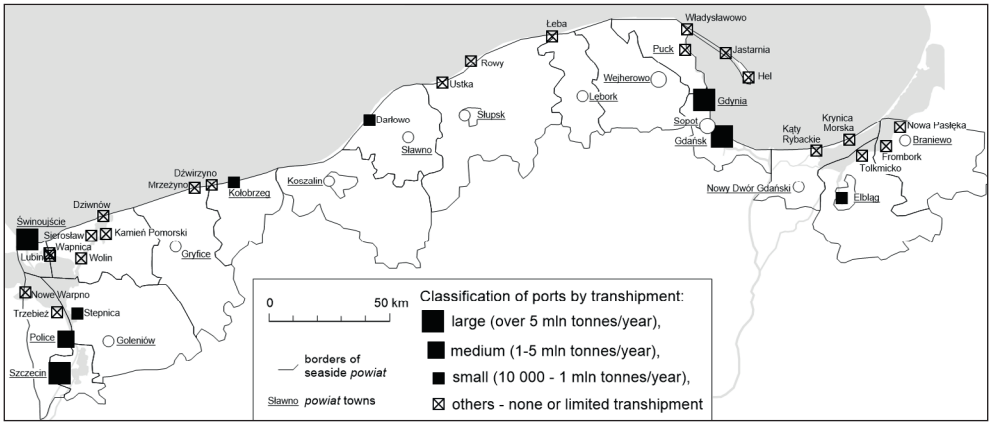
There were 32 seaports in Poland (Figure 1), nine of which in the second decade of the 21st century served as cargo ports (transhipping). This group included four commercial ports of primary importance (Gdańsk, Gdynia, Świnoujście, Szczecin) – transhipping from seven to over 30 million tonnes per year, Police industrial port with over 1,5 million tonnes and four commercial ports of regional importance from 15 000 to 400 000 tonnes (Kołobrzeg, Darłowo, Elbląg, Stepnica). The remaining 23 operated mainly as fisheries or for leisure. Transhipment took place in Władysławowo and sporadically in Ustka and Trzebież (Table 3). However, it had disappeared entirely from Wolin, Kamień Pomorski, and Łeba. In the past, goods were transhipped in 15 ports (Bocheński, Palmowski, 2015).

The level of industrial development of a port and its importance for the economy is reflected in the number of manufacturing enterprises, their share in the total number of economic entities and the percentage of employees in the industry.

In ten ports, there were over ten manufacturing entities per 1000 inhabitants concerning both the cities/towns with the most important ports and with small ports that do not handle transhipments, i.e. Tolkmicko, Wolin, Puck, and Łeba (Table 3). According to Śleszyński's calculations, the share of active economic entities in the total number (according to the data of the Central Statistical Office (*GUS*) in 2018) amounted to 73% in Elbląg, 66% in Gdańsk, 63% in Gdynia, 60% in Świnoujście and 58% in Szczecin (unpublished materials). This overestimation concerned mainly the service sector and to a lesser extent, manufacturing.

Data on employment structure published by the Central Statistical Office (*GUS*) was available only at the *powiat* level, and this made the analysis difficult. Ports were

Figure 1. Location of seaports in Poland



Source: author's study based on Table 3

Table 3. Seaports and cargo turnover along with ports and the number of industrial entities in Poland: 2018

