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Transportation Costs of Containers from Asia to Europe via DCT Gdansk and Hamburg Seaports

Abstract. The aim of this study was to compare the transportation costs of containers being transported from Asia to Europe via Hamburg and Gdansk seaports. Three indexes are considered to be important for a logistic operator while choosing the transport route for 20 TEU containers: costs, time, and distance. This study confirms that Deepwater Container Terminal in Gdansk transports containers more effectively.

Key words: transport, seaport, maritime transport, intermodal transport, Hamburg, DCT Gdansk

Introduction

World supply chains are evaluating, developing, and prolonging which make them more and more complex. Globalization, production, regionalization, and consolidation of production are the factors that generally determine these changes. Globalization and other factors have led to the fact that goods from all continents are to be transported across the world. Supplying goods tends to be a strong part of acting logistic operators.

The aim of this paper was to compare the transportation services offered by DCT Gdansk and Hamburg seaports with regard to non-special cargo from Asia to Europe. Three indexes are considered to be important for a logistic operator while choosing a transport route: costs, time, and distance. This study hypothesizes that Deepwater Container Terminal in Gdansk transports containers from Shanghai to Moscow more effectively from the perspective of cost and time.

Through years of development, seaports have undergone a significant evolution. From the time seaports have started to handle basic cargos and involve in transportation, they have become significant links in land-sea supply management. Based on various studies (Grzelakowski & Matczak, 2012; Montwiłł, 2014) modern seaports are divided into four categories (Table 1).

The fourth category of seaport is described as areas that connect water and land passenger streams, industrial multimodal and intermodal transport, as well as port and urban functions, simultaneously realizing the port's function and connecting it, for example, with trade, distribution, logistics, and urban aspects, such as services and industrial and communications functions.

Therefore, modern seaports synchronize and integrate worldwide supply chains. In those key-links of supply networks, the variety of economic activity is carried out. It includes comprehensive support for moving the object, sea-land transport involved in the carriage cargo etc (Bichou, 2009). Ports are managed based on technological, organizational, logistical, economical, and legal processes (Klimek, 2012; Baran &

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Górecka, 2014). Seaports are rarely considered as bodies of supply chain management, but they provide logistics services to logistics operators (Bernacki, 2012). The increasing assimilation and amalgamation of ports into supply chains (Pettit & Beresford, 2009) have amplified the potential of ports in supply chain disruptions.

A significant moment in the history of maritime transport was the introduction of standardized containers that helped in the development of intermodal transport. In fact it was the beginning of broadly understood logistics chains, which encompasses a combination of both sea and land transports. Since 1980 the use of containers has increased rapidly. The largest increase was observed after the year 2000 (Fig. 1). Shippers have standardized the market in terms of legal, technical, organizational, and technological requirements. The demand for high-quality service has changed. Today, standard logistic process is understood as door-to-door system. Moreover, price is still a very important factor for buyers. Therefore, these two indexes (time and price) are extremely important when taking "good transport" into consideration.

Table 1. Characteristics of seaports of the first, second and third generation (UNCTAD TD/B/C.4/AC.7/14, 1991)

	I generation	II generation	III generation
Limit dates	Until 1960;	After 1960	After 1980
Dominant factors	Labor and capital	Capital	Capital. Technology and know-how
Dominant tape of cargo	Dry bulk cargo, Other cargo nes,	Dry and liquid bulk cargo, Other cargo nes,	Dry and liquid bulk cargo, Large containers Ro-ro mobile
Main objective function	Transport	Transport, Industrial, Commercial	Transport, Logistics & distribution
The basic role of the port	Transport hub / note	Transport-industrial complex connected to commercial center	Distribution center / Logistics center / Logistics platform, Information center
Strategy	Conservative	Expansive	Market
Basic principle of the strategy	Seaport waiting for cargo	Port acquires areas, and stimulates the development of the port industry, thus obtains loads	Port co-creates supply chains
Range of service	Handling and storage services for the cargo. Simple administrative services, manipulation and control for cargo	Handling and storage services for the cargo. Processing and production of goods Complex administrative services, manipulation and control for cargo	Handling and storage services for the cargo. Distribution cargo Logistics services for cargo Gathering and processing of information Organization chain supply
VAL	Low	Higher	High
Operating principles the port environment (internal environment harbor)	Atomization Informal relationships with port users	There are no permanent links between deferent sectors port A close relationships with port users Ad hoc relationships with city	Unity of action sphere of operation Integration of organizational or capital sea port companies with its users Close relationship with the port city and region

Source: Montwiłł 2014, p. 259.

