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LINER SHIPPING NETWORKS AND PORTS CONNECTIVITY IN THE BLACK SEA REGION

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Abstract: *The development of feeder networks in modern liner shipping has undergone significant changes during the last two decades. The hub-feeder systems and short sea shipping networks have largely expanded in the Black Sea and the Mediterranean regions due to fluctuating containerized cargo volumes. The present article analyses the feeder networks structure in the Black Sea region, examines the liner shipping connectivity based on the liner shipping connectivity index (LSCI) and further outlines the current trend of regional cargo transportation network expansion. The liner shipping connectivity index reflects the long-term objectives of liner operators for maximizing revenue via extensive market coverage. Despite the negative effect of the economic crisis and excess supply on the market a distinct trend towards increased service frequency and expanded geographical coverage are observed.*

Keywords: LINER SHIPPING NETWORK, FEEDER LINES, LINER SHIPPING CONECTIVITY INDEX, HUB-FEEDER SYSTEM

1. Introduction

The present article analyses the development of feeder networks in the Black Sea region. The hub-feeder systems and short sea shipping networks have largely expanded in the Black Sea and the Mediterranean regions due to fluctuating containerized cargo volumes. The status of liner shipping connectivity measured by the liner shipping connectivity index (LSCI) further outlines the current trend of regional cargo transportation network expansion. The examined data prove that the feeder network in the region has intensified its services due to the lower regionalization of the ports and lack of reliable hinterland links. LSCI reflects the long-term objectives of liner operators for reducing costs and maximizing revenue via extensive market coverage. Despite the negative effect of the economic crisis and excess supply on the market a distinct trend towards increased service frequency and expanded geographical coverage are observed.

2. Development of liner shipping networks – factors and trends

Liner shipping networks design is influenced by the strategic goals of liner shipping companies which are based on shippers' demand for certain services. As such, the location of a port or a region within the global liner shipping network is determined by the density of trade flows to and from a specific port or region [9].The structure of the liner shipping networks, the number of vessels deployed and the frequency of service are based on the capacity and characteristics of the ports and cargo volumes. Based on these determinants, the service frequency (including the fixed days/hours of the week for departure/arrival), loading capacity of the transport equipment used, number of port calls per roundtrip and stops at intermediate terminals (transhipment/relay) are all determined [1].

Factors related to ports include: the specifics of the hinterland access, the specifics and capacity of the port infrastructure and superstructure, the characteristics of access to the berths/piers and also the geographical location of the ports in the region. As concerns national and international policies the factors include regulations related to cabotage sailing, customs formalities, international and regional regulations for the transport corridors, type of port management. From a market point of view the port operator model, cooperation between port operators, concentration level between liner operators, market strategy of liner companies, etc. are also decisive. The land access to the ports and the developed logistical chains, reliability of hinterland transport and pertaining costs are also of importance. The higher density of liner shipping networks allows for lower transshipment ratios, deployment of larger ships and higher level of capacity utilization. Nevertheless, additional operations for containers handling at relay terminals affect the quality of the service in terms of time integrity. There is a standing trade-off between the supplementary costs and the higher revenue from higher capacity utilization. Furthermore, the regional feeder services design is based on the structure of the company's main liner routes. The quality issues are resolved via different strategies: increase of sailing frequencies, reduced time of shipping, higher reliability of services.

Another tendency predominant in liner shipping networks development is port regionalization. Port regionalization is characterized by strong functional interdependency and even joint development of a specific load centre and logistics platforms in the hinterland [6]. The main problems associated with regionalization include limitations to land expansion, draft requirements at berths and approaching channels, availability of investment financing, etc. Figure 1 displays the container port systems in Europe and its multiport gateway regions as of 2007. The position of the Black Sea region allows for respective access to hinterlands along with the established transport corridors. Among the major winners are the Spanish Med ports (from 4% in 1993 to 7.5% in 2008) and the Black Sea ports - from virtually no traffic to a market share of 1.9% in 2008 [4]. Intermodality is the driving factor for feeder networks expansion and cooperation in transshipments, development of consolidation centers, warehousing, etc.

