Application of the AHP and PROMETHEE II methods to the evaluation of the competitiveness of Polish and Russian Baltic container terminals

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ABSTRACT

The rapid growth in the volume of international container transport enforces the improvement of competitiveness in the entire transport chain, including maritime container terminals. Reports and scientific surveys on the Baltic Sea Region (BSR) tend to concentrate on annual results achieved by entire ports, largely ignoring the efficiency of individual terminals. The aim of the article is to fill this research gap and consequently examine the competitiveness of the most important maritime container terminals in Poland and their Russian competitors. To this end, selected Polish and Russian bases were examined with regard to a number of criteria, such as the length of the quay ($c1$), the number of RTG ($c2$) and STS ($c3$) cranes, the number of shortsea shipping connections ($c4$), the maximum depth at the quay ($c5$), the distance from motorways and expressways/national roads ($c6$) or the distance from the national railway station ($c7$). The above seven criteria were subsequently used to perform a strategic group mapping as well as AHP and PROMETHEE II multi-criteria rankings that enabled to specify those Baltic Sea container nodes which are in the area of strategic benefits for the analysed market sector. According to the results obtained, the Russian Petrolesport and the Polish DCT Gdańsk are the leaders of the market. This fact confirms their competitive advantage over other market players of the sector in question.

ARTICLE INFO

1 Introduction

The dynamic development of maritime trade contributed to the rapid growth in the volume of international container transport, which accounted for 17.1 % of the total freight transported by sea in 2017 [36, p. 12]. The intensive development of container transport, in turn, increased the competitiveness of the entire transport chain, including maritime container terminals. Since Poland and Russia's transport potential is conditioned by the direct access to the Baltic Sea, one of the most exploited water areas in terms of transport in the world [13, p. 1], it is worth characterising briefly the largest Baltic container ports.

Considering the number of twenty-foot containers (TEU) transhipped annually, St Petersburg was the largest container port in the Baltic Sea Region (BSR) in 2017, with approx. 25 % market share (figure 1). Compared to previous years, however, its advantage over Gdańsk (approx. 20 % market share), Gdynia (approx. 9 % market share), Hamina/Kotka (also approx. 9 % market share) and Goteborg (approx. 8 % market share) decreased.

Yet a year later, in 2018, the real leadership in the BSR was taken over by Gdańsk, which was classified as the fifteenth and the only Baltic port in the ranking of fifteen largest container ports in Europe published by the Shanghai Maritime University [21]. This is also confirmed by an analysis of industry reports from recent years. Already in 2017, the Port of Gdańsk was listed among one hundred largest container ports in the world [20], mainly due to good results of the deepwater DCT terminal and the construction of the new T2 quay. The same year, Gdańsk also recorded the largest increase in the volume of transhipped twenty-foot containers (year-over-year change: + 21.6 %). At the same time, the growth rate of other terminals in the BSR was much lower. Other largest year-over-
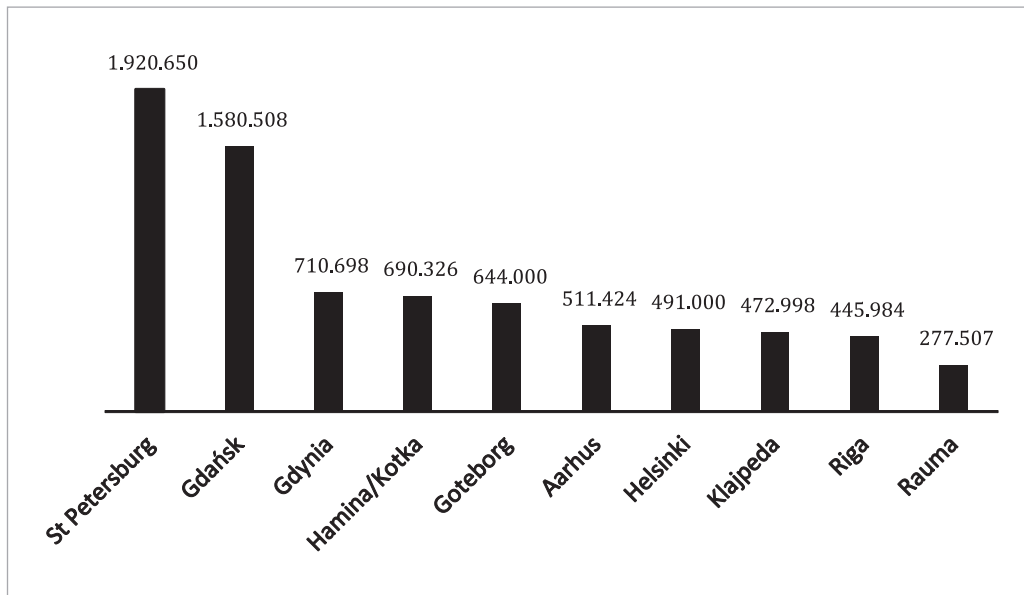
Figure 1 Ten largest Baltic container ports in 2017 (TEU)

