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## TRANSPORT, 1



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# **GeoProgress Journal**

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**TRANSPORT, NR. 1**



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## Editorial Note

**Transport 1** is the first special issue of the GeoProgress Journal on the various and multiple themes of transport, a field of studies that is truly important and central to a journal, like this, that is primarily concerned with development problems from the global to the local scale.

The papers proposed for publication in this Special have obviously been subjected to the same evaluation process as those proposed for the ordinary issues and approved according to the same rules and, in addition, on the basis of their thematic coherence.

We are grateful that the AGeI (Association of Italian Geographers) Group has proposed to this Journal the publication of the results of research of its members and its meetings and we can only hope that they will develop their research and put forward new proposals. We also hope that other study groups of the same AGeI and, no less, of other associations and disciplinary sectors, will entrust us with the editing and publication of the results of their scientific works.

For the specific contents of this issue, we refer to the Introduction, by Giuseppe Borruso.



## Introduction

### *The Trieste Conference 2023*

This special issue, dedicated to the broad and articulated theme of transport from a geographical perspective, brings together some contributions from colleagues with interests in transport and logistics within the AGEI working group on the Geography of Transport and Logistics. More specifically, the contributions in this issue can be traced back in part to the conference “Transport and logistics between global challenges and local development”, held in Trieste on November 22 and 23, 2023, and they are just a small part of the results of this meeting.

In fact, the Trieste Conference – organized by the undersigned and intended as a handover in the coordination of the group from Giuseppe Borruso to Marcello Tadini of the AGEI Group “Geography of Transport and Logistics” – aimed to provide an opportunity for interdisciplinary debate with the participation of colleagues from various national and international institutions in the fields of geography, economics and law, as well as territorial stakeholders interested in these issues. Two round tables addressed the theme: “Maritime transport between local and global challenges. Geoeconomic and geopolitical aspects” and “Logistics and supply chain. Scenarios for logistics chains between de-globalization and re-globalization”; two thematic sessions also delved into the topics of “Smart cities, ports & regions. City, port, region relations; last mile distribution, accessibility and internal areas” and “Sustainability and transport. Circular economy and energy transition”. The discussions around these events, during the Trieste days and in the subsequent period, have resulted in several contributions that, in this volume, address a varied and articulated series of topics, independent of each other but broadly centred on the themes of current debate on the issue of transport and logistics.

A first point of view is an expression of the reflection on the issues related to the development, in a broad sense, of territories linked to the articulation of the logistics and transport system. In this sense, the contribution on the relationship between hinterland and foreland (Prezioso) is positioned, recalling the port and coastal function as a line of demarcation and development for the two parts (sea and land) of the same context. In line with this, focusing on the land side, is the contribution on SEZs - Special Economic Zones (Esposito), on which there is ongoing debate and regulation, from a political and economic point of view, on their ability to attract and create local development, especially in the contexts of Southern Italy, specifically in the Italian case. To align with the maritime component, the contribution on the specialization and characteristics of the Italian port system (Tadini), between containerization and the development and consolidation of other traffic categories. The sea side is also joined by the energy issue, with reflections on the opportunities, risks, and hypotheses regarding the use of alternative fuels in shipping (Di Fazio, Palmentieri, Paradiso). On the subject of mobility, moving on to consider collective mobility, the review is concluded by the virtuous case of innovation in on-demand transport systems for areas with weak demand in the case of Friuli Venezia Giulia (Mazzarino).

*Giuseppe Borruso* (Università degli Studi di Trieste)

## *Research priorities of the AGEI Group “Geography of Transport and Logistics”*

The AGEI Group “Geography of Transport and Logistics” intends to investigate the main research topics in the field of transport geography, finding a study segment in the relationship between the transport of goods and people in relation to territory and space. The aim of the Group is to bring together the different research paths in the field of transport geography in a common space of comparison and research.