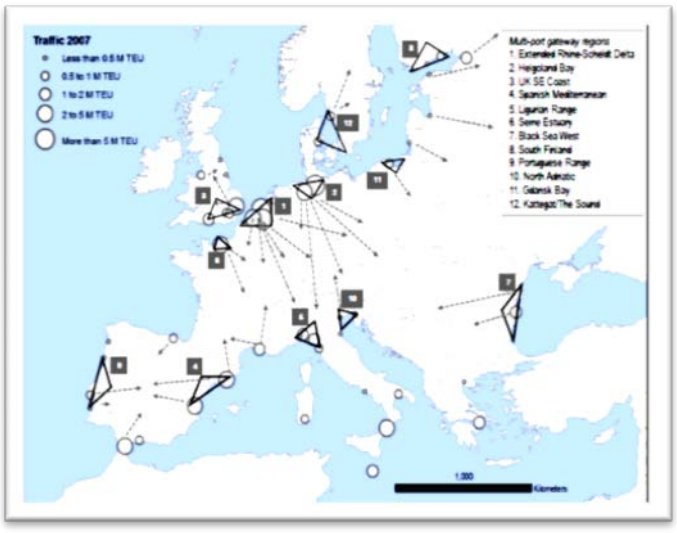

Figure 1. *The European container port system and its multi-port gateways regions* [6]

The point-to-point network is the traditional layout of liner shipping networks emphasizing on regionalization of services with low level of connection to other markets. In order to achieve better connectivity with outside markets intermediate ports are developed as hubs. The latter is the underlying factor for the creation of the hub-and-spokes system. Thus the respective port regions gain competitiveness via higher level of connectivity. However, due to

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the cargo flow concentration the port development strategies undergo significant changes in the form of new approaches of port management. The latter gives way to increased investment via shareholding in port ownership and stevedoring activities. The increased cargo flows density gradually leads to geographical expansion of hinterland facilities and land connections and eventually of adding new ports in the already existing services. In the long run, the market share of certain hub ports grows significantly which allows for the liner operators offering direct services having the comparative advantage of decreased port stay. The described process is in fact the trigger for development of new regional ports which will enhance the local area connectivity and the implementation of other feeder networks.

3. Liner Shipping Connectivity Index and implications for the Black Sea region

Liner Shipping Connectivity Index (LSCI) is developed by UNCTAD in 2004 [7]. LSCI aims at capturing a country's level of integration into the existing liner shipping network by measuring liner shipping connectivity [6]. The LSCI is based on several components [4]:

- number of companies providing shipping services from/to a country's ports;

- size of the largest ship deployed from/to a country's port (TEU capacity);

- number of liner services connecting one country's ports to other countries;

- number of ships deployed on services from/to the country's ports;

- container carrying capacity of the vessels providing services from/to the country's ports (TEU).

The volume of maritime trade depends on the costs of transportation and the available access to shipping services and vice versa. Connectivity depends on the port infrastructure, location, demand and trade facilitation measures. Figure 2 presents the values of the LSCI for 2016 for the top 15 countries in the world. These countries have dynamic trade relations and large volume of exports.

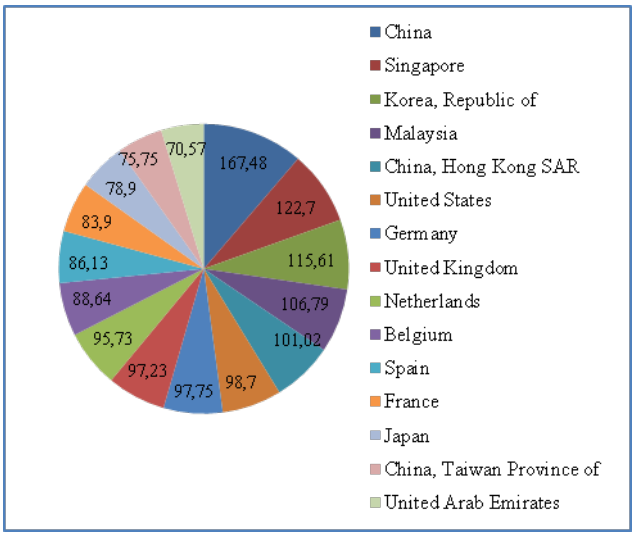

Figure 2. *Liner Shipping Connectivity Index – top 15 countries in 2016 [12]*

A higher value of the index demonstrates better access to port and hinterland facilities and ensures for more frequent connections between ports. LSCI is regarded both as a value of connection levels in shipping and as a means for facilitating trade. The structure of the LSCI allows for quantifying the strategic goals of liner operators for achieving larger market shares and wider geographical coverage. The countries that have the highest LSCI values are actively involved in trade. The latter includes larger volume of exports and transshipments at liner shipping hubs. On the other hand, the share of direct links between countries within liner shipping networks is considerably low thus higher number of transshipments are planned. The design of the traditional hub-and-spokes networks in liner shipping has certain limitations, namely with respect to the number of hubs in a network and other technological factors that allow for efficient service. The transshipment markets' role encompasses maritime connections between mainline areas and regional port systems.