year changes were recorded in ports in Riga (+15.6 %), Aarhus (+12.4 %) and Gdynia (+10.7 %). The worst results were achieved by the Port of Goteborg, which recorded a drop of 19 % in the number of transhipped twenty-foot containers in 2017. Poor results of the Swedish port were triggered by, among other things, the conflict between trade unions and the management of the APM Terminals [26]. Therefore, taking into consideration the fact that the growth rate of the former market leader, St Petersburg, amounted to + 10.1 % at the time, the Port of Gdańsk is expected to strengthen its position as the largest Baltic Sea container node.

However, as it turns out, industry reports and research on the BSR usually take into account the annual results achieved by individual ports only, ignoring the effectiveness of the terminals which they are composed of. Consequently, this article will fill this research gap and examine the competitiveness of the largest Baltic container terminals in Poland (DCT Gdańsk, BCT Gdynia, GCT Gdynia, DB Port Szczecin), relative to their biggest competitors, i.e. Russian terminals.

2 Competitiveness of the Baltic container terminals

So far, apart from several industry reports [6, 16], only a few Polish [2, 5, 17] and foreign [9, 15, 31] researchers have described the competitiveness of Baltic ports, including Russian [24, 32, 39] and Polish [12, 13, 14, 28, 29] ones. At the same time, multi-criteria analyses were carried out to this end in merely two Polish articles [18, 23]. Consequently, it is worth taking a closer look at the Polish maritime con-

tainer terminals and find out what their competitive position is in relation to their biggest competitors in the region.

Competitiveness can be defined as a kind of a measure of past performance [3, p. 56]. Competitiveness of the maritime container terminal is primarily influenced by such factors as the technical infrastructure, work organisation, the use of advanced information technologies or provision of comprehensive logistics services [35, 37].

Since technical infrastructure is the main factor conditioning the functioning of the container terminal, those terminal elements whose correct construction and layout determine its efficiency were of the uttermost importance in the study, including the length of the quay, the maximum depth at the quay, the distance from the nearest motorways, expressways/national roads and national railway stations. The study also analysed suprastructural (the number of STS, Ship to Shore, and RTG, Rubber Tyred Gantry, cranes) as well as service (the number of line shipping connections served) factors. In the latter case, regular shortsea shipping connections were taken into account, one characteristic feature of which is the maintenance of permanent connections between specific ports of a given region, served in accordance with a regular departure schedule.

There are fifty-five container terminals in the BSR which are located within the territory of nine countries: Denmark, Estonia, Finland, Lithuania, Latvia, Germany, Poland, Russia and Sweden. The list includes only those container terminals that belong to the Baltic Sea due to their location. As a result, the Norwegian bases, whose transport routes for most cargos join the Baltic transport system through Denmark and Sweden, are not taken into account [7, p. 15].

Table 1 Large Baltic container terminals in Poland and Russia (2019)

Country	City	Terminal (code)
Poland	Gdańsk	Deepwater Container Terminal Gdańsk (DCT Gdańsk)
	Gdynia	Baltic Container Terminal Gdynia (BCT Gdynia) Gdynia Container Terminal (GCT Gdynia)
	Szczecin	DB Port Szczecin (DB Port)
Russia	St Petersburg	Bronka Container Terminal (Bronka CT) Container Terminal Saint–Petersburg (CTSP) First Container Terminal (FCT) Moby Dick (MD) Neva–Metal Terminal (NMT) Petrolesport (PLP)
	Ust–Luga	Ust–Luga Container Terminal (ULCT)

Source: Author

There are six Baltic container terminals in Poland: two in the ports of Gdańsk and Gdynia, one in Szczecin and one in Świnoujście. The DCT Gdańsk, the BCT as well as the GCT Gdynia and the DB Port Szczecin are the largest of them with regard to their annual maximum transhipment capacity. In order to determine their competitive position in the BSR, the study first examined which Russian competitors belong to large container terminals of the Baltic Sea (the maximum annual transhipment capacity over 150 thousand TEU). The boundary of this division is conventional. For comparison, Katarzyna Karwacka [11, p. 697] distinguishes three types of terminals: peripheral ones with a transhipment of several hundred thousand TEU, regional with a transhipment of over one million TEU and large (the so-called continental hubs).