In general, this discipline intersects issues such as trade flows, communication and connectivity systems, tourism, demography, migration phenomena, politics, society and culture. Few disciplines are able to put the role of territory and space so much at the centre of their scientific interests.

The research areas that the Working Group is focusing on concern the freight transport in relation to territory and space. This is a topic that is particularly declined in terms of globalisation, international trade, supply chains and complex systems and networks. Innovations and trends relating to urban transport are of definite scientific interest in the future, with particular reference to the freight sector in terms of sustainability, assisted by the theme of great interest represented by the development of transport infrastructures and networks.

A further topic of great relevance is the issue of the energy transition that is affecting the transport and mobility sector in particular (transition to electric mobility), calling into question the analysis of the repercussions on the geography of energy sources and world geopolitics and geo-economics. The energy transition, again, brings with it the issue of environmental sustainability and the effects on the environment, primarily in terms of pollutant emissions and global climate change.

The theme of transition also strongly recalls the strategic relevance of modal shift choices and the development of intermodal transport in the transfer of goods and people, which have increasingly become essential issues in modern public policies.

Connected to the phenomena of globalisation is the area of study concerning maritime transport and port activities. The processes triggered by this phenomenon are causing profound territorial transformations, in the areas of exchange (ports and retro-port regions) and in the places of destination, changing the logics of production and transport in a reticular way. Lastly, in the sphere of maritime-port transport and its territorial values, the role played by the cruise sector is worth mentioning, in its twofold value, linked to its importance in terms of tourism, its economic impact in the territories affected by the flows, as well as environmental and safety issues.

*Marcello Tadini* (Università degli Studi del Piemonte Orientale)

## THE SPECIALISATION OF MARITIME TRAFFIC: TAXONOMY AND ITALIAN PORTS GEOGRAPHY

Marcello Tadini\*

### *Abstract*

The paper focuses firstly on the recent evolutions of global maritime traffic and its repercussions on port functions. Subsequently, the main characteristics of modern port functions are described, highlighting their peculiarities and evaluating their effects on port facilities. Considering the analysis of seaport functions, this paper investigates on the literature concerning ports classification with the aim of proposing a taxonomy of their specialisation. The case study is the Italian peninsula, whose port specialisation is analysed (during the period 2012-2022) and the resulting geography is outlined.

*Keywords:* Ports specialisation, maritime traffic, port geography, Italian ports.

### 1. Introduction

Addressing the themes of maritime traffic and ports' role necessarily requires the analytical and interpretative support of geographical discipline and, in particular, of transport geography (Tadini, 2022b).

According to Rodrigue *et al.* (2006), transport geography is a sub-discipline of geography interested in movements of freight, people and information. It aims at linking spatial constraints and attributes with the origin, the destination, the extent, the nature and the purpose of movements. Within this mainstream vision, transport geography should analyse the cross interactions between “spaces” and “transports”; this is relevant from the local to the global level. In other words, transport geographers should analyse how territory constraints transport and how transport affects the territories served or crossed (Dobruszkes, 2012). This means that transport geography examines the movement of people, goods and information within or across different regions. The analysis of flows between regions implies the use of the so-called network approach (Black, 2003). Therefore, it is possible to identify three core dimensions of transport geography: flows, nodes/locations and networks (Hesse and Rodrigue, 2004). Nevertheless, transport geography also studies the different modes of transportation such as road, rail, aviation and ships.

This work focuses attention on ports as strategic nodes of freight transfers but also on the shipping connectivity, the terrestrial infrastructures and the port functions that define their role in the maritime freight flows.

Over the last few decades, the process of globalisation of the world economy has led to significant growth in international trade. In this scenario, the transport service has played a fundamental role in transferring goods to ever greater distances and in an increasingly rapid way (Vallega, 1997). Considering the geomorphological configuration of our planet, characterized by a prevalence of water on land surfaces, it

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seems intuitive to understand how the most used mode of transport to transfer goods on an international scale is mainly maritime.

