HAL open science

Shipping in peripheral seas : the case of Baltic Sea region and Adriatic sea

Arnaud Serry

▶ To cite this version:

Arnaud Serry. Shipping in peripheral seas : the case of Baltic Sea region and Adriatic sea. 19th International Conference on Transport Science : ICTS 2020, Slovene Association of Transport Sciences; University of Ljubljana, Faculty of Maritime Studies and Transport; University of Split, Faculty of Maritime Studies, Sep 2020, Portoroz, Slovenia. pp.281-287. hal-02943433

HAL Id: hal-02943433

https://normandie-univ.hal.science/hal-02943433v1

Submitted on 19 Sep 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

19th International Conference on Transport Science

ICTS 2020

MARITIME, TRANSPORT AND LOGISTICS SCIENCE

Conference proceedings

Slovene Association of Transport Sciences

University of Ljubljana, Faculty of Maritime Studies and Transport

University of Split, Faculty of Maritime Studies

SHIPPING IN PERIPHERAL SEAS: THE CASE OF BALTIC SEA REGION AND ADRIATIC SEA

Arnaud Serry, D.Sc.

University Le Havre Normandie
25 rue Philippe Lebon, Le Havre, France
serryarnaud@gmail.com

ABSTRACT

World trade has changed in the twenty years such that container traffic flows are oriented towards more parts of the European continent. The European container port system is not a homogeneous set of ports; instead it consists of several big ports (e.g., Rotterdam, Hamburg, Algeciras...) and a large number of medium and small ports.
The main focus of the paper is on the container network in two peripheral seas, the Baltic Sea Region and in the Adriatic Sea, studying contemporary changes and organization, as well as explaining the main driving forces of this situation. The geographical configurations of the region naturally place both seas away from major global shipping lines. This situation is accentuated by the organization of maritime regular lines, centred in Northern European ports or Mediterranean transhipment hubs. So, the idea is to compare flows and networks in these two European peripheral seas having welcomed a remarkable growth during the last decade.
The Baltic Sea is a transport corridor between Eastern and Western Europe. Over the last decade maritime transport in the Baltic Sea area has changed significantly. The disintegration of the Soviet Union forced Russia to start developing its own Baltic ports and terminals and to find new routes to export its oil and gas.
The Adriatic Sea looks also like a transport corridor between Southern and Central Europe. Adriatic ports, Rijeka, Koper, Trieste, Venice and Ravenna…, are small ports. Each of these ports have different development plans but in varying degrees' common hinterlands and costumers.

Keywords: Containerization, Baltic, Adriatic, AIS, maritime network

1 INTRODUCTION

According to Notteboom (2010), the European container port system is concentrated in the Hamburg-Le Havre range, which is of primary importance as they handle close to half of total container throughput in Europe; the Mediterranean range, which has the fastest-growing container throughput; and the UK, Atlantic, Baltic, and Black Sea ranges.

Maritime traffic has evolved significantly over the last few decades. The biggest ships operate on multi-port itineraries calling at a restricted number of ports (Ducruet, Notteboom, 2012). The main transoceanic services link a series of key ports in Europe. These ports connect regional port systems, including the Baltic and the Adriatic ones, to transoceanic routes, mainly through hub-and-spoke and feeder services (Rodrigue, 2012). Extensive hub-feeder container systems and short-sea shipping networks are used to manage increasing volumes and to connect to other port ranges (Rodrigue, Notteboom, 2010).

"Peripheral" (or marginal) seas are parts of an ocean bordering the continental landmass and partly enclosed by peninsulas or archipelagos, such as the East China Sea (Vego 2015). More specifically, enclosed seas, such as the Baltic or the Adriatic, lie wholly within the continental shelf and are surrounded by a landmass except for a strait connecting them to an ocean. Because of their restricted communication with the open ocean, enclosed seas have several specificities, physical ones as well as economical ones. Furthermore, most peripheral seas suffer from poor accessibility in terms of few route options, low frequency of services, long travel times and high transport costs.

From a transportation perspective, peripherality has been increasing by the development and innovations in transport such as shipping technology and the development of hubs – spokes (Knowles 2006). Peripheral ports are smaller ports which are competing for feeder traffic from larger ports (Hayuth 1981). Peripheral ports will eventually be able to capture traffic when the larger ports are congested, which is mentioned (Wiradanti, 2019). In the specific context of seaports, peripheral ports can generally be identified by the size. They are primarily small and 'desperate' for cargoes brought by carriers from load center ports (Hayuth 1981).