Subsequently, the competitiveness of the terminals selected for the study (table 1) was tested for $c = 7$ criteria, using a strategic group mapping and AHP (Analytic Hierarchy Process) as well as PROMETHEE II (Preference Ranking Organisation Method for Enrichment Evaluations) multi-criteria methods. The analysis excluded the criteria

for which no reliable and comparable data could be found for all terminals examined in the study. The omitted criteria include: the number of marinas, the number of oceanic connections, the number of nests for refrigerated containers, the length of tracks at the railway siding or the size of the storage yard and the warehouse.

3 Research method

3.1 Strategic group mapping

Prior to the multi-criteria analysis, a strategic group mapping was performed [19, p. 247–258] for three uncorrelated pairs of criteria (the absolute value of Pearson's linear correlation coefficient $|r| < 0.2$). In the subsequent figures, after taking into account the measurement scale of the criteria, each terminal was assessed according to a selected pair of criteria, while the results obtained were plotted in the form of points on the chart. The size of each point depended on the size of the absolute market share for individual players (table 2). The indicator was calcu-

Table 2 Absolute market shares for Polish and Russian Baltic container terminals

Terminal	Absolute market share
Deepwater Container Terminal Gdańsk (DCT Gdańsk)	16.19
First Container Terminal (FCT)	6.75
Baltic Container Terminal Gdynia (BCT Gdynia)	6.48
Bronka Container Terminal (Bronka CT)	5.40
Petrolesport (PLP)	5.40
Container Terminal Saint–Petersburg (CTSP)	4.05
Gdynia Container Terminal (GCT Gdynia)	3.43
Neva–Metal Terminal (NMT)	2.70
Ust–Luga Container Terminal (ULCT)	2.38
Moby Dick (MD)	2.16
DB Port Szczecin (DB Port)	0.81

Source: Author

lated on the basis of the maximum transhipment capacity of all fifty-five terminals of the region of interest in this paper. Finally, the area of strategic benefits was determined in each of the analysed cases. It was assumed that it is the most advantageous for individual terminals if the length and the depth of the quay as well as the number of STS cranes are the largest, while the distance from the national railway station remains the shortest.

3.2 Selected methods of a multi-criteria analysis

The problem of a multi-criteria discrete optimisation deals with the decomposition of a complex decision problem and an indication of the best decision from a discrete, finite and countable n-element set. The decision maker is looking for a variant that best suits their preferences determined by means of the previously selected C criteria [34, p. 189].

There are numerous methods of a multi-criteria decision support, the most popular of which include the AHP and the PROMETHEE II. These are ranking methods in which incomparability of variants cannot occur. Both methods, however, allow for some blurring of variant ratings. The PROMETHEE II uses equivalence and preferences thresholds, while in the AHP the values of a given criterion can be assigned only to one of the nine categories of assessment. At the same time only nine categories can be divided into weights of individual criteria. Since both methods are widely described in the literature of the subject [1, 27, 33], they will not be discussed in greater detail in this article, and the following paragraphs will contain only summary results of the study conducted by the authoress.

Suffice it to say that the goal in the proposed multi-criteria scheme was to indicate the best terminal among all eleven alternatives (CTn, where n = 1,2, ..., 11) on the basis of seven criteria (Cn, where n = 1,2, ..., 7). As mentioned earlier, it was desirable for some selected measures to look for alternatives with the highest value (criteria from $c1$ to $c5$), while for others – with the lowest value ($c6$, $c7$).

4 Empirical study

4.1 Data collection

Table 3 presents the criteria selected for the study along with their weight and direction in which they should go, while the following two tables (tables 4–5) provide information on the length of the quay ($c1$), the number of RTG ($c2$) and STS ($c3$) cranes, the number of shortsea shipping connections ($c4$), the maximum depth at the quay ($c5$), distances from motorways and expressways/national roads ($c6$) as well as national railway station ($c7$) for all eleven terminals.

The data for the first five criteria was taken either from the websites of individual terminals or from various types of collective studies. All these criteria should be maximised. The biggest weight (8) was assigned to the criteria $c1$ and $c4$ since these parameters significantly affect the efficiency and accessibility of maritime container bases. A slightly lower weight (7) was assigned to the maximum water depth at the quay, as it is a parameter that determines the size of ships that can call at a given port, and consequently affects also the ability to maintain oceanic connections. The $c3$ (weight 5) and $c2$ (weight 4) criteria were considered the least important as some container terminals use other types of equipment for handling multimodal units at the quay and in the storage yard. The technical equipment of container terminals may include gantry cranes, side lift trucks, front lift trucks or reach stackers. However, both criteria were included in the analysis because the use of specialised equipment significantly improves the efficiency of container bases. The distance from motorways and expressways/national roads as well