The traditional network layout is based on the "hub-and-spoke" system whereas the Mediterranean, Southeast Asia and the Caribbean are being the most important regions. Within the Black Sea region the container ports are both competing with each other and with adjacent port regions to increase their transshipment traffic. In 2006 UNCTAD secretariat has also developed an index for measuring bilateral connectivity between countries. The bilateral connectivity is derived from the assessment of the availability of direct connections between two countries basis the shortest possible link. The lower the value of the index of bilateral connectivity, the larger the number of transshipments are needed. This index measures country's integration in the global shipping networks including liner shipping. The types of connections between the countries are ranked according to the availability of direct connections and the necessary number of transshipments between two countries. Table 1 presents the bilateral connectivity index of the countries in the Black Sea region.

Table 1. *Bilateral connectivity index for the Black Sea region in 2016 [12]*

PARTNER ECONOMY	Bulgaria	Georgia	Romania	Russia	Turkey	Ukraine
Bulgaria	-	0,25	0,26	0,27	0,28	0,26
Georgia	0,25	-	0,26	0,27	0,28	0,26
Romania	0,26	0,26	-	0,43	0,45	0,42
Russia	0,27	0,27	0,43	-	0,52	0,46
Turkey	0,28	0,28	0,45	0,52	-	0,47
Ukraine	0,26	0,26	0,42	0,46	0,47	-

4. Black Sea region feeder networks development and connectivity

During the last decade the LSCI has marked a steady growth although not at a high pace. It is mainly due to the tendency to deploy larger ships (for economies of scale), decrease the number of deployed vessels, lower the liner services frequency, etc. Liner shipping is by default a capital intensive industry. Following the economic crisis in 2008 and its effect on the transportation of finished goods the liner companies sustained significant losses. The rationale behind the new strategies of liner operators lies within the several possible strategic scenarios: restructuring of liner services as networks, withdrawal and scrapping of vessels, flexibility in terms of slot numbers, improvement the rate of utilization, decreasing overheads.

The sequence and the number of port calls in a feeder liner network have its specifics. The assigned vessels may call the ports in a different than geographical rotation or call some of the port twice during the full voyage cycle. Due to the lack of post-crisis economic recovery liner shipping operations still suffer from strong imbalances between demand and supply. Feeder services, however, have undergone a different path of development which led to increase of port number, increase of number of deployed vessels which allowed for increased turnover and higher frequency of services. The structure and development of the feeder lines in the Black Sea region is presented in Table 2. All major liner operators have introduced additional services within/via Black Sea, increasing the number of port of calls and the frequency during the last five years [see 8].

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Table 2. *Feeder networks in the Black Sea region in 2017 [own elaboration]*

Liner operator	Feeder service rotation	Number and capacity of containerships	Number of ports	Round voyage duration (days)
Maersk	Ambarli – Bourgas – Varna – Ambarli (Z39 EMES Bourgas Service)	1 vessel 1155 TEU	3	5
	Damietta – Port Said – Ambarli – Constanza – Odessa – Chernomorsk – Novorossiysk – Constanza – Ambarli – Port Said - Ashdod	4 vessels 6800 TEU	8	26
MSC	Gioia Tauro – Piraeus – Batumi – Odessa – Constanza – Bourgas – Gioia Tauro	2 vessels 1400 TEU	6	14
ZIM	Cagliari – Varna – Constanza - Kagliari (W Med Black Sea - WBS)	3 vessels 1600 TEU	3	17
	Piraeus – Ambarli – Novorossiysk – Constanza – Varna – Ambarli – Piraeus (Black Sea Shuttle – BSH)	2 vessels 1700 TEU	5	14
Arkas Line	Marport – Bourgas – Varna - Marport	1 vessel 900 TEU	3	7
	Marport – Varna – Constanza – Marport – Gemlik – Piraeus – Cagliari - Gemlik	4 vessels 1400 TEU	6	14
CMA CGM	Malta – Piraeus – Istanbul – Poti – Novorossiysk – Ambarli – Piraeus - Malta (Black Sea 1)	2 vessels 100 –1200 TEU	6	14
	Malta – Ambarli – Odessa – Constanza – Varna – Ambarli – Piraeus - Malta (Black Sea 3)	2 vessels 900–1200 TEU	6	14

