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► **To cite this version:**

Ronan Kerbiriou, Arnaud Serry. Estimation and analysis of container handling rates in European ports. *Journal of Transport Geography*, 2023, 108, pp.103565. 10.1016/j.jtrangeo.2023.103565 . hal-04042387

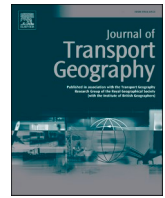
**HAL Id: hal-04042387**

**<https://hal.science/hal-04042387v1>**

Submitted on 28 May 2023

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## Visualising Transport Geography

## Estimation and analysis of container handling rates in European ports

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## ARTICLE INFO

## Keywords:

Containers  
European ports  
Maritime traffic  
Port performance

## 1. Introduction

In less than ten years, the carrying capacity of container ships has doubled, from 12,500 TEUs to 24,000 TEUs for the most recent Megamax-24 generation ships. In the interest of economic viability, ship-owners have set up maritime services in order to optimize their ports of call and therefore concentrate their flows on a limited number of ports. In order to accommodate these giants of the seas and to improve the flow of goods, port authorities make massive investments and attempt to highlight their competitive advantages by favouring the mass development of hinterland connections in particular. However, the physical capacity of a port to accommodate and manage the transport of these goods does not guarantee it can attract these flows.

In a context of global economic competition, comparisons between ports are based on traffic statistics published principally by the port authorities. These raw data do not provide any information on port performances. Above all, they give no information on the capacity of the port to be a port of call for the ship-owners in their way to organize their maritime services (Fremont and Soppe, 2005).

Had these data existed, it would provide a new perspective on port traffic. Indeed, the performance of a port cannot be evaluated through the sole examination of the volumes handled. Other criteria should also be considered. Unfortunately, some information is missing or some works should be undertaken on existing data (Ducruet, 2020; Ng, 2012).

This paper will compare the European TEU port traffic in 2020 with the port calling capacity provided by container ships. This will make it possible to determine the average handling rate of ships making calls during the year and thus provide a complementary tool for analysing European ports.

## 2. Method and data

The objective is to propose a finer approach to containerization in Europe by supplementing traditional data (port traffic in volume...) with data made from original information (Automatic Identification System, AIS) (Feng and al., 2020; Yang and al., 2019).

First, the 2020 statistics of container traffic in European ports were used. These data come from port authorities, activity reports and national statistical institutes. However, these statistics may be biased because they may be overestimated due to transshipment traffic, among others. Transshipment traffic is counted twice in the statistics (namely, once for import and once for export). Unfortunately, the port authorities rarely provide data on transshipment in their statistics.

The second data source considered comes from AIS signals. AIS signals make it possible to track vessels and thus to compute the annual number of calls made by container ships in each port here under investigation. In order to fulfil its prerogatives on safety, security of shipping and safety of life at sea, in 2000 the International Maritime Organization adopted the development of AIS on ships. This technology is intended to help ships avoid collisions and to monitor maritime traffic. This requirement came into force on 31 December 2004. AIS is a system for exchanging data between ships and between ships and land-based platforms automatically. AIS receivers handle the sending and receiving of various geographically relevant information, including message coordinates, speed, heading, ship identifier, time and date of message and the port of destination. These data make it possible to envisage different thematic exploitations in economic/transport geography, environmental studies, traffic management and safety/security issues.