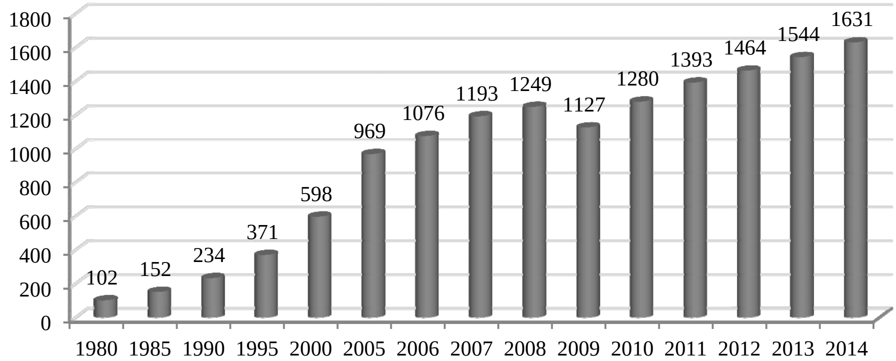

Fig. 1. International seaborne trade carried by container ships from 1980 to 2014 (in million tones loaded)
Source: statista.com

Seaports act as individual companies that compete with each other. The competition among them is based on three factors: cost, time, and distance. Meersman et al. (2010) emphasized that in recent years competition has evolved between individual ports and entire supply chains in such a way that for a port to succeed it must be part of an efficient supply chain.

Research methods

Preliminary and secondary data were used in this study. Reports collected from a logistic operator and data of interviews conducted with managers of logistics were taken as preliminary data. Name of the organization was kept confidential at the participant's request. A literature review with a strong emphasis on the meaning of seaports in supply chains served as secondary data. Indicators such as cost, time, and distance were compared and analyzed. For simulation purposes, Shanghai was chosen as the starting point and Moscow as the end point of the route. In this study, transport process was offered via two seaports in Europe: Hamburg and Deepwater Container Terminal in Gdansk. Six routes with different possible transport modes were compared:

- Shanghai–Hamburg–Moscow (sea-road)
- Shanghai–Gdanks–Moscow (sea-road)
- Shanghai–Hamburg–Warsaw–Moscow (sea-rail-road)
- Shanghai–Gdansk–Warsaw–Moskow (sea-rail-road)
- Shanghai–Hamburg–Warsaw–Moskow (sea-road-rail)
- Shanghai–Gdansk–Warsaw–Moskow (sea-road-rail)

Spearman rank correlation (r_s) test was used to compare the data to determine the factors that influence the total transportation costs of container (1) (1966).

$$y = \frac{\frac{1}{6}(n^3-n)-(\sum_{i=1}^{n} d_i^2)- T_x- T_y}{\sqrt{\frac{1}{6}(n^3-n)- 2T_x)(\frac{1}{6}(n^3-n)-2T_y)}} \tag{1}$$

where:

$d_i = Rx_i - Ry_i$ the difference between *i-th* rank for variable *x* and *i-th* rank for variable *y*

T_x T_y the factors for tied ranks described by (2):

$$T = \frac{1}{12} \sum_j (t_j^3 - t_j\ ) \tag{2}$$

where:

t_j number of observations for *j-th* rank in the analyzed data set

The following factors were used in the calculation of Spearman rank correlation:

y – total transportation costs for the route

x_1 – distance in km

x_2 – transportation time

x_3 – total costs of container handled in the seaports

x_4 – costs of additional modes of transports

From the perspective of a logistic providers, one of the most important factors that influence seaport choice is cost. Seaport cost comprises various elements. The first element is the fee collected as per the international trade rules based on sales, costs, responsibility of the purchaser, and the type of transport - Incoterms. For simulation purposes, in this study, Incoterms of Group F (FOB[2]) were adopted. Group F refers only to transport by water.

The next element is the type of THC (terminal handling charge). This fee is imposed in maritime transport to remove a container from a ship to storage yard and transport cargo to the warehouse, from the warehouse, onto the truck, etc.