The adjustment between supply and demand is achieved through the change of the number of ships deployed. Presently, due to the on-going decrease of demand the change of supply is a vital component of liner companies' strategy. One of the options is slow steaming thus considerable savings in voyage costs can be achieved. However, the latter can result in increase of transit times (rescheduling) and loss of market share to other transport modes' competitors especially for sensitive goods. As for ships withdrawal the main long-term considerations are the environmental benefits from non-deployment of older ships. In a logistics world confronted with mounting reliability and capacity issues, routing flexibility is a keystone for the logistics attractiveness of a region [9]. The inter-connections among several gateways give the opportunity of better routing options and more alternatives for logistics companies. Successful port development is therefore based on complete utilization of logistical options with other transport modes.

The Black Sea container terminals of Romania, Ukraine, Russia, Georgia and Bulgaria handled 2,46 mln. TEU in 2016, including empty containers and excluding transshipment [10]. The number of containers loaded amounted to 1,785 mln. TEU that is an increase with 9.63% as compared with year 2015. All container ports reported increase in throughput except for the ports in Georgia (Figure 3).

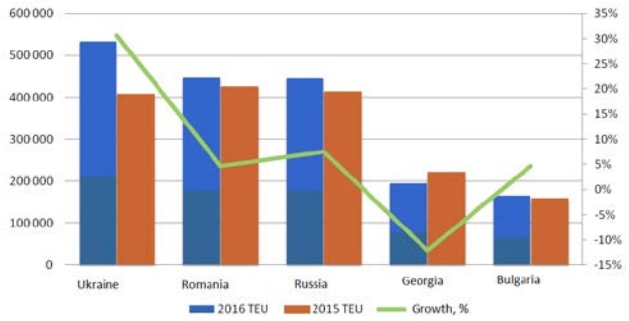

Figure 3. *Container throughput of Black Sea region in 2015-2016, TEU loaded [10]*

Imports and exports of containers in the region accounted for 51.37% and 48.63% respectively. The percentage of empty containers handled was three times lower than that of loaded containers. The exports from Bulgaria and Romania showed insignificant changes in 2016 unlike the ports in Georgia where a decrease by 14.93% is reported. The imports into the region grew by 6.95% in average mainly due to the increase of imports in Ukraine, Russia and Georgia. The countries' shares in terminal handling of loaded containers in 2016 are as follows: Romania – 24.99%, Russia – 24.92%, Ukraine – 29.87%, Georgia – 10.93%, Bulgaria – 9.29%. The leading positions of major liner companies is preserved (Figure 4) - Maersk Line (24,21%), MSC (20.44%), CMA CGM (10.47%), Arkas (10,16 %) and ZIM (8,10%).

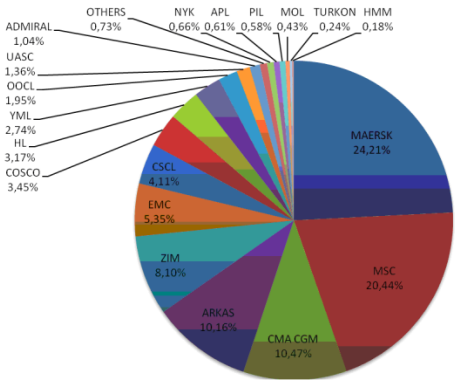

Figure 4. *Shares of Black Sea lines in the region (2016) [10]*

In terms of port regionalization the Black Sea region is divided into three multi-port gateway sub-regions - Black Sea West (Burgas, Varna, Constantza), Black Sea North (Odessa, Iliychievsk, Yuzhnyi, Mariupol) and Black Sea East (Poti and Batumi). and one separate gateway (Novorossiysk). The ports of Constanza, Odessa, Iliychevsk, Yuzhny and Novorossiysk are called directly by shipping lines. During the last fifteen years the size of the vessels, visiting these ports, grew to 8000 TEU whereas the maximum size is about 9000 TEU due to the navigational restrictions of the Bosporus strait. The smaller ports in the Black sea region are called by feeder vessels and the ports of Istanbul, Piraeus, Damietta, Port Said, Gioia Tauro, Malta, etc. are used for transshipment. This shift occurred after the crisis in 2008 whereas the transshipment operations in the region declined in volume. Presently direct and feeder calls are almost evenly distributed within the network. The largest container vessels are handled in the port of Constantza. One of the major factors is the considerable investment of leading port operators. The container terminals of Ukraine, Romania, Russia and Bulgaria demonstrated a growth of 30.66%, 4.71%, 7.52% and 4.65% respectively (Figure 5).