2 GENERAL CHARACTERISTICS OF CONTAINER SHIPPING IN ADRIATIC AND BALTIC SEA

Both seas, Baltic and Adriatic, are very transport-intense. Maritime traffic is relatively diffused throughout the whole seas. Baltic Sea traffic growth is particularly significant in the field of containerisation (Serry

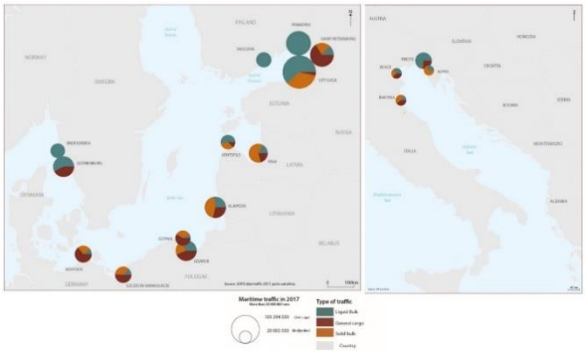
Transnav 2017) and this is also the case in the Adriatic Sea, like in Koper. In particular, large container vessels, ro-ro and tanker traffic has been increasing throughout the last decade (Perkovic, Harsch, Ferraro, 2016).

Since the end of the nineties flows in Baltic Sea and Adriatic Sea ports have grown quite constantly what has (inevitably) required a necessary modernization of harbour facilities and also their extensions. Thus, In the BSR, the maritime traffic has almost doubled between 1997 and 2018, from 420 million tons (Mt) to nearly 800 Mt while during the same period, the growth of world maritime traffic was by nearly 65% (Serry, 2019). When Central Europe becomes more closely integrated into international commerce, new markets take shape for the ports of the Adriatic Sea. Though still with modest tonnage levels compared to their counterparts in the North Sea and the Western Mediterranean, these ports, given European perspectives and recent dynamism tied to new ambitions. The Adriatic Sea becomes more transport-intense. For instance, in the bulk sector, Adriatic ports are a natural gateway for Central and Eastern European traffic and are well placed take advantage of any hinterland infrastructure improvements to attract cargo currently routed via Northern European ports.

In both areas, this development can be attributed to three factors:

- Worldwide economic growth has led to an increase in the volume of goods carried by sea;
- The profound geopolitical changes in the central and eastern Europe which have (re)opened the shores to the market economy;
- The needs of port capacity for Russia or central European countries.

In both areas, even if container traffic is not the dominant one (Figure 1), its progression is fast. Adriatic and Baltic ports operate in a relatively closed system in which the market and customers are restricted. Container throughput in the Adriatic Sea is significant and even during the global financial and economic crisis of 2008, the decline in overall container throughput in was insignificant. We can establish the reason for this is the good geographical location: maritime transport from China to the EU is shorter using Adriatic ports compared to North-European ports (Twrdy, Batista, 2016).



Source: Port Authorities, 2018.

Figure 1: Traffic Structure in 2017

Particularly, the northern Adriatic is at the crossroads of the European Union transport Corridor V between Lisbon and Kiev and the Baltic-Adriatic corridor which is one of the trans-European-road and railway axes in Central Europe on 2400 kilometers. It goes from the Baltic seaports of Gdansk, Gdynia, Szczecin or Świnoujście, to the Adriatic ports of Koper, Trieste, Venice and Ravenna, crossing the industrial regions of Central and Southern Poland, Czech Republic Slovakia and Austria. So, sea ports in the Adriatic - Baltic Corridor offers a favourable competitive conditions. That allows their logistical potential and getting better developed network of road and rail transport. The railway that links the Baltic and Adriatic seas exemplifies this opportunity. Two trains a week to and from the Slovenian port of Koper at the northern tip of the Adriatic Sea are already handled by Baltic Container Terminal in Gdynia (Lorentzon, 2014).

3 SIMILAR CONSIDERATIONS BUT DIFFERENT CARGO STUCTURES

Due to their peripherality, the Baltic and the Adriatic Seas are facing several common issues and adopting similar strategies.