Port	Seaport cargo turnover [in 000']	Percentage of manufacturing entities in the total number	Selected divisions of manufacturing (Section C of PKD 2007) in ports					Number of manufacturing entities per 1000 residents
			Number of entities (Section C)	Chemical and petrochemical industries, including plastics (Divisions 19, 20, 22)	Metallurgical and metal industry (Divisions 24 and 25)	Production of machines and equipment (Divisions 27 and 28)	production of other transport equipment (Division 30)	
Szczecin	9 362.3	7.9	5 452	222	1090	172	200	13.5
Police	1 534.4	13.7	475	72c (96)	150 (202)	3(8)	47 (53)	14.5
Stepnica	16.4	11.6	32a	2	–	2	2	13.0
Świnoujście	16 806.8	7.1	442	5	50	5	5	10.8
Wolin	–	11.0	78	3 (6)	14 (32)	0 (1)	0 (2)	16.2
Kamień Pomorski	–	4.7	72	2	10	2	21	8.1
Dziwnów	–	2.5	15	–	4	–	–	5.6
Kołobrzeg	296.7	4,1	340	16	30	13	5	7.3
Darłowo	255.8	4.8	93	1	16	2	1	6.8
Ustka	0.5	6.4	137b	1 (4)	18 (32)	2 (3)	7 (7)	8.8
Łeba	–	3.0	38	–	6	–	2	10.3
Władysławowo	7.3	3.0	72	1	10	–	1	7.2
Hel	–	2.2	14	–	1	–	–	4.3
Puck	–	8.8	128	4	43	5	8	11.4
Gdynia	20 974.3	10.1	4 039	154	1006	138	133	16.4
Gdańsk	42 437.6	8.7	6 670	212	1531	234	447	14.3
Frombork	–	6.5	16	1	5	1	–	6.8
Tolkmicko	–	19.5	58	–	47	–	–	21.5
Elbląg	106.0	8.4	1 059	33	363	24	9	8.8

number of entities: (...) including a rural *gmina* (municipality) or a rural area of an urban-rural *gmina* (municipality)

[a] in the neighbouring *gmina* of Goleniów there is a large industrial park and special economic zone; [b] the special economic zone operates on the border of the town and the *gmina* of Słupsk; [c] including one of the largest chemical plants in Poland

Source: author's study based on the Local Data Bank of the Central Statistical Office (*GUS*); Statistical Yearbook of Maritime Economy 2019

located in 17 *powiats* (including four cities with *powiat* rights), there were a few ports in 8 powiats (Table 4). It should also be mentioned that in the case of Słupsk *powiat*, the industry was concentrated in the special economic zone in the rural *gmina* of Słupsk, and in Goleniów *powiat* in the industrial park in the *gmina* of Goleniów. However, in Police *powiat*, the industry was concentrated mainly in Police itself where the special economic zone and a large chemical plant operated.

Table 4. Selected data on industry in *powiats* with seaports in Poland in 2017

Powiat	Seaports in administrative units	Percentage employed in industry and construction	Number of economic entities in the manufacturing (PCA 2007)/PKD
City of Szczecin	Szczecin	19.56	5 676
Police	Police, Trzebież, Nowe Warpno	44.57	1 171
Goleniów	Stepnica	40.47	820
City of Świnoujście	Świnoujście, Przytór	19.25	432
Kamień Pom.	Kamień Pomorski, Dziwnów, Wolin, Wapnica, Lubin, Sierosław	18.35	435
Gryfice	Mrzeżyno	18.68	435
Kołobrzeg	Kołobrzeg, Dźwirzyno	21.71	672
Sławno	Darłowo	27.87	402
Słupsk	Ustka, Rowy	45.89	919
Lębork	Łeba	35.86	854
Puck	Władysławowo, Puck, Hel, Jastarnia	32.80	1 047
City of Gdynia	Gdynia	20.56	4 257
City of Gdańsk	Gdańsk	19.71	7 155
Nowy Dwór	Kąty Rybackie, Krynica Morska	24.59	477
Braniewo	Frombork, Nowa Pasłęka	13.70	231
Elbląg	Tolkmicko, Suchacz	36.71	583
City of Elbląg	Elbląg	35.22	1 109

Source: author's study based on the Local Data Bank of the Central Statistical Office (*GUS*)

Port and near-port industry

Research carried out in the 1980s shows that the port industry in Poland was relatively underdeveloped compared to the ports of Western Europe, where near-port industrial districts had been established (Andruszkiewicz, 1984). This observation was confirmed by the study of the seaports located within the Baltic Sea region by Bocheński (2019). During the study, in Polish seaports there were over 20 industrial plants apart from shipbuilding and fish processing.

The most industrially developed ports in Poland (in terms of the number of industrial entities) were Gdańsk, Szczecin, Gdynia, Police, and Elbląg. In the seaports located there, there were also port industries unrelated to the maritime economy with a location determined for economic reasons. In contrast, in the port of Gdynia, it was marginal, but at the same time, there were nearby plants producing equipment and components mainly for the maritime industry classified as a near-port industry.