Customs policy and legal conditions differ from one country to another and, therefore, customs service fee is included under seaport cost. Some of them are as follows:

- BAF (Bunker Adjustment Factor) – a fee collected in case of an unexpected rise in the fuel costs;
- CAF (Currency Adjustment Factor) – a fee to balance currency fluctuations in reference to operators;
- DDC (Destination Delivery Charge) – fee determined in relation to container size. It defines total waste resulting from container handling on the terminal;
- other custom service fees.

Custom service charges have been aggregated as per the requirement of this study.

Another fee that a logistic provider considers when choosing a seaport is documentary charges determined in the port of loading/unloading. In this study, documentary charges refer to transport documents transmitted to participants in supply chain.

In addition, in DCT Gdansk, a minimum charge of 150 PLN (34 EUR) has to be paid to the security customs duties and taxes. All costs refer to a single standard (20 TEU) container with non-special cargo (e.g., clothes). Comparison helps to identify the most appropriate solutions for a logistic operator.

[2] FOB – "Free on board" indicates port of loading.

Comparison of DCT Gdansk and Hamburg seaport operations

Hamburg seaport contributes significantly to the entire German economy, with an added value of approximately 20 billion Euros. Port of Hamburg along with other seaports worldwide links more than 5700 (stat.gov.pl, 2015) containers across the world. This fact underlines its position as a European leader in cargo handling and distribution. However, to maintain this leader status and to attain an optimal port throughput, infrastructure of roads, rails, and inland waterways needs to be developed, which attracts more investment. Owing to the modern strategy consequently implemented by the management, 2014 was the breakthrough year with the record in handling operations. More than 7.4 million TEU were loaded loaded/reloaded, which is 20,000 TEU per day. German ports create a seamless communications network with the mainland, which gives them an advantage over other ports in Europe.

Compared to Hamburg seaport, DCT Gdansk is a new terminal and it received its first vessel in June 2007. During its first years of operations, the terminal specialized in handling feeder vessels, thereby gaining important operational experience. Since January 2010, DCT Gdansk is the only deep-sea terminal in Poland. It started receiving 8,000 TEU container vessels on a weekly basis departing from the Far East bringing Polish imports, picking up Polish exports, and carrying trans-shipment for the key Baltic ports. This direct connectivity with Asia boosted the development of DCT Gdansk and it became the Baltic Sea hub, achieving 180% growth in 2010 that made DCT one of the fastest growing terminals in the world. The new era for DCT bloomed in May 2011 when it started to handle Maersk Line’s E-type class container vessels with a capacity of 15,500 TEU. As a result, DCT joined a prestigious group of North European deepwater container ports, thereby serving ultra-large container vessels on a weekly basis, which is the only such facility in the East of the Danish Straits. In 2012, the container terminal handled its second millionth TEU since its operations have begun, with another annual volume record of approximately 900,000 TEU. In 2013, it handled more than 1.15 million TEU. This record has put DCT permanently on the map of the world’s major container terminals and ensured its position as the biggest container terminal in the Baltic area (dctgdansk.pl, 2016).

Hamburg and Gdansk seaports differ not only in the location, size, or number of containers handled (available infrastructures) but also in the characteristics of services offered (Table 2).

Table 2. Comparison of the non-infrastructural characteristic of the service in Hamburg and Gdansk seaports.

Characteristics	Hamburg port	DCT Gdansk
Time of container handling in the port	Short	Long
Large number of direct services=better punctuality	Yes	No
Fast and efficient customs service	Yes	No
Deferred VAT	Yes	No
Possibility of making customs clearance in the simplified procedure	No	Yes
Costs: • seaport costs	High	Low
• loading control costs	High	Low
• possible container downtime	High	Low
Offices rigor	Low	High

Source: own elaboration based on euro-dane.com.pl

Loading time, punctuality, and deferred VAT are the strengths of Port of Hamburg, whereas simplified customs procedure is the strength of DCT Gdansk. Although the fact is that German port has higher charges, the legal terms and conditions of the customs offices of the Polish port are more stringent (dctgdansk.pl, 2016).