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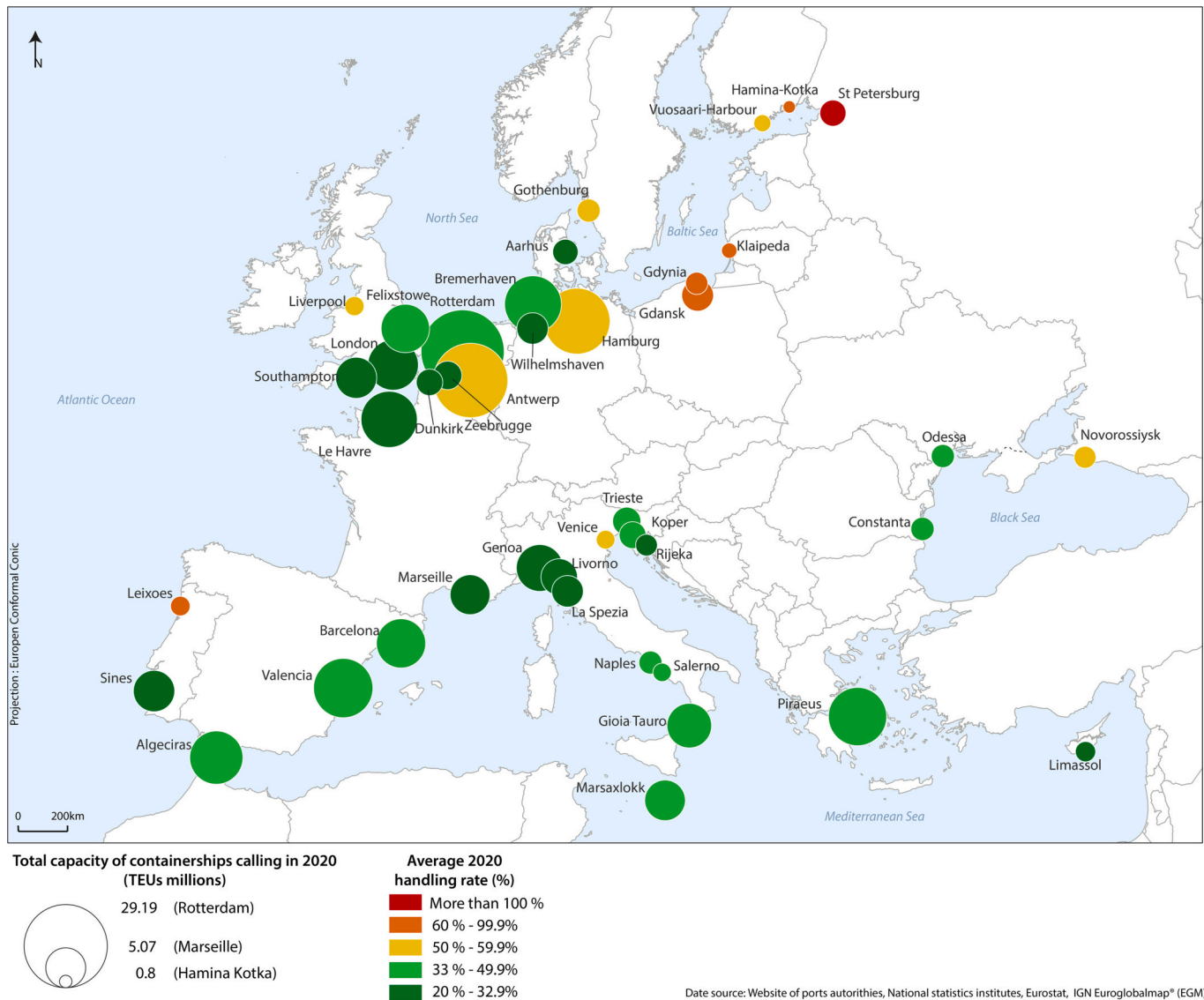


Fig. 1. Capacity and average handling rate of containerships calling at the main European container ports in 2020.

The third piece of data used is the database that gives information about the maximum capacity of transport in TEUs<sup>1</sup> provided by ships (IHS Maritime). The capacity of transport is calculated by adding the capacities of all the containerships making a call at a certain port over a certain period.

Consequently, calculation has been made for each port and its linkage between its container traffic in 2020 and the capacity of transport in theory provided by all the containerships calling at the port in the same year. This made it possible to determine an average handling rate of containerships making a call in 2020. This average handling rate allows to assess the average number of containers which are loaded and unloaded during a call. For instance, an average handling rate of 30% on a container ship with a transport capacity of 10,000 TEUs means that 3000 TEUs will be handled on average. The maximum rate can be 200% under hypothesis that the ships are unloaded and reloaded completely.

For the selection of European mapped ports, two criteria have been combined:

- Ports with traffic of over 500,000 TEUs,

- Ports in which the theoretical annual capacity provided is over 1,000,000 TEUs.

The surface of proportional circles corresponds to the total TEU capacity provided at a port of call and the colour gradient shows the average handling rate. When it comes to the rate, the distribution of the statistical series is multimodal; the natural thresholds as the discretization method were applied.