The port industry, i.e. industrial plants located in seaports or functionally related to them, included over 90 entities, of which 37% were in Szczecin, 27% in Gdańsk, 17% in Gdynia, 6% in Elbląg and 4% in Świnoujście, and in the remaining five ports, where only shipyards were located, totalling 8% (Table 5).

Table 5. Number of identified industrial plants in seaports and port industrial districts in Poland in 2019

Town/ city	in total	Shipyards		Other offshore*	Chemical	Agri-food processing	Metal and machinery	Energy	Others
		altogether	with ship repair only						
Total	95	53 (3)	27	19	6 (1)	5 (2)	5 (1)	5 (1)	2 (2)
Gdańsk	26	18 (1)	5	2	2	3	–	1	–
Gdynia	16	9	5	3	1 (1)	1 (1)	1 (1)	–	1 (1)
Szczecin	35	14	12	14	2	1 (1)	–	3 (1)	1 (1)
Świnoujście	4	4	2	–	–	–	–	–	–
Kołobrzeg	2	2	1	–	–	–	–	–	–
Ustka	2	2 (2)	–	–	–	–	–	–	–
Darłowo	1	1	1	–	–	–	–	–	–
Władysławowo	1	1	1	–	–	–	–	–	–
Police	2	1	–	–	1	–	–	–	–
Elbląg	6	1	–	–	–	–	4	1	–

* production of components and elements for the maritime industry and ports; (...) including those without access to the waterfront

Source: author's study based on Maritime Economy Guide 2019; National Register (*Krajowy Rejestru Sądowy* 2019); Szczecin Shipyard 2019; information published by individual companies

A special place in ports is occupied by industrial sectors directly related to the maritime economy, i.e. shipbuilding and marine construction (shipbuilding and offshore industry) and fish processing.

In 2017 there were 6 501 entities involved in the production and repair of boats and ships in Poland, employing 34 718 workers. In the years 2004–2017, there was a 67%-increase in the number of shipbuilding enterprises, while employment in this sector increased by only 2%. The number of vessels produced in this period increased significantly, with small units dominating, e.g. yachts and motorboats, with a simultaneous decrease in the production of large vessels (Statistical Yearbooks of the Maritime Economy – *Rocznik Statystyczny Gospodarki Morskiej*, 2007–2018). Concerning the number of companies, most Polish boat building is not located on the coast. However, the available statistics do not provide a breakdown of boat and shipbuilding companies according to specialisation, and there are manufacturers both of seagoing and river/ lake vessels, as well as yards that only repair. The companies located away from the coast produced small boats that could be relatively easily transported to a port chosen by the customer. It concerned the largest yacht shipyards: *Ostróda Yacht Sp. z o.o*. in Ostróda, *Delphia Sp. z o.o*. in Olecko, and *Galeon Sp. z o.o.* in Straszyn near Gdańsk which produced vessels for both but were intended mainly for export. However, in seaports,

shipyards specialised in the construction of larger seagoing vessels, as well as producing steel components and other elements for the offshore sector.

The author's analysis of 2019 shows 53 shipyards operating in ports with ship repair accounting for half of them (Table 5). Some also offered steel components, e.g. for the maritime industry. Among ship production yards, three did not have access to the water. Additionally, 19 other companies were operating, producing various types of steel components and industrial installations and over 60% of these enterprises were established after 1989. The largest shipyards, including two-thirds of those building new seagoing vessels, worked in Gdansk and Gdynia. In Gdańsk, there were two shipyard holdings: *Stocznia Gdańsk SA* and *Grupa Remontowa Holding SA*, and in Gdynia: *Stocznia Remontowa Nauta SA*, *Crist SA*, *Vistal Gdynia SA*, and *Damen Shipyards Gdynia SA*. In Szczecin, there were mainly small shipyards with the largest one being *Morska Stocznia Remontowa Gryfia SA* along with plants manufacturing various types of steel components and installations for both maritime and land construction. Smaller shipyards also operated in other ports. Polish shipyards focus on the production of specialised vessels, e.g. for servicing wind farms or drilling platforms, yachts and cutters, as well as hulls, superstructures and other components for foreign shipyards (information published by individual shipbuilding companies). For comparison, in 1989 there were about 20 shipyards including the no longer existing large ones in Gdynia and Szczecin.