One interesting point of comparison between Baltic and Adriatic cases is the fact that ports are interesting in far hinterlands. Unlike the Italian (Genoa, La Spezia), French (Marseilles, Le Havre) or German ports (Hamburg, Bremerhaven), where industries in direct proximity of the port generate a large shipping demand, the Adriatic ports actively aspire on serving contestable hinterlands in the Central and Eastern Europe, aside from their immediate vicinity (Stamatovića, De Langen, Groznika, 2018) when Baltic ports are looking to Ukraine or Central Asia. Northern Italian ports, in particular northern Adriatic ones, are in a favorable position to attract in their hinterland Central European countries, especially Austria and southern Germany (Acciaro & al., 2017). In the Baltic Space, new operators are setting up block-trains between the Baltic States and FSU or China. Block-trains enable “door-to-door” delivery, safety and easy border crossing as well as customs procedures (CIS/EU border in 30 min). The most successful pattern is the shuttle train Viking, launched in 2003, between Klaipeda (Lithuania), Odessa and Illichivsk which carries about 40,000 TEUs per year. Railways and shipping companies, ports of Lithuania and Ukraine, cooperate to simplify customs procedures, so trains can travel in 52 hours the 1,734 kilometers that separate the two ports. The second good example is the Baltica transit, a twice weekly block-train service between Riga and Almaty (Kazakhstan). Transit time is 8-10 days. In Latvia, the train is operated by LDZ Cargo in cooperation with FESCO (Far Eastern Shipping Co.) for the Russian part.

We could also show how cruise development is a common characteristic of the both seas. The Mediterranean region is divided into four sub regions; among which the Adriatic is the second most visited, only falling behind the Western Mediterranean (Zanne,

Beškovnik, 2018). The Adriatic Sea is an attractive region for cruising, Venice and Dubrovnik were ranked 3rd and 7th, respectively, in the leading Mediterranean cities visited by cruise passengers in 2010 (Perucic, Puh, 2012). Cruise tourism in Croatia started to grow steadily in the first decade of 21st century with Dubrovnik as the prime destination, and Croatia is important not only for cruises within the Adriatic Sea, but also for cruises from the Greek Islands to Venice (Caric, Mackelworth, 2014). The maritime cruise industry in the Baltic Sea is changing, especially rapidly growing. This activity is now becoming increasingly popular in Baltic ports and port cities. The figures, provided by Cruise Baltic, prove that in 2018 cruise ships carried 5.8 million passengers (Kizielewicz, 2019).

As quite closed seas, Adriatic and Baltic Sea are very vulnerable to environmental problems. As a result of its intense traffic, they are unfortunately subject to illicit operational discharges and dumping from ships. Numerous environmental issues connected to maritime transportation are present in the studied spaces. For instance, as semi-enclosed seas and vulnerable environments, special attention has to be paid regarding the risk of introducing Harmful Aquatic Organisms and Pathogens via ships' ballast water (Rak & al., 2019).

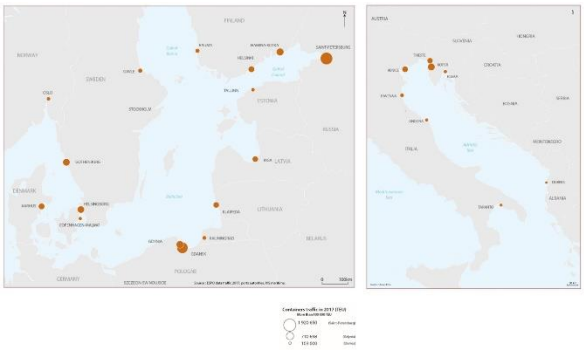
The first significant difference between this two spaces is that there are more ports in the BSR and often biggest ones (Figure 1). This situation is mainly the consequence of a biggest market but it is also connected to some geographical specificities: The Baltic Sea is the main exit door for Russian exports by sea, like crude oil, coal or fertilisers. So, in volume, liquid bulk is the main transported good in the BSR and also in Adriatic Sea but total volumes are very different. In the main field, dry bulk is strongly present in the Baltic ports but not in the Adriatic ones.

For these reasons, it is much more interesting to compare containerized networks. In volume, the Baltic market is again much more important than the Adriatic one but it is relevant to compare how containerization is developing in the both area because of their peripheral location.

The quantity of containers transported in the Baltic Sea is determined by the proximity of consumer markets, Russia being the key destination point. Only a minority of ports handle large quantities of containers. The largest regional container port, Saint-Petersburg, stands only 15th in Europe. In 2019, the number of containers handled among Baltic Sea ports amounted to 10.9 million TEUs. The configuration of the 20 largest container ports remained stable: St. Petersburg is clearly the undisputable leader in this segment, while Gdansk recorded considerable and continued growth in container traffic (Serry, 2017). Container traffic in Gdansk has increased tenfold in the last 10 years. The port is now at the second regional position behind St. Petersburg and competes heavily in Gothenburg (Figure 2). Gdansk has benefited from PSA's investments in the Deep Sea Container Terminal (DCT), which alone accounts for nearly two-thirds of Poland's container traffic.