Table 3 Criteria selected for the competitiveness analysis along with their weights and desired direction

Criterion	c1	c2	c3	c4	c5	c6	c7
Direction	max	max	max	max	max	min	min
Weight	8	4	5	8	7	6	6

Source: Author

Table 4 Baltic container terminals in Poland

Terminal	c1	c2	c3	c4	c5	c6	c7
DCT Gdańsk	1,300	35	11	8	16.5	2,600	10,400
BCT Gdynia	800	20	8	9	12.7	4,100	3,100
GCT	620	14	6	15	13.5	3,300	2,700
DB Port	1,000	4	2	2	9.5	500	2,600

Source: Author

Table 5 Baltic container terminals in Russia

Terminal	c1	c2	c3	c4	c5	c6	c7
Bronka CT	1,220	8	4	8	14.4	1,500	5,500
CTSP	787.2	19	4	3	11.4	4,000	4,600
FCT	780	12	7	12	11.0	2,600	3,000
MD	321	5	1	2	8.9	230	10,900
NMT	738	1	1	5	11.0	2,900	3,200
PLP	2,201	20	10	13	11.0	3,700	4,000
ULCT	440	11	4	5	13.5	3,100	8,500

Source: Author

as national railway stations was, in turn, determined on the basis of own calculations carried out with the use of navigation programmes and digital maps. In both cases, the parameters go to the minimum, and their weight is 6.

A group of large Baltic container terminals includes four Polish maritime bases (table 4), two of which are located in Gdynia (BCT, GCT) and the other two in Gdańsk (DCT) and Szczecin (DB Port) [10]. Each of them uses STS and RTG cranes for container reloading. Owing to the 16.5-metre long quay, the DCT Gdańsk was among the first Polish maritime transport hubs to break the monopoly of the North Sea ports for servicing European oceanic relations with Asia. Thus, given the Baltic market, the DCT is one of the leaders in a TEU transhipment per year. Its turnover amounted to over 1.9 million in 2018, which exceeds the annual maximum transhipment capacity of the BCT and GCT terminals in Gdynia (amounting to over 1.8 million TEU in total). On the other hand, DB Port Szczecin, the smallest port in the analysed group, is most conveniently located as far as the access to land facilities is concerned. It is situated just 0.5 km from the nearest national road and about 2.6 km from the national railway station.

Russia has as many as seven large Baltic container terminals, six of which are located in St Petersburg (table 5). Considering the annual maximum handling capacity expressed in twenty-foot containers, the largest St Petersburg terminals include the First Container Terminal (FCT), Bronka CT and Petrolesport (PLP). All Russian container bases use quay and yard cranes for container reloading. Considering the distance from the nearest national railway station, the Moby Dick (MD) and the terminal in Ust-Luga (ULCT) are definitely in the least favourable locations. The latter, together with the Petrolesport (PLP), is also the furthest location from motorways and expressways/national roads.

4.2 Results

If all the criteria were equally important and considered individually, the DCT Gdańsk would achieve the best results (in categories *c2, c3, c5*), whereas the Moby Dick – the worst (in criteria *c1, c3, c4, c5, c7*). However, the Russian MD would win the category "distance from motorways and expressways/national roads" (*c6*). At the same time, it turns out that the terminal in Szczecin maintains the fewest regular shortsea line connections in the analysed group beside the already mentioned MD. Nevertheless, its location is the closest to the national railway station. In addition, the most regular connections are handled by the GCT, while the Russian Neva–Metal uses only one STS and one RTG crane for container handling and the Petrolesport has the longest quay.

The analysis of a strategic group mapping reveals that the Petrolesport (PLP) places itself in the area of strategic benefits in all three analysed cases in terms of selected pairs of criteria (figures 2–4). Thus, it is expected that this terminal should also take a high position in the final multi-criteria rankings. Its biggest competitors are the DCT Gdańsk, which has the largest market share in the analysed group, and the Bronka CT, which achieves worse results only in the third criterion (the number of STS cranes). On the other hand, the competitive position of two Russian bases (MD, ULCT) seems to be the worst and the DB Port is the terminal with the lowest market share in the group.