The shipbuilding industry underwent the most significant transformation in Szczecin and Gdynia. In 2009 Gdynia Shipyard collapsed and some of the areas were taken over by other yards that moved their activities there. The same movements were made by various companies producing for the needs of the maritime economy and by the *Pomorski Park Naukowo-Technologiczny* – Pomeranian Scientific and Technological Park. The infrastructure was modernised, and the research and development facilities were expanded. Most of that area was included in the subzone of the Pomeranian Special Economic Zone – a project called the *Bałtycki Park Nowy Technologii* – Baltic Park of New Technologies (BPNT) (Palmowski, Tarkowski, 2016). In Szczecin, in the area of the bankrupt Szczecin Shipyard, Szczecin Industrial Park was established in 2014, and by 2019 there were about 60 businesses there both for production and services (Stocznia Szczecińska 2019) including ten small shipyards and other plants partially producing for the maritime industry. In 2016 in connection with the government's plan to reactivate the shipbuilding industry in Szczecin, *Szczecińskie Konsorcjum Okrętowe* – Szczecin Ship Consortium was established which included 19 industrial and service companies, most of which operated in the Szczecin Industrial Park (Portal Morski, 2016; information published by individual companies).

The vast majority of fish processing plants are located outside seaports, and often outside ports. The companies in this sector, initially based in the port, were closed down, limited to cold storage services, or moved their production to another location. While in the ports, there were a few rather small processing plants (Czapliński, 2011, 2018). The fish processing industry in Poland was concentrated in Pomorskie and Zachodniopomorskie Voivodeships, where, in total, more than half of the enterprises were located. In 2017 there were 709 entities processing and preserving fish and fishery products in Poland, employing 21 500 people. In the years 2004–2017, the number of enterprises increased by 5,2%, though there were some fluctuations. However, employment was continually growing, and its growth in these years amounted to 61% (Statistical Yearbooks of the Maritime Economy, 2007–2018). These data apply to the

entire fish processing sector, including plants processing only freshwater fish, e.g. from fish farming. However, most fish on the Polish market came from the sea, i.e. about 80% of the catch and most of the imports.

Fisheries services, i.e. boatyards, ice factories, pre-treatment plants and cold stores, were of significant importance. These were associated with fishing companies or institutions and fish auction centres. In the nine analysed ports, there were a total of 14 auction centres for fish, including five in Kołobrzeg, two in Darłowo and Ustka, and single ones in Dziwnów, Łeba, Władysławowo, Hel and Gdańsk. There were cold stores and ice factories in their area, and they also ensured the sorting and filleting of fish (Najwyższa Izba Kontroli, 2016).

Fish processing plants operating in Polish ports closed or moved. Ustka was a place where a canned fish factory called *Łosoś* worked in the port area until the beginning of the 21st century when it was moved to Włynkówko near Słupsk where a new plant was built in the special economic zone (*Przetwórstwo Rybne Łosoś...,* 2020). During the heyday of Polish fisheries and the development of deep-sea fishing, large fish processing plants operated in the ports of Szczecin: Gryf Deep Sea Fishing and Fishing Services Company (*Przedsiębiorstwo Połowów Dalekomorskich i Usług Rybackich Gryf*), and after 1991 Gryfryb Food Industry Enterprise (*Przedsiębiorstwo Przemysłu Spożywczego Gryfryb*) (Gryf, 2017), and in Gdynia, Dalmor Deep-Sea Fishing *Dalmor Połowy Dalekomorskie* (Karnicki, 2012). As of 2019, only one cold store operated in Szczecin, and the plant in Gdynia had been closed.

Ports and their industrial districts in Poland

Standard port and industrial districts with plants which can access the waterfront and use sea transport were developed in Szczecin, Gdańsk, and Elbląg. Their origin stretches back to the end of the 19th century and initially included shipbuilding, and later also other sectors, e.g. agri-food, chemical, metal and machinery (see: Piskozub, 1982; Dutkowski, 1983).