In Russia, the containerized port system in the Gulf of Finland is completed with the Ust-Luga facilities and the new terminal of Bronka. The ambitions for Ust-Luga are considerable. Ubiquitous investment already placed the port as the regional leader in terms of total volume with 103,43 Mt in 2017. These two ports provide 70% of container traffic originating from or destined to Russia in the BSR. The rest of Russian traffic provides transit traffic mainly to Hamina-Kotka (Finland), Riga (Latvia) and Klaipeda (Lithuania).

Concerning ocean-going container ships, the Baltic Sea is restricted by physical prerequisites. Small markets and limited hinterlands may also reduce the competitiveness of ports (Lorentzon, 2014). Baltic ports are therefore essentially served by a feeder network. Starting from Northern Range ports, the rotations of the feeder ships are either circular, serving a few number of ports, either direct to one or two ports. So Baltic ports are not relays of large European and global flows but rather secondary nodes in the maritime network, even the most developed of them are connected through feeder services to some other ports' range.



Source: Port Authorities, 2018.

Figure 2: Container traffic in 2017

The Adriatic Sea container traffic is concentrated in the northern part. The north Adriatic multiport gateway system is made up by the Italian ports of Ravenna, Venice, and Trieste, Koper in Slovenia and the Croatian port of Rijeka (Luipi, 2019).

In 2017 the Port of Trieste achieved a container traffic of 616.156 TEU and was the leader on the Italian shore, in front of Venice with 611.383 TEU. The port of Ravenna is an interesting case study: it is the second largest dry bulk and general cargo port in Italy (and the first in the Adriatic Sea), even if it appears smaller - in general terms - in comparison with the other main Adriatic ports (Acciaro & al., 2017).

The port of Koper is handling various types of goods and practised a significant increase of throughput in the last years: it has become the first container port of the North Adriatic with a container traffic of over 911.528 TEUs in 2017. The main characteristics of container ports are different in all ports. The throughput in Koper and Trieste is limited by the capacity of terminals, while in Rijeka, utilization is quite low. Trieste and Koper have the shortest land routes, connected with more direct maritime services from Asia. There is no doubt that with the steady

increase in container traffic, these two ports are on the verge of reaching the necessary threshold to play a gateway role (Beyer, Sevin, 2008).

Rijeka instead recorded a much slighter throughput, handling 249.975 TEU which is approximately 40% more compared to 2007 (Host, Pavlić Skender, Mirković, 2018). Like in the Baltic Sea, the majority of container traffic of northern Adriatic ports refers to feeder services with transhipment at the hub ports of Gioia Tauro, Marsaxlokk (Malta), Piraeus (Greece), and Port Said (Egypt). Adriatic ports instead play only a negligible role in direct deep sea services.

Consequently, mainly because theirs trade volume remain too small to attract pendulum services, Adriatic and Baltic ports have limited global connectivity (Arvis, Vesin, Carruthers, Ducruet, Langen, 2018).

4 CONTAINER NETWORK ANALYSIS

4.1 Data & methodology

Thanks to the AIS data and in relationship with external databases, we are able to reconstruct each vessel's trajectory in such a way as to identify the navigation lanes then to match the daily traffic in its temporal and quantitative dimensions. It is then possible to analyse the maritime networks.

Automatic Identification System (AIS) is a system of monitoring ship movements that was made obligatory by the International Maritime Organisation (IMO) in 2004. AIS benefits to maritime transportation actors: improvements in safety or in the management of fleets and navigation. The data acquired from AIS systems also constitute a new means of information for the maritime community, or the wider public. Thus, it provides valuable material, not only to crews but also to terrestrial regulatory authorities, not forgetting individuals and research scientists. This material was first used for works based principally on the subject of security or on coastal spaces. Subsequently it has spread in many other fields including international maritime law, physics, signal processing, geopolitics... One of the most fruitful areas of research is in the analysis of shipping networks (Faury & al., 2019).

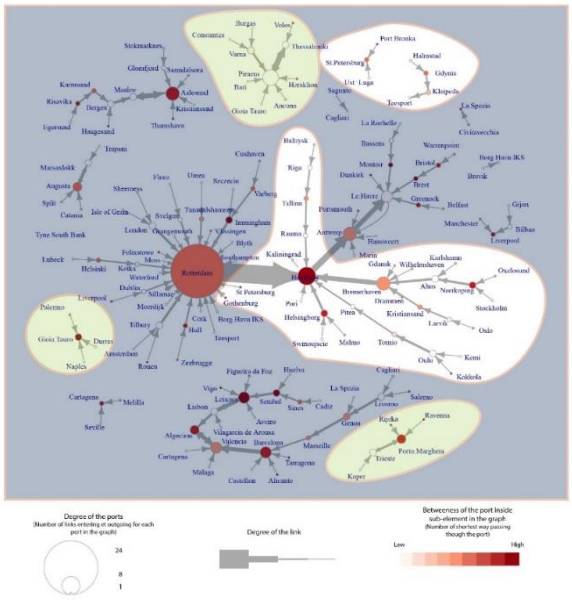
We have elaborated a platform which receives, decodes, cleans, stores and analyses AIS messages. Data is collected on the port of destination, the navigation status, the draught of the ship and ETA (estimated time of arrival). In this way it is possible to identify the maritime networks. The method used in this paper involves a spatial analysis within a geographical information system (GIS) combined with a database server, that makes it possible to rebuild each vessel's trajectory. It is then possible to analyse whole maritime networks.