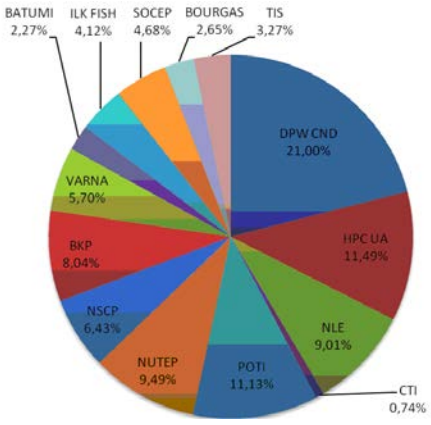

Figure 5. *Share of Black Sea terminals in 2016 [10]*

Terminal productivity plays an important role in the future development of container terminals in the Black Sea region, where operators in both Ukraine and Russia such as Odessa and Novorossiysk are trying to attract both transshipment and

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import/export business [2]. The number of ports within the regional feeder networks have increased but with no definite model of cargo concentration. This is also due to the fact the traffic and cargo volumes increased in transshipment ports, i.e. in Istanbul and Piraeus. The ports of Varna and Bourgas have been competing with the port of Constanza during the last two decades, also Odessa has gained advantage to Iliychevsk. The technological level of the Black Sea hinterland is far from serious advances, which, combined with the lack of efficient modal shifts, further prevents concentration of cargo flows in the ports.

Due to the lack of cargo concentration in Black Sea region ports the maritime links still play an important role but impede the development of hinterland logistical centers and the realization of scale economies also on inland services. Containers for the more distant hinterland benefit from a port's strong local cargo base as local containers often provide the critical mass for allowing frequent deepsea liner services [5]. The sub-region of Black Sea West (Constanza) has a potential to develop a strong hinterland region with developed intermodal services for the Central European Countries, South Germany, Austria, etc. The main consideration of liner operators in the region is the minimization of operational cost (liner services, inland transportation) and maximization of the quality of service by customer-oriented approach while having direct calls as much as feeder calls. Feeder shipping lines in the Black Sea region are a growing segment for connectivity in Europe. Local or immediate hinterlands remain the backbone of ports' cargo bases [5]. The requirements for reliability and capacity issues makes the flexibility in cargo routing the major factor for the regions logistical efficiency. Hinterland links to several multi-port gateways allows for diversity in routing options and higher flexibility for all logistics companies.

5. Conclusion

Despite the fact that the container market is in general becoming more concentrated in Europe, the Black Sea region still remains a secondary market benefiting presently by the higher level of regional connectivity. Furthermore, as the intermodal networks are vital for the development of the EU port system, a significant level of cargo flows concentration is required to achieve efficient modal shifts. There is a serious potential that the larger ports in the Black Sea region attain higher concentration and benefit from economies of scale (both of maritime and inland modes) and of the increased frequency of liner port calls. Important impetus for smaller ports, located closer to larger ones, are the existing hinterland links of the latter.

References:

1. Fagerholt, K., Designing optimal routes in a liner shipping problem, Maritime Policy and Management, 31(4), 2004, 259–268

2. Grushevska K, T. Notteboom, An Economic and Instittional Analysis of Multiport Gateway Regions in the Black Sea Basin, IAME 2014, Norfolk

3. Hoffmann, J., Corridors of the Sea: An investigation into liner shipping connectivity, UNCTAD

4. Notteboom, T. E., Concentration and the formation of multi-port gateway regions in the European container port system: an update, Journal of Transport Geography 18, 2010, 567–583

5. Notteboom, T., Economic analysis of the European seaport system, Report serving as input for discussion on the TEN-T policy, ITMMA, 2009

6. Rodrigue, J. P, Maritime Transportation: Drivers for the Shipping and Port Industries, International Transport Forum Transport and Innovation: Unleashing the Potential, 2010

7. Transport Newsletter No. 27, 2005, UNCTAD

8. Varbanova, A., Current issues in operational planning of general cargo transportation on container feeder lines in the Black Sea region. The International Virtual Journal for Science, Techniques and Innovations for the Industry 'Machines, Technologies, Materials', 2011 (3), 35–38.

9. Wilmsmeier G., T. Notteboom, Determinants of liner shipping network configuration: a two-region comparison, GeoJournal, 76, 2011, 213–228

10. http://en.portnews.ru

11. http://summit.portsukraine.com

12. http://unctadstat.unctad.org