In Gdańsk, the port and industrial district covers almost the entire southern part of the inner port – a total of about 230 ha. The most substantial part was the shipyard area of about 200 ha. In the eastern part of the city, there were several smaller shipyards and a refinery connected by a pipeline system from a fuel storage facility to an oil terminal in the outer port.

In Szczecin, the industrial district covered the northern part of the port, and there were shipyards, chemical plants, a paper mill and a steelworks (which closed in 2005). The largest area, about 120 ha, was occupied by the shipyard, including 45 ha of the Szczecin Industrial Park, and the remaining part, located partly on the Ostrów Brdowski island, was held by the *Gryfia* repair yard. The industrial park, operating under the name of Szczecin Shipyard since 2018, was established in 2014 on the premises of the former Szczecin Shipyard which went bankrupt in 2009 (Bocheński, Palmowski, 2015). Single industrial plants were also located in the central part of the port of Szczecin. According to Dutkowski (2017), the industrial potential of Szczecin was minimal after the political and economic transformation.

Industry in the port of Gdynia was almost exclusively shipbuilding and supplying plants as well as individual enterprises in the agri-food sector. In 2009 Gdynia Shipyard collapsed, some of its areas were taken over by other yards that moved

their activities along with various companies producing for the needs of the maritime economy, and the *Pomorski Park Naukowo-Technologiczny* – Pomeranian Scientific and Technological Park. The infrastructure was modernised, and the research and development facilities were expanded. Most of that area was included in the subzone of the Pomeranian special economic zone in a project called the Baltic Park of New Technologies (BPNT) (Palmowski, Tarkowski, 2016). The shipyard areas, which could be considered a port and industrial district, covered an area of about 69 ha (Geoportal, 2019; Port Gdynia, 2020).

In Elbląg industry was concentrated along the river, on its right bank. The primary and oldest industrial area was Łasztownia with an area of approximately 45 ha, but there are no longer any operating shipyards. However metallurgical industry (iron foundry), and metal and machine plants. Until the 1990s, it was a single enterprise whose area and infrastructure were taken over by several specialised companies as a result of restructuring.

The port in Police was a typical industrial port built for the needs of a chemical plant owned by a company in the chemical synthesis industry called *Zakłady Chemiczne Police*. The plants themselves were away from the river but connected by a network of conveyor belts and pipelines with transhipment terminals.

In the remaining ports, no larger industrial districts were established. Only fish handling and small repair yards operate nearby.

The use of sea transport in the servicing industry

Industry is an essential generator of cargo. The location of industries based on imported raw materials and/or exporting their products to other countries is common throughout the world. The development of industry in a port influences the increase in transhipments and available statistics relate to those in a given port. Only some terminals publish their statistics and information on the volume of transhipments for specific customers is not available, only partial information for selected years can be found.

Police port serves only the chemical plant *Zakłady Chemiczne Police SA – Grupa Azoty,* but it was the fifth seaport in Poland in terms of transhipments. In 2015, 1725 tonnes were transhipped, including phosphorites, apatites, ilmenite, potassium salt, and fertilisers such as ammonia and sulphuric acid (Dolecki, 2016). This plant is the most significant Polish producer and exporter of fertilisers, white titanium and pigments. In 2019 a contract was signed for the construction of a petrochemical complex in Police: *Polimery Police* with a new transhipment terminal at the seaport. The investment is to be completed in 2022 (Kontrakt na budowę…, 2019).

In Szczecin, transhipment for the chemical plant *Fosfan SA* (Port Nad Odrą, 2019) and *Baltchem SA* while the chemical plant in Szczecin (*Zakład Chemiczny w Szczecinie*) was of considerable importance. Besides these, cocoa beans were imported mainly from the Ivory Coast for the needs of *Przedsiębiorstwo Przemysłu Cukierniczego Gryf* belonging to the *Cémoi* group (Pakos, 2015; Zapach czekolady..., 2016). In the central part of the port was the thermal waste disposal plant for the Szczecin Metropolitan Area (*Szczeciński Obszar Metropolitalny* SOM) (*EcoGenerator*, 2013) opened in 2017. Despite its convenient location, it did not have a quay, but water transport could potentially be used to deliver garbage, e.g. from Świnoujście, which is part of the Szczecin Metropolitan Area. *Apis Sp. z o.o.* and the Szczecin heat and power plant (*EC Szczecin*), despite