Since the 1990s, maritime transport has been characterised by a new phase of development under the pressure of the renewed international division of labour, transnational economic integration and the increase in world trade (Vallega, 1997). As a result, sea transport has increasingly become an essential element of the global economic system because without the former intercontinental trade would be impossible. Maritime transport has become an integral part of the global economy due to its ability to move goods over long distances and at low costs. It is configured as a network of specialized ships, of the ports that welcome them and of the infrastructures that allow transport from the production sites to the terminals, distribution centres and markets (Corbett, Winebrake, 2008).

## **2. Maritime traffic and port functions**

In the traditional port, whose functional profile had been refined in the twenty years following the Second World War, the port functions were definable about the nature of the goods transferred (Vallega, 1994). The classification of maritime transport of goods was based on the type of goods moved and included two main categories (Vallega, 1994; Foschi, 2005):

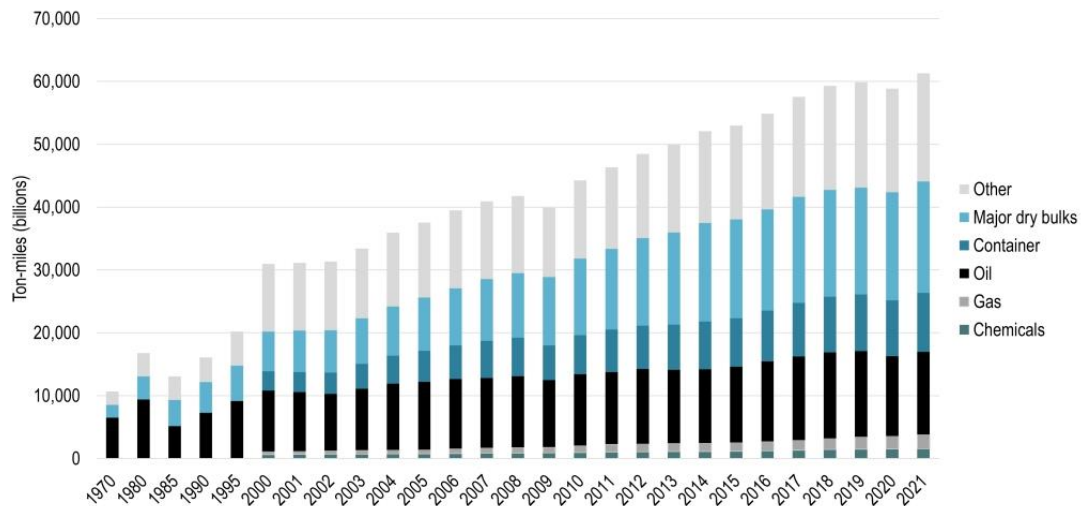
- goods that could be transported in bulk, divided into solid (or dry, called dry bulk, mainly minerals and cereals) and liquid (called liquid bulk, mainly hydrocarbons, chemical products, oils);
- other goods, mainly finished and semi-finished products, which required some form of packaging, known as miscellaneous goods (or general cargo).

Maritime progress, in the period between 1950 and the early 1970s, took shape through the technically integrated sequences of land-sea transport, largely of liquid or dry bulk goods serving industry. In the aforementioned period there was a growth of traffic which gave rise to a continuous expansion of the size of the market based on specialized sequences by product category that responded to the transport needs of the industry (Marchese, 2002, p. 37-38).

As Campione (2004) recalls, in the so-called “neo-industrial” stage of evolution of maritime ports, which lasted until the beginning of the Seventies, port functions were linked to bulk and general cargo. Therefore, it was usual to distinguish port functions into three main types, depending on whether they concerned liquid bulk, solid bulk or miscellaneous goods.