As for the multi-criteria analysis, firstly the AHP method was used to evaluate the competitiveness of eleven chosen objects. Subsequently, the PROMETHEE II multi-criteria analysis was carried out for the same alternatives, weights and criteria. As the main purpose of the study was to perform a strategic group mapping and multi-criteria rankings and thus to specify those Baltic Sea container nodes which are in the area of strategic benefits in the BSR, a sensitivity analysis was omitted and only one set of weights was considered in both cases. Table 6 shows the synthetic AHP ranking and table 7 presents the PROMETHEE II input, output and net dominance flows (*n* = 11). The abovementioned table is also the final ranking of the terminals in question. The container bases are ranked there in relation to the decreasing values of φ. The values of φ+ and φ− are given only to facilitate the assessment of the extent to which the considered variants are better or worse than all others, respectively.
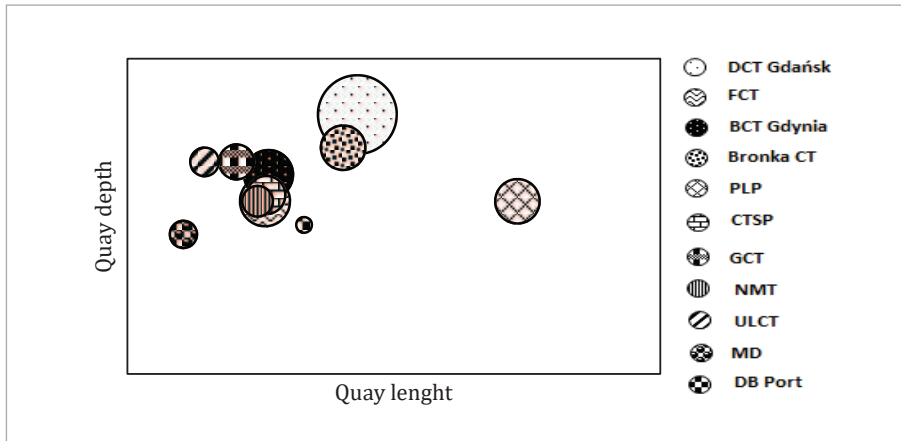
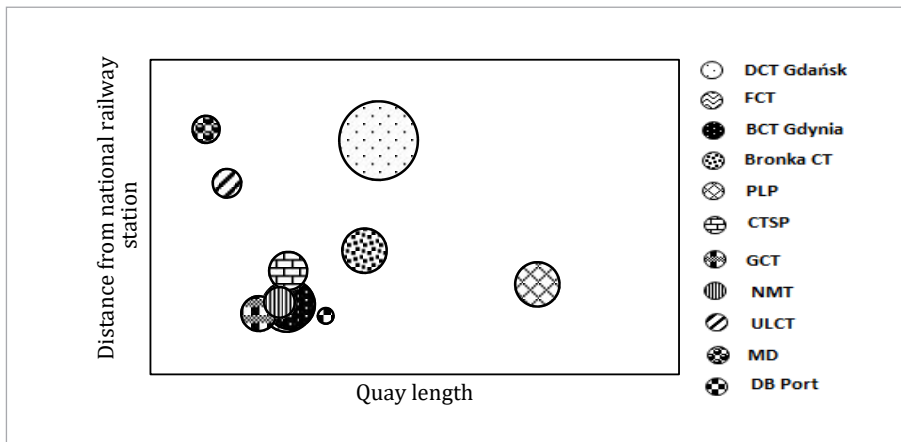**Figure 2** Strategic group map – quay length vs. quay depth

Source: Author

Figure 3 Strategic group map – quay length vs. distance from national railway station
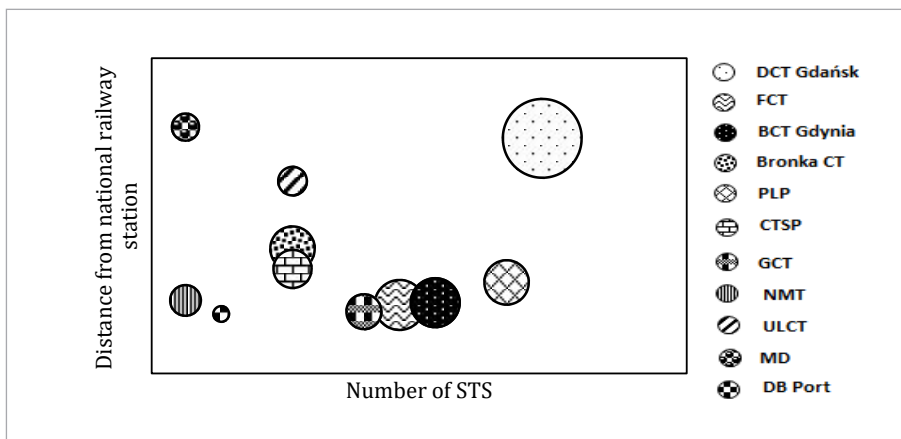
Source: Author