having quays did not use water transport. In 2012 *EC Szczecin* began using biomass, and the fuel was supplied only by land (information obtained from *EC Szczecin* employees in June 2017). Overall, cargo transhipping declined, which may be partly related to the decline of the port industry in the 1980s. In the mid-1990s transhipments reached several million tonnes – e.g. 14,3 million tonnes in 1997, but since 2002 they did not exceed 10 million with 8,7 million in 2018.

In Gdańsk, mainly crude oil and its refined products, raw materials and chemical products, as well as grain, were transhipped for the needs of local industry. For example, in 2012, about 3 million tonnes of products from the Gdańsk refinery were shipped by sea (Jamroż, 2013), which accounted for 11% of total transhipments in Gdańsk. However, transhipments at the Chemików quay connected with the chemical plant *Fosfory Sp. z o.o.* in 2004, exceeded 1.5 million tonnes, which was a further 6% of transhipments at the port. It is the place where goods were transhipped not only for the Gdańsk plant but for the entire Puławy Group, as well as for other entities (Fosfory Sp. z o.o., 2018; Port Gdańsk, 2018). Transhipments of cereals accounted for approximately 3% (Bocheński, Palmowski 2015) and some of this was intended for the malting plants of Malteurop Polska and Gdańsk Flour Mills (*Gdańskie Młyny Sp. z o.o*.). The transhipments at the port were also used by the *Zakłady Tłuszczowe Kruszwica SA* (until 2006 *Zakłady Przemysłu Tłuszczowego Olvit Sp. z o.o.).* However, the port was not used by Polish Energy Group Energia (*PGE Energia Ciepła SA*) – a branch of the Wybrzeże Heat and Power Plant (*Elektrociepłownia Wybrzeże*).

Rol-Ryż Sp. z o.o. producing various types of rice and rice flour did not have a quay, so it transhipped in Gdynia. *Gafako* (Spigarski, 2016) and the 'Port Technical Company' (*Portowy Zakład Techniczny SA*) (Portowy..., 2020) included in the offshore industry, exported its products by sea intended mainly for the maritime industry and ports (including steel components, machines, and transhipment equipment). In Gdynia, in the Pomeranian Special Technical Zone (*Bałtycki Port Nowych Technologii – BPNT*), there were also plants producing components for the shipbuilding industry, including hydraulic cylinders – *Hydromega*; electrical equipment – HG Solution; and anti-corrosion systems – *Makromor* (Palmowski, Tarkowski, 2016). They did not use the port directly, and their location resulted from cooperation with Gdańsk and Gdynia shipyards; *Gafako* also cooperated with shipyards.

In Elbląg, the port industry includes four plants located in Łasztownia: General Electric (formerly: *Alstom Poland Sp. z o.o.*), *FLSmidth MAAG Gear Sp. z o.o*., *Metal Expert Sp. z o.o*., and Elzamech Foundry (*Odlewnia Elzamech Sp. z o.o*.). These plants used water transport to a small extent and rather sporadically, e.g. in 2017, a turbine was shipped by water to the Opole power plant (Dimitrov, 2017).

To sum up, in terms of transhipments for the needs of industrial plants, the ports of Police and Gdańsk were the most significant with the port of Police operating only for the needs of nearby plants. In contrast, the port in Gdańsk was the most important Polish commercial port, and plants located in its vicinity accounted for a significant part of total transhipments. In Szczecin, the industrial role has lost its importance, and some plants, despite their quays, did not use them; transhipment was used primarily by chemical plants and a cocoa mill. In Elbląg, although several plants had access to quays, transhipping for the needs of local industry was rare.