The post-industrial economy (during the 1970s) brought considerable transformations in port functions and the aforementioned distinction began to no longer be representative of reality. In particular, this became evident at the beginning of the nineties, because the third category (various goods) was progressively transforming, breaking down into important subcategories, identified considering the methods of movement (Vallega, 1994). The change and innovation were based on the progressive growth of intermodal transport (mainly with the massive use of containers in the first phase and subsequently also of wheeled vehicles) for the movement of various goods. Therefore, the framework of port functions has become more articulated and complex and based on functions carried out with conventional methodologies (bulk cargo), with vertical loading methodologies of standardized load units (containers) called lift on-lift off and with horizontal loading methodologies of wheeled cargo (called Ro-Ro, i.e. roll on – roll off) (Vallega, 1994).

What has just been described was achieved in the context of the growing global use of maritime transport, which growth rate for all product categories has been high, particularly since the new millennium (Fig. 1).



*Figure 1: World seaborne trade by cargo type.*  
*Source: Rodrigue (2020).*

### 3. The different port functions and their implications on port facilities

The varied framework of port functions has significant implications for the necessary port facilities.

Maritime bulk traffic is strongly linked to port structures and their operational dynamics, as the movement of this type of goods requires suitable terminals (ISTAO, 2016). In particular, dry bulk terminals play a leading role in the transport chain by connecting producers with end users. It is important to highlight how their efficiency is influenced by a series of internal and external factors. These terminals operate at the service of ships equipped with large holds, usually divided into compartments that can be used selectively according to the type of goods. The optimal location of this type of terminal is determined by maritime factors, such as weather exposure and seabed depth, combined with the ease of land transport (road/rail) and the availability of large storage areas. For the management of spaces and equipment and the specialisation of personnel there is an element of strong economy of scale, represented by the concentration of movements for one or a few types of products in high quantities (ISTAO, 2016, p. 17).

Liquid bulk terminals must be equipped to handle cargoes in liquid and gaseous forms, such as crude oil, petroleum products and natural gas. These products are shipped via oil tankers, chemical tankers and gas tankers. Loading and unloading tanks requires special equipment such as loading pipes or loading arms that include safety accessories. The yard of a liquid bulk terminal usually consists of a collection of storage facilities and other technical installations such as pumping stations. Many liquid bulk terminals are connected via pipelines directly to chemical or petrochemical production sites (Notteboom *et al.*, 2022).

The general cargo (or break-bulk) category is quite varied and is therefore managed in

different types of terminals which in many cases are highly specialized for a specific type of cargo. In general, it can be stated that the cargo is handled by cranes on the quay or by the ship's loading equipment (deck crane). Various types of cranes are used on the docks for the handling and lifting of packages which occurs using hooks, rope slings, canvas slings, chain slings, cargo nets and lifting beams. The use of these tools varies depending on the weight, size and type of goods (Notteboom *et al.*, 2022).

Break bulk differs from liquid and dry bulk since cargo refers to goods that must be loaded individually. One of the challenges of designing a general cargo terminal is making sure that the terminal is flexible in handling and safely storing the potentially large variety of goods (Van Koningsveld *et al.*, 2023).

At the beginning of the nineties, the category of various goods (or general cargo) was progressively transforming, breaking down into important subcategories, identified considering the methods of movement (Vallega, 1994). This change was based on the progressive growth of intermodal transport and containerisation (first subcategory).

Containerisation has conquered a notable share of the general cargo transport market: goods that in the past were transported as general cargo are increasingly introduced into containers (European Parliament, Mol and Vanroye, 2009).

General cargo is currently characterised by the following types of goods (ESPO, 2007; Notteboom *et al.*, 2022):

- Project cargo: power generation equipment (generators, turbines, wind turbines), oil and gas industry equipment (cables on reels, gas tanks, modules, petrochemical plants), mining equipment, building and construction and heavy machinery.
- Steel products: coils, sheets, steel bars, steel cables, pipes and tubes.
- Forest products, including wood and paper products.
- Cargo of reefer ships: mainly fruit and meat.