4.2 Network and shipping companies

Then, AIS data combined to network analysis illustrates strong differences in both containerised networks (Figure 3). This graph of the containerships' maritime network in Europe was made using the so-called "major flows" method. This method consists of retaining for each node (here the ports) only the strongest link (in value) and to remove all the other ones (Ducruet, 2011).

The Baltic network is strongly connected to a major external node, Hamburg. Already in 2015, 88% of Baltic container ports maintained at least a link with Hamburg. 34 ports were served by regular lines departing from Hamburg (12 in Sweden, 9 in Finland, 4 in Denmark, 3 in Russia and Poland, 1 in Estonia, Latvia or Lithuania). There is also a strong internal connectivity with some local particularities like southern axis Gdynia-Klaipeda or a Bothnian axis. In the BSR, regionalisation is evident because of the concentration of sea connections on a low number of north European ports. New emerging nodes, like Gdansk, tend to centralise sub-regional dynamics.

The Adriatic network is quite different and less connected than the Baltic one: it is clearly more diffuse and burst even if the container terminal of Porto Marghera and Gioia Tauro seem to act as transshipment nodes for the region.



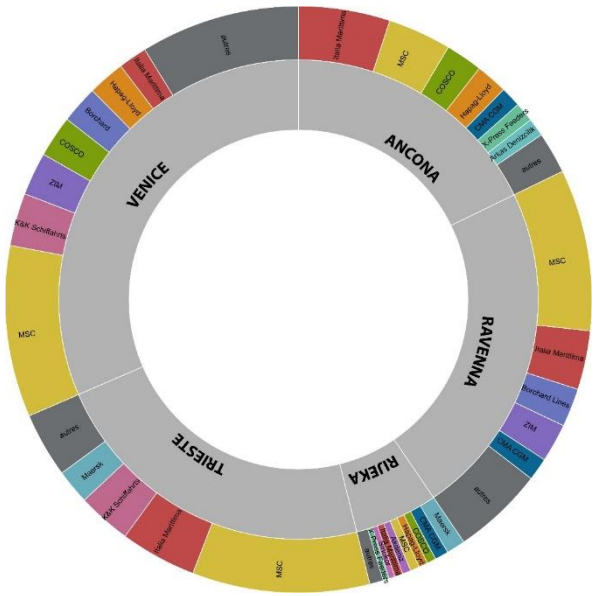
Source: IHS Maritime, 2019.

Figure 3: European containerized networks in 2018

Containerised network analysis also shows some quantitative differences. In 2018, there were 2 times more containerships' calls in the Baltic Sea (11716) than in the Adriatic Sea (6060). These ships were also coming back more often in the BSR than in the Adriatic ports but average ships' size is bigger in the Adriatic Sea (2919 TEU) than in the Baltic Sea region (1574 TEU). This last result can surely be explained by the different strategies of shipping companies which are analysed below.

So, to reinforce the analysis, we can also use AIS data to study container shipping companies and operators' strategies. At first, AIS data clearly shows that when there are a lot of companies acting in the BSR in 2018, their number was really smaller in the Adriatic area: 34 shipping companies were present in the Saint-Petersburg about twice as much as in the biggest Adriatic port.

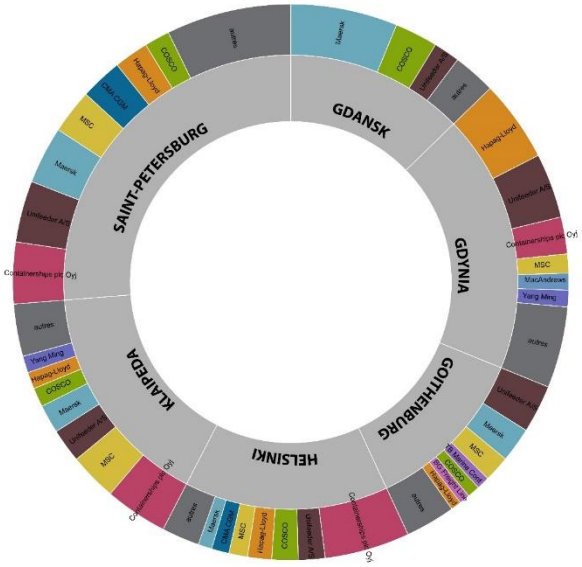
Secondly, this result also proves that there is less interest (and less competition?) from shipping companies in the Adriatic market than in the Baltic one.