Classification of ports in terms of industrial development

Based on the analysis, considering the importance of a given port as an industrial centre (several manufacturing companies), the development of port industry, and the size of the port and industrial district (Table 6), ports were divided into four groups:

A. with a developed and diversified industry: Gdańsk and Szczecin;
B. with one industry sector dominating: Gdynia, Police, Elbląg;
C. with a small shipbuilding industry and plants operating for the needs of fisheries: Świnoujście, Kołobrzeg, Władysławowo, Ustka;
D. no developed industry (other ports).

Additional factors influencing the classification of individual ports lay in the specific conditions of industrial development: in Kołobrzeg, Ustka and Świnoujście development are limited because they are spa towns. In Police, however, there is one of the largest chemical plants in the country and a typical industrial port which is still expanding.

Table 6. Industry in ports in Poland

Town/ city	Number of processing entities (in thousands)	Number of port industry plants	Industries with at least two plants using the port	Port and industrial district
Gdańsk	6.7	26	shipbuilding, offshore, chemical[a], agri-food	yes, the area of over 230 ha*
Gdynia	4.0	15	shipbuilding	yes, shipyard areas with an area of 69 ha*
Szczecin	5.5	35	shipbuilding, offshore, chemical	yes, shipyard areas with an area of 120 ha*
Świnoujście	0.4	4	shipbuilding	absent
Kołobrzeg	0.3	2	shipbuilding, fisheries	absent
Ustka	0.1	2	shipbuilding[b], fisheries	absent
Darłowo	0.1	1	fisheries	absent
Władysławowo	0.1	1	fisheries[c]	absent
Police	0.5	2	chemical	absent
Elbląg	1.1	6	metal and machine	yes, an area of 45 ha*

[a] including the second-largest crude oil refinery in Poland; [b] the shipyards were outside the harbour with no access to the waterfront; [c] Władysławowo – the largest fishing port in Poland, one company manages the port, the ship repair yard and provides comprehensive fisheries services

* only land surface, i.e. without adjacent port basins

Source: author's study based on Table 5 and Geoportal 2019

Summary and conclusions

The largest industrial centre among port cities and towns in Poland is Gdańsk. At the same time, it is also the most important Polish commercial port and fourth in terms of transhipments in the Baltic Sea Region. Its developed industrial function favours increasing transhipments while one-third of the shipyards in ports in Poland are in

operation there. A significant part of its transhipment is crude oil and its products, and the oil terminal is inextricably linked with the construction of the refinery.

There are two other ports of primary importance, Szczecin and Gdynia, and the typical industrial port in Police. In Szczecin, about 30 companies operate in the former area of one of the largest shipyards, including small ship repair yards and plants producing various types of steel components. The situation is similar in Gdynia, but in this case, other production yards have moved into the former area of Gdynia Shipyard. The infrastructure and research and development facilities have also expanded. In Police, however, the shipbuilding industry is currently being developed along with the seaport that serves it. Elbląg has established industry, though due to difficult access to the sea, the use of this port for the needs of industry was sporadic.

In five other ports, only shipbuilding and fish processing were present (Świnoujście, Kołobrzeg, Darłowo, Władysławowo, and Ustka). The ports of the central coast and the Bay of Puck mainly served fisheries and leisure, while only Kołobrzeg and Darłowo were significant in handling cargo. This situation has influenced the development of industrial functions both in the ports themselves and in port cities and towns. In Ustka, industry 'escaped' beyond the port, and even the town itself, and the transhipment function disappeared. The shipyards currently operate outside the port, and fish processing plants moved to neighbouring *gminas* including the special economic zone near Słupsk.

Apart from shipbuilding, port industries in Poland are dominated by chemical (Police, Szczecin, Gdańsk) as well as metal and machine production (Elbląg, Szczecin, Gdynia). Some plants did not use their location in the seaport, and this was typical of heat and power plants (Szczecin, Gdańsk, Elbląg), and the waste incineration plants and paper mills in Szczecin. Also, the metal and machine industry in Elbląg used water transport only sporadically, and its location was not used.

This article certainly does not exhaust the subject. Further, in-depth research would be recommended focusing on an analysis of changes and the role of transport and the industrial functions of individual seaports, the use of sea transport in supply chains and servicing individual industrial plants, and the functioning of the port and industrial districts including related problems and changes in the industrial range of these districts as a result of the disappearance of industrial functions.

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