### 3. Results and analysis

Fig. 1 unveils wide disparities between European ports: handling rates range from 21% (Le Havre) to 112% (Saint Petersburg). From one extreme to the other, there are groups of ports with thresholds that are easily identifiable and correspond to the bounds set for the discretization.

This part will briefly discuss the key findings by large European maritime zones (namely, the Mediterranean Sea, the North Range and the Baltic Sea). In the Mediterranean, homogeneity between the different ports can be noted. Only few ports concentrate a traffic capacity much greater than the others. In contrast, most ports (16 out of 26), including the main ones, have a handling rate of between 33% and

<sup>1</sup> Twenty-foot equivalent unit

49.9%. This corresponds to the average found for Europe. It can be noted, however, that the ports near to the Gulf of Genoa (which are the furthest away from the maritime route between the Suez Canal and the Straits of Gibraltar) have a handling rate of below 33%.

Concerning the ports in the North-European range, port capacities available seem logically very high for many ports but the handling rates are considerably more heterogeneous due to the diversity of container traffic. For instance, the handling rate is 21% at Le Havre compared with 53% at Antwerp. This high rate for both the port of Antwerp and Hamburg (50%) reflects their dual role of gateway port and hub port within the Northern Range. The port of Le Havre, despite its enviable geographical position in the Northern Range (first port of call for imports and last for exports in the Northern Range), has a very low average handling rate compared to its main competitors. This is due to the weakness of transshipment traffic and also by the fact that some calls are simply used to reorganize and complete ships before leaving Northern Europe (Kerbiriou and Serry, 2020).

In these two areas, several ports have lower average handling rates than other ports in the region (e.g., Le Havre and Southampton in the Northern Range, Marseille and Genoa in the Mediterranean). This highlights their secondary role in the main world trades. In the event of a restructuring of maritime services and a concentration of calls on a smaller number of ports, these ports risk no longer being served by large container ships and becoming regional ports.

In addition, the Baltic ports are very interesting to observe. The capacity provided is relatively low but the handling rate is very high. Within our sample, the ports of Saint Petersburg (112%), Hamina-Kotka (78%), Klaipeda (75%), Gdynia (67%) and Gdansk (66%) have the five highest handling rates. Several explanations can be put forward. Some ports, like Gdansk, play the role of regional transshipment port that raises the handling rates. Others, especially those in the Gulf of Finland, which are served to small units, are impacted by a dead-end effect, which also explains the rather high rates (Serry, 2019).

Finally, the Portuguese port of Leixoes stands out from the other Atlantic ports: it is served by rather small feeder vessels (average size of 1085 TEU) that have high handling rates (64%).

#### 4. Conclusion

The European maritime ranges have very high port concentrations, which accentuate the competition between them with overlapping hinterlands. The analysis of average handling rate shows that there are major differences between European ports. In the strategies of the large shipowners, some ports

of call are less important. In the event of a reorganisation of shipping lines, shipowners may choose to remove some ports from their services and concentrate on a smaller number of ports. In order to maintain the shipping services of the world's major shipping companies, the major ports must be able to fix cargo flows to remain an essential stopover in the shipping services or risk becoming a secondary port. To achieve this, it is necessary to offer logistics services as close as possible to the port passage and to have efficient multimodal transport services.

In addition, the approach presented here remains exploratory. However, the calculation of the handling rate makes it possible to estimate the average number of containers handled at port of call. Ports that are "hubs" load and reload over 2000 TEUs per call. Some ports stand out. In the Mediterranean, there are three hubs of Gioia-Tauro, Algeciras and Marsaxlokk. In northern Europe, Hamburg is the main hub as well as Rotterdam and Antwerp playing the role of pivot port in Europe when Gdansk is becoming a regional hub for the Baltic Sea.

Finally, comparing these results with the data provided by the container terminal manager would enable the analysis to be completed.

#### Author statement

**Ronan Kerbiriou:** Data curation, Methodology, Visualization, Formal analysis, Writing - Original Draft, Writing - Review & Editing.

**Arnaud Serry:** Conceptualization, Formal analysis, Writing - Original Draft, Writing - Review & Editing.

#### Data availability

Data will be made available on request.

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