Source: IHS Maritime, 2019.

Figure 4: Operators in the Adriatic Sea in 2018

In the Adriatic Sea, MSC (Mediterranean Shipping Company) seems to be the leading company (Figure 4) when in the Baltic Sea, the traffic is much more balanced between several companies (Figure 5). The place of specific feeder companies is also more important in the BSR than in the Adriatic. We can focus on operators, their strategies or their networks. So some companies like Joy Marine have quite local strategies with ships calling only in Bari when others like MSC propose services to almost all the ports. In addition, it is also possible to determine the capacity offered by each company in each port. It is an interesting way to focus on the three different types of actors present in the region: some major ones in the feeder field, some global carriers (MSC or CMA-CGM) and regional ones (Tarros SpA, Bia Shipping…).



Source: IHS Maritime, 2019.

Figure 5: Operators in the Baltic Sea in 2018

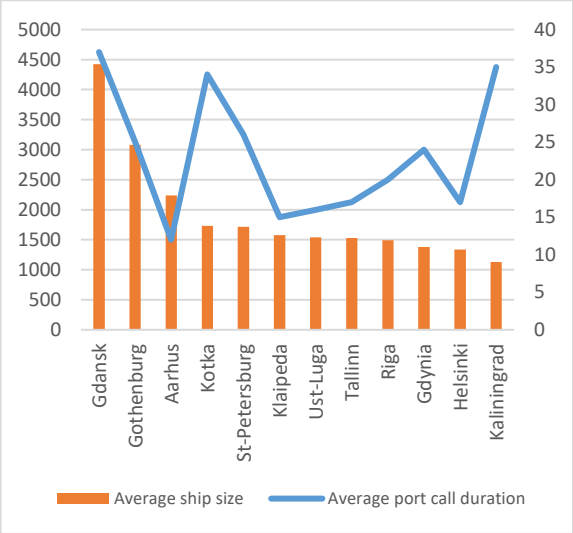
To synthetize, companies have different strategies: global carriers concentrate their flows on some ports like Venice or Gdansk which apparently act as a regional hub when companies specialized in feeder services have a more decentralized network. For instance, we mapped the capacity offered by COSCO in 2016. It is concentrated in the North of the Adriatic Sea principally in the ports of Koper, Trieste, Venice and Rijeka. COSCO uses the ports of Piraeus and Ayios Nikolaos (Greece) like a hub as it is the owner of these ports. Afterward, it transfers the goods to the Adriatic Sea. The behavior of COSCO matches with analyzes on the precedent map and a concentration of the calls is on the ports of the North of Adriatic Sea.

4.3 Network and shipping companies

Nowadays, the question of port competitiveness is crucial for port authorities and operators. In such a scheme, the question of port productivity is central for all the stakeholders. It especially concerns port operation efficiency levels, handling charges, reliability or landside accessibility. Thanks to the AIS data and in relationship with external databases, we determined all container ships that called at a Baltic or Adriatic port in 2019.

In the both peripheral seas, we can analyse port efficiency using the duration of port calls given by AIS data.

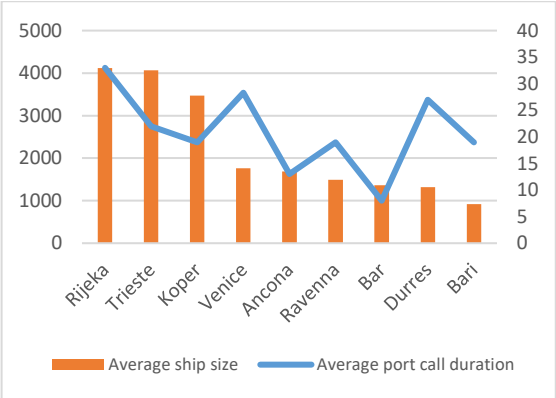
Baltic container ports appear very differently (Figure 6): two ports in particular, namely Gothenburg and Gdansk, are served by ships offering a larger capacity than in the other ports. Combining this analyses to operator's strategies is also interesting. In the case of Gdansk, the situation is clearly the result of Maersk Line choice to make the polish port its Bal-tic hub (Serry, 2017). AIS data shows that 35% of all port calls are made by Maersk Line, with an average capacity of 4530 TEU.