Figure 4 Strategic group map – number of STS vs. distance from national railway station

Source: Author

Table 6 The AHP multi-criteria ranking (n = 11 CT)

Terminal	Multi-criteria index
Petrolesport (PLP)	0.205
Deepwater Container Terminal Gdańsk (DCT Gdańsk)	0.156
Gdynia Container Terminal (GCT Gdynia)	0.133
Bronka Container Terminal (Bronka CT)	0.090
First Container Terminal (FCT)	0.089
Baltic Container Terminal Gdynia (BCT Gdynia)	0.085
Ust–Luga Container Terminal (ULCT)	0.063
Container Terminal Saint–Petersburg (CTSP)	0.053
Neva–Metal Terminal (NMT)	0.044
Moby Dick (MD)	0.043
DB Port Szczecin (DB Port)	0.039

Source: Author

Table 7 The PROMETHEE II flows (n = 11 CT)

Terminal	φ	φ+	φ−
Petrolesport (PLP)	0.358	0.462	0.104
Deepwater Container Terminal Gdańsk (DCT Gdańsk)	0.239	0.411	0.172
Gdynia Container Terminal (GCT Gdynia)	0.190	0.304	0.114
Bronka Container Terminal (Bronka CT)	0.128	0.258	0.130
Baltic Container Terminal Gdynia (BCT Gdynia)	0.111	0.247	0.136
First Container Terminal (FCT)	0.087	0.224	0.137
Container Terminal Saint–Petersburg (CTSP)	-0.148	0.105	0.253
DB Port Szczecin (DB Port)	-0.171	0.155	0.326
Ust–Luga Container Terminal (ULCT)	-0.176	0.110	0.287
Neva–Metal Terminal (NMT)	-0.234	0.068	0.301
Moby Dick (MD)	-0.384	0.109	0.493

Source: Author

The Petrolesport (PLP) and the DCT Gdańsk take the first two places in the multi-criteria rankings presented in the above tables, while the GCT terminal in Gdynia occupies the high third position, ahead of the Russian Bronka CT. The last three positions in the discussed rankings are held by the Russian Moby Dick (MD) and Neva–Metal (NMT) as well as the Polish DB Port Szczecin. At the same time, six out of eleven considered objects belong to the group of dominant bases (positive φ value) which means that the remaining 55 % terminals should be assigned to the group of dominated objects (negative φ value).

5　Concluding remarks

If maritime container terminals, like other economic entities, are to succeed, they must build on their competitiveness which is influenced by natural factors (geographical location along major shipping routes, within or near large production and/or consumption centres, etc.), infra-

structure factors (terminal equipment, transport connections) or quality factors (quality of services, frequency of shipping connections).

As research on the BSR usually takes into account the annual results achieved by individual ports, largely ignoring the effectiveness of the terminals they are composed of, the article examines the competitiveness of the largest Baltic container terminals in Poland relative to their biggest competitors, i.e. the Russian terminals. This may be further built on by the research into the competitiveness of all fifty-five container terminals in the BSR.

The results of the analysis of the competitiveness of the Baltic container terminals reflect the real situation on this market. As data shows, considering the number of TEU transhipped annually, St Petersburg, Gdańsk and Gdynia were the largest container ports in the analysed market sector in 2017 (see figure 1). Moreover, four (DCT Gdańsk, BCT Gdynia, Bronka CT and PLP) out of the top-five analysed terminals with regard to the maximum transhipment capacity

(see table 2) are also the leaders of the presented multi-criteria rankings. In both cases the Russian Petrolesport (PLP) and the Polish DCT Gdańsk take the first two positions while the Bronka CT occupies the fourth position. Importantly, the top-five of the rankings in question include other two Polish terminals (GCT, BCT Gdynia). This, in turn, confirms that the Tri-City ports create competition between as many as three agglomeration terminals. At the same time, it seems that if the merger of Gdynia terminals announced three years ago had taken place, the balance of power in the region could have undergone significant changes [4, 22].

The analysis of a strategic group mapping, in turn, provides evidence that although the most favourable position on the container transport market in the BSR seems to currently belong to the Russian Petrolesport (PLP), the DCT Gdańsk terminal is its main competitor, with its largest market share and the fastest growing year-over-year annual turnover of twenty-foot containers. The competitive advantage of the latter is mainly due to Gdańsk's favourable location and economic potential as well as the fact that it belongs to the Baltic non-freezing ports and thus offers the possibility of servicing regular oceanic connections throughout the whole year [30, p. 101]. However, as a well-developed land transport infrastructure increases the effectiveness of all seaports worldwide, the omission of the Gdańsk Port in the work plans for the North Sea–Baltic corridor of the TEN-T (Trans-European Transport Networks) may weaken its competitive position [8, p. 18]. The same may be generated, yet to a lesser extent, by a strong competition from the largest North Sea container terminals (Hamburg, Bremerhaven, Rotterdam), as well as those of the northern Adriatic coast (Ravenna, Venice, Trieste, Koper and Rijeka) [25, p. 181].