Simulation of cost, time, and distance for the transport of 20 TEU containers from Shanghai to Moscow

Costs, time, and distance are the key factors that are analyzed in this study (Table 3). Results show that the total costs of container transport were low for the route Shanghai–Gdansk–Warsaw–Moscow using sea–rail–road intermodal transport (1,449 EUR). The second lowest total costs (1,535 EUR) were for the route Shanghai–Gdansk–Warsaw-Moscow by sea–road–rail transport. The third possibility (2,206 EUR) was through Hamburg (Shanghai-Hamburg-Warsaw-Moscow). With regard to transport time, Shanghai-Gdansk-Moscow route along with sea–road transport was found to be the most preferable route with a traveling time of 33 days and 12 hours. On the other hand, it is worth noting that this route is the second expensive route. The second fastest route is via Shanghai–Gdansk–Warsaw–Moscow with a traveling time of 33 days and 20 hours.

Table 3. Simulation of costs, distance and time of transporting container from Shanghai to Moscow

Route	Shanghai-Hamburg-Moscow	Shanghai-Gdansk-Moscow	Shanghai-Hamburg-Warsaw-Moscow	Shanghai-Gdansk-Warsaw-Moscow	Shanghai-Hamburg-Warsaw-Moscow	Shanghai-Gdansk-Warsaw-Moscow
Transport modes	sea-road	sea-road	sea-rail-road	sea-rail-road	sea-road-rail	sea-road-rail
Distance (km)	22265	21714,5	22385	21907,5	22385	21907
Time (days)	34	33,5	34,2	33,85	34,45	33,9
	Port operation costs (EUR)					
FOB	396	396	396	396	396	396
THC	260	140	260	140	260	140
Custom fee	115	150	115	150	115	150
Documentary fee	5	8	5	8	5	8
Additional fee	0	34	0	34	0	34
Total	776	728	776	728	776	728
Additional transport mode cost (EUR)	2000	1950	1430	721	1680	807
TOTAL COST (EUR)	2776	2678	2206	1449	2456	1535

Source: own elaboration based on logistic operator data.

With regard to distance (Table 3), the shortest transport route is the Shanghai-Gdansk-Moscow route (21,714.5 km). The factors that are correlated with total transportation costs are analyzed using Spearman rank correlation test (Table 4).

Table 4. Correlation of time, time and distance of the transport

Variable	Spearman Rang Correlation				
	y	x_1	x_2	x_3	x_4
y	1.000000	0.057977	0.142857	0.487950	1.000000
x_1	0.057977	1.000000	0.927634*	0.891133*	0.057977
x_2	0.142857	0.927634*	1.000000	0.878310*	0.142857
x_3	0.487950	0.891133*	0.878310*	1.000000	0.487950
x_4	1.000000	0.057977	0.142857	0.487950	1.000000

*correlation coefficients are important for $p < 0.05000$

Source: own elaboration calculated in Statistica 12 software.

The results show a moderate dependency (0,48795) between the cost (y) of container transport and total costs of container handling in the seaports included in this study (x_3) and a high dependency (1,00) on the costs of additional mode of transports (x_4).

Summary

This study focused on the problems of transporting goods from Asia to Europe. A logistic operator chooses the route from Shanghai to Moscow based on three important criteria: costs, distance, and time. All other alternatives are based on the idea of intermodal transport through Hamburg seaport in Germany or DCT Gdansk in Poland.

The results show that transportation costs vary depending on the seaports selected for the service. Comparison analysis also confirmed the hypothesis that the transportation costs via DCT Gdansk is lower when goods are transported via two intermodal combinations: sea-rail-road and sea-road-rail. Transporting via DCT Gdansk takes a shortest traveling time and the traveling route is also much shorter; however, in this case transportation costs are much higher.

Spearman correlation test drew an interesting result, that is, the total costs of shipping container from Shanghai to Moscow depends mostly on the costs of additional mode of sea transport. Sea transportation costs via Hamburg or Gdansk seaport slightly differ from each other. This might be significant information for logistic operators who focus on reducing the total costs of shipping. They can reduce the transportation costs by using non-sea transport simulation. It should be noted that the factor "distance" also seems to increase the transportation charges and fees. On the other hand, for fast sipping, logistic operator can opt for suitable routes with higher costs.

Northern Europe has been depending on the Hamburg seaport for its seaport market until 2007. Therefore, logistic operators started to work on new alternatives that will help increase worldwide supply chains. Three effective factors such as costs, time, and distance, including DCT Gdansk, are to be considered. Nevertheless, the threats posed by the Polish port such as the difficulties faced during transportation, stringent regulations of public offices, and complexity of documentation processes are to be rectified.

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