Source: IHS Maritime, 2020.

Figure 6: container ships' capacity and duration of port call in some Baltic Sea ports in 2019.

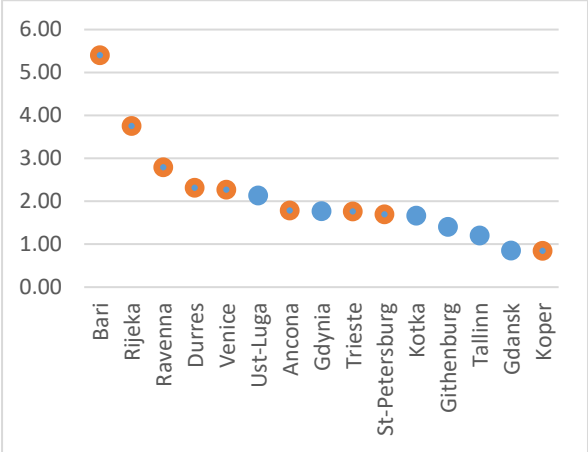
Concerning the Adriatic Sea ports, container ports also appear very heterogeneous (Figure 7): three ports in particular, Koper, Rijeka and Trieste, are served by ships offering a bigger capacity than in the other ports. The graph also shows the dissimilarity between the southern and the northern parts of the Adriatic Sea.



Source: IHS Maritime, 2020.

Figure 7: container ships' capacity and duration of port call in some Adriatic Sea ports in 2019.

By integrating the port traffic in the research process, it is possible to estimate the average length of handling of a TEU in each port. The first result is that Baltic ports seem to be more efficient in container handling speed than the Adriatic ones (Figure 8): average operational speed is 2.17 min per TEU when it is 1.56 in the Baltic sea in the same period. Of course, such analysis could be refined with the number of cranes in each terminal for instance.



Source: IHS Maritime, 2020.

Figure 8: Average speed per TEU (minute).

At least, it also appears that container terminal efficiency is very variable in the Adriatic ports: in the port of Koper, the most efficient one, it takes four times less time than in Rijeka to operate one TEU.

In the BSR container terminal efficiency is also very inconstant: in the port of Gdansk, it takes three times less time than in Kaliningrad to operate one TEU.

5 CONCLUSION

Political and economic mutations have shaped new conditions for development of trade and transport in the Baltic Sea Region and in the Adriatic area. The expansion of international trade has led to an increase in cargo turnover in the ports, primarily due to the active development of consumption markets and at a second level to new transshipment activities.

Competition between ports is evident, as we can see between Gdansk and Gothenburg or between in the BSR or between Trieste and Koper in the Adriatic Sea. This competition between ports consists of ports which can handle container ships and propose distribution of goods to similar markets.

By their connections to the global container-shipping network, the Baltic and the Adriatic Seas have gained in maritime efficiency what they have lost in direct access to the vast world. On the contrary, they have deepened relations with the world ocean as regional hubs emergence prove it.

Despite similarities and comparable challenges due to their location on the European periphery, this comparison has shown that the two seas are differently integrated in the maritime networks especially with container services. Probably because of its proximity to the northern range which dominates and concentrates the containerized flows of the European continent, the Baltic Sea is very heavily feederized. This is evident both in the structure of the marine network and in the strategies of the shipping companies.

The role of feeder ship connections is just as important in the Adriatic Sea, but their organization seems a little different, in particular due to the situation of the Adriatic

ports close to the multiple Mediterranean transshipment hubs, but also the contemporary smaller size of the Adriatic market.

From a prospective point of view, recently, northern ports have been favored, especially Hamburg. But the rise of economic centers in the Baltic area and at the coastline of Mediterranean Sea have created opportunities for several multi-port gateway regions to develop transport networks. Furthermore, new opportunities might arise for port systems in the Baltic Sea as well as in the Adriatic Sea. An observation is that countries such as Czech Republic, Poland, Slovenia and Hungary have strong railway networks enabling extension of the hinterlands (Notteboom 2012). Goods from Asia may be reloaded at ports of the Adriatic Sea and further distributed by train to places in East- and Central Europe. A result is shorter distance by sea-transport and saving of time (Lorentzon, 2014).

REFERENCES

[1] Acciaro, M. & al. (2017) Contested port hinterlands: An empirical survey on Adriatic seaports. Case Studies on Transport Policy, 5, 342-350.