All the above confirms the conclusions drawn by Hanna Klimek [12, p. 122], who argues that Polish seaports operate on a market characterised by a fierce competition as they have to compete for cargo not only between themselves, but also with foreign ports (mainly of the North Sea and of the southern Baltic), as well as with land transport. At the same time, it confirms the conclusion of Ilona Urbanyi-Popiołek [38, p. 215] that the characteristic feature of the Baltic container shipping is the carriage of goods coming from outside or directed outside the region. The turnover of cargo transported in containers in intercontinental relations influences, in turn, the model of organisation of oceanic line services based on the hub and spoke system which consists in servicing a reduced number of large base ports (the so-called hubs) and the development of a network of feeder services, providing delivery and transport of containers to terminals deprived of oceanic connections.

References

[1] Bahzadian, M., Kazemzadeh, R.B., Albadvi, A., Aghdasi, M. (2010). PROMETHEE: A comprehensive literature review on methodologies and applications. *European Journal of Operational Research*, 200 (1), pp. 198–215.

[2] Bernacki, D. (2004). *Analiza konkurencyjności portów południowego Bałtyku*. In: K. Chwesiuk (ed.), *Zmiany w lądowo-morskich łańcuchach transportowych w rejonie basenu Morza Bałtyckiego. Szanse i zagrożenia dla polskich interesów morskich*. KREOS, Szczecin.

[3] Bernacki, D. (2003). *Znaczenie wartości dodanej w określaniu konkurencyjności portów morskich*. TRANSLOG, Szczecin.

[4] Borkowski, M. (2017). Mysz, która może ryknąć. *Namiary na Morze i Handel*, 8, pp. 7–8.

[5] Christowa-Dobrowolska, M. (2007). Konkurencyjność portów morskich basenu Morza Bałtyckiego. *Studia Akademii Morskiej w Szczecinie*, 48, pp. 3–262.

[6] *Conclusions on increasing smart competitiveness in the Central Baltic region* (2013). Juvenes Print, Tampere.

[7] Czermański, E. (2012). Charakterystyka gospodarcza regionu Morza Bałtyckiego. *Studia i Materiały Instytutu Transportu i Handlu Morskiego*, 9, pp. 15–29.

[8] EC (2016). *North Sea–Baltic. Second Work Plan of the European Coordinator Catherine Trautmann*. European Commission, Brussels.

[9] Grushevska, K., Moskvichenko, I. (2013). Competition among ports on the Eastern coast of the Baltic Sea for the Russian and Eastern European market. *Contemporary Economy*, 4 (4), pp. 25–44.

[10] *Historia Spółki OT Port Świnoujście* (2019). Available at : http://www.otport.swinoujscie.pl/pl/historia.html (accessed: 12.03.2019).

[11] Karwacka, K. (2011). Rozwój polskich terminali kontenerowych. *Logistyka*, 5, pp. 697–702.

[12] Klimek, H. (2006). Konkurencyjność polskich portów morskich na bałtyckim rynku usług portowych. *Studia Gdańskie. Wizje i rzeczywistość*, 3, pp. 112–138.

[13] Klimek, H., Dąbrowski, J. (2018). Polskie porty morskie na rynku usług portowych. *Studia i Materiały Instytutu Transportu i Handlu Morskiego*, 15, pp. 1–16.

[14] Kotowska, I., Pluciński, M. (2010). Stan obecny i perspektywy rozwoju funkcji transportowej polskich portów morskich na tle pozostałych portów południowego Bałtyku. *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy Transportu i Logistyki*, 565 (8), pp. 185–199.

[15] Lorentzon, S. (2014). *Containerization of the Baltic Sea – A competitive perspective*. Working Paper, School of Business, Economics and Law at University of Gothenburg, Gothenburg.

[16] Merten, T., Stūrys, V., Lukša, N. (2013). *Market Potential and Competition Analysis for selected ports of the Amber Coast*. SIA "NK Konsultāciju birojs", Riga.

[17] Miler, R. (2017). Systemowa analiza czynników konkurencyjności portów basenu Morza Bałtyckiego (Baltic Sea Region – BSR). *Prace Naukowe Wyższej Szkoły Bankowej w Gdańsku*, 51, pp. 135–160.