Consequently, the category of miscellaneous goods has changed in nature, becoming a specialised sector, handling goods that cannot be transferred via containers or for which containerisation does not represent an economically viable proposal.

Containerisation led to the greatest transport revolution of the twentieth century (Maribus, 2010; Sellari, 2013) and can be considered an essential element of globalization processes (Fremont and Soppè, 2005). Containerisation, together with the increasing use of intermodality that it has produced by offering the advantage of an integrated transfer of goods between the different carriers, produced significant effects and changes in maritime transport (Vallega, 1997; Vigariè, 1999). The easy transferability of the container determined a substantial impact on the organization of geographical spaces along logistics chains and has led to a redefinition of port facilities and related links with territories (Porceddu, 2009).

According to the literature, in the last years containerization has reached huge dimensions (Fig. 2) obtaining an essential role in international trade. This growth of containerization requires the optimal design of seaport terminals not only in terms of necessary space for activities but also in terms of operations and related equipment. The development of maritime containerized traffic has determined a functional port reshaping and a changing role of these nodes (Tadini, 2022b).



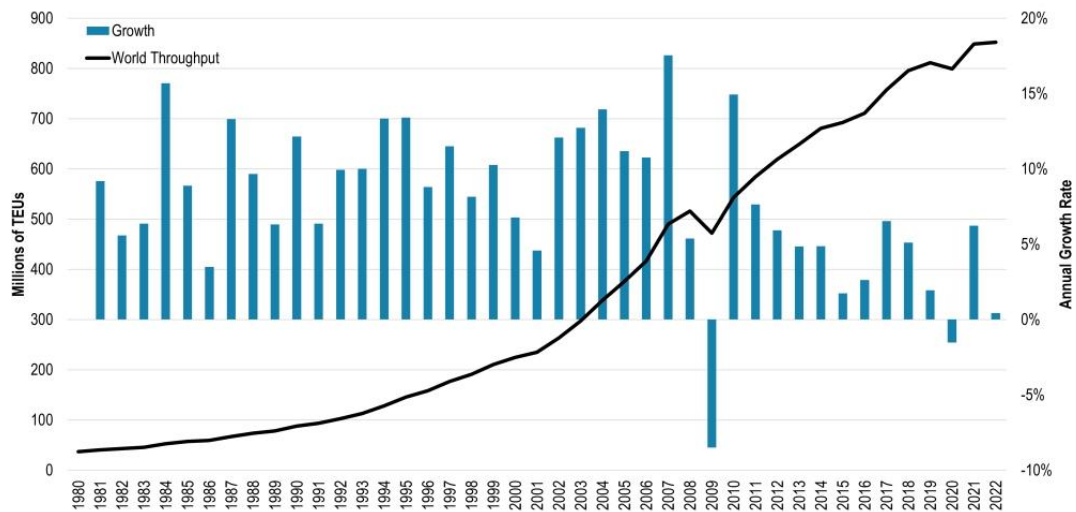


Figure 2: World container throughput.  
 Source: Notteboom et al. (2022).

A shipping port specially equipped to handle containerized cargo is called container port. In detail, these ports are characterized by the presence of dedicated spaces: container terminals. A container terminal is a place where vessels dock on a berth and containers are loaded and unloaded. Besides, this terminal can be roughly divided into two main areas, the quayside for berthing vessels and the storage yard for holding containers. The quayside is made up of several berths for vessels to moor. The storage yard is typically divided into many blocks where the containers are stored. Each container block is served by several yard cranes (Lee *et al.*, 2006).

The second subcategory of change in general cargo was another type of intermodal transport with horizontal loading of wheeled freight vehicles (called Ro-Ro).

The interest of the literature on maritime transport has mainly focused on containerized loads (Lift on-Lift off), while the analyses on Ro-Ro traffic have been less numerous (Albanese, 2010