[2] Arvis, J.F., Vesin, V., Carruthers, R.. Ducruet, C. & De Langen, P. (2018) MaritimeNetworks, Port Efficiency, and Hinterland Connectivity in the Mediterranean. World Bank Group,, International Development in Focus.

[3] Beyer, A. & Sevin, J.C.. (2008) Les ports-frontières de Trieste, Koper et Rijeka, futurs débouchés pour les conteneurs d'Europe centrale., Méditerranée, 111, 39-49.

[4] Caric, H. & Mackelworth, P. (2014) Cruise tourism environmental impacts - The perspective from theAdriatic Sea. Ocean & Coastal management, 102, 350-363.

[5] Ducruet, C. (2011) Simplification et partitionnement d'un graphe. 2011. halshs-00579065.

[6] Ducruet, C., Notteboom, T. (2012) The worldwide maritime network of container shipping: Spatial structure and regional dynamics. Global Networks, 12 (3), 395-423.

[7] Faury, O. & al. (2019) Analysis of the Russian Arctic port system using AIS data in O. Lassere & O. Fautry (Ed), Arctic Shipping: Climate Change, Commercial Traffic and Port Development (Routledge Studies in Transport Analysis) 1st Edition.

[8] Knowles, R.D. 2006. Transport shaping space: differential collapse in time–space. Journal of Transport Geography 14(6), 407-425.

[9] Hayuth, Y. (1981) Containerization and the load center concept. Economic Geography, 57(2), 160-176.

[10] Host, A., Pavlić Skender, H. & Mirković, P.A. (2018) The Perspectives of Port Integration into the Global Supply Chains - The Case of North Adriatic Ports. Scientific Journal of Maritime Research, 32, 42-49.

[11] Kizielewicz, J. (2019) Prospects of Development of the Cruise Ship Tourism Market - the Case Study of the Baltic Sea Region. Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, 7(63), 244-255.

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

[13] Lupi, M., Pratelli, A., Licandro, C. & Farina, A. (2019). The evolution of deep sea container routes: the italian case. Transport problems, 14, 69-80.

[14] Notteboom, T. (2010) Concentration and the formation of multi-port gateway regions in the European container port system: an update. Journal of Transport Geography, 18, 567-583.

[15] Notteboom, T. (2012) Dynamics in port competition in Europe: implications for North Italian ports. Workshop "I porti del Nord"- Milano - 18 April 2012.

[16] Perkovic, M., Harsch, R. & Ferraro, G. (2016) Oil Spills in the Adriatic Sea. In A. Carpenter & A.G. Kostianoy (Ed), Oil Pollution in the Mediterranean Sea: Part II -National Case Studies. Hdb Env Chem (97-131).

[17] Perucic, D. & Puh, B. (2012) Attitudes of citizen of Dubrovnik towards the impact of cruise tourism on Dubrovnik. Tour. Hosp. Manag, 18(2), 213-228.

[18] Rak G & al. (2019) The implementation of the ballast water management convention in the Adriatic Sea through States' cooperation: The contribution of environmental law and institutions. Marine Pollution Bulletin, 147, 245-253.

[19] Rodrigue, J.P. &Notteboom, T. (2010), Foreland-based regionalization: Integrating intermediate hubs with port hinterlands'. Research in Transportation Economics, 27(1), 19-29.

[20] Rodrigue, J.P. (2020) The Geography of Transport Systems, Fifth edition. New York: Routledge.

[21] Serry, A. (2017), Automatic Identification System (AIS) as a Tool to Study Maritime Traffic: the Case of the Baltic Sea. Marine Navigation, CrC Press, 139-146.

[22] Serry, A. (2019) Containerisation in the Baltic Sea region: development, characteristics and contemporary organisation. European Spatial Research and Policy, 26(1), 9-25.

[23] Stamatovića, K., De Langen, P. & Groznika, A. (2018) Port cooperation in the North Adriatic ports. Research in Transportation Business & Management, 26, 109–121.

[24] Twrdy, E. & Batista, M. (2016) Modeling of container throughput in Northern Adriatic ports over the period 1990–2013. Journal of Transport Geography, 52, 131-142.

[25] Vego, M. (2015) On Littoral Warfare. Naval War College Review, 68(2), 30-68.

[26] Available at: https://digital-commons.usnwc.edu/nwc-review/vol68/iss2/4

[27] Wiradanti, B. (2019) Container hub development un a peripheral location - The Case of Indonesia. PhD thesis, Management Section of Cardiff Business School, Cardiff University.

[28] Zanne, M. & Beškovnik, B. (2018) Assesing Home Port Potential of Selected Adriatic Ports. Transaction on maritime science, 02, 143-153.