[18] Miler, R., Pac, B., Gogołkiewicz, M. (2016). Badanie konkurencyjności morskich terminali kontenerowych Gdańska i Gdyni w oparciu o wielokryterialną analizę ich potencjału logistycznego. *Prace Naukowe Wyższej Szkoły Bankowej w Gdańsku*, 46, pp. 45–70.

[19] Mruk, H. (2003). *Analiza rynku*. PWE, Warszawa.

[20] Nightingale, L. (2018). *Lloyd's List. One Hundred Ports 2018*. Lloyd, London.

[21] Notteboom, T. (2019). *Top 15 container ports in Europe in 2018*. Available at: http://www.porteconomics.eu/2019/

02/22/portgraphic-top15-container-ports-in-europe-in-2018/ (accessed: 2.03.2019).

[22] Ostrowski, M. (2016). *Planowana fuzja terminali BCT i GCT – początek trudnej walki o kontrahenta*. Available at: http://morzaioceany.pl/inne/archiwum/88-porty-morskie/ba %C5 %82tycki-terminal-konterenowy/3367-planowa-na-fuzja-terminali-bct-i-gct-pocz %C4 %85tek-trudnej-walki-o-kontrahenta.html (accessed: 12.03.2019).

[23] Pac, B., Miler, R. (2016). Ocena konkurencyjności portów morskich Polski i Niemiec na Bałtyku Południowym z wykorzystaniem metod wielokryterialnych. *Współczesna Gospodarka*, 7 (3), pp. 109–127.

[24] Popodko, G., Nagaeva, O. (2015). Opportunities and challenges of large investment projects in the new economy: the port of Ust-Luga. *Baltic Region*, 3, 69–82.

[25] Raben, D. (2016). Rozbudowa infrastruktury polskich portów morskich jako warunek rozwoju przewozów intermodalnych w ramach korytarzy sieci bazowej TEN-T. *Problemy Transportu i Logistyki*, 2 (34), pp. 177–184.

[26] *Record-breaking results of Top 10 Baltic container ports in 2017* (2018). Port Monitor, Gdynia.

[27] Saaty, T.L. (1980). *The Analytic Hierarchy Process*. McGraw-Hill, New York.

[28] Salomon, A. (2010). *Konkurencyjność terminali kontenerowych zlokalizowanych w polskich portach morskich na tle otoczenia bałtyckiego*. In: H. Salomonowicz (ed.), *Polska gospodarka morska. Restrukturyzacja. Konkurencyjność. Funkcjonowanie. Rozwój*. Zapol, Szczecin.

[29] Salomon, A. (2017). Lokalizacja i potencjał portu Gdynia jako elementy jego konkurencyjności. *Współczesna Gospodarka*, 8 (2), pp. 49–70.

[30] Salomon, A. (2017). Potencjał portu Gdańsk na rynku usług portowych. *Prace Wydziału Nawigacyjnego Akademii Morskiej w Gdyni*, 32, pp. 91–105.

[31] Serry, A. (2019). Containerisation in the Baltic Sea Region: development, characteristics and contemporary organisation. *European Spatial Research and Policy*, 26 (1), pp. 9–25.

[32] Thorez, P. (2011). Les enjeux portuaires de la Russie en mer Baltique. *Territoire en mouvement*, 10, pp. 49–59.

[33] Trzaskalik, T. (2014). *Wielokryterialne wspomaganie decyzji. Metody i zastosowania.* PWN, Warszawa.

[34] Trzaskalik, T. (2008). *Wprowadzenie do badań operacyjnych z komputerem*. PWE, Warszawa.

[35] Tubielewicz, A. (2009). Konkurencyjność portów morskich w globalnym otoczeniu. *Zeszyty Naukowe Uniwersytetu Szczecińskiego*, 572, pp. 345–354.

[36] UNCTAD (2018). *Review of Maritime Transport 2018*. UNCTAD, New York–Geneva.

[37] Urbanyi, I. (2010). Determinanty logistycznej obsługi ładunków i środków transportowych na morskich terminalach kontenerowych, *Logistyka*, 6, pp. 1–10.

[38] Urbanyi-Popiołek, I. (2013). Żegluga bliskiego zasięgu na Morzu Bałtyckim a projekty sieci TEN-T, implikacje dla polskiego rynku żeglugi promowej. *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy Transportu i Logistyki*, 754 (21), pp. 213–225.

[39] Yudnikova, E., Aleksandrova, S. (2016). Evaluation of the resource potential of maritime container terminals of St-Petersburg and Leningrad region, *Russian Journal of Logistics and Transport Management*, 3 (2), pp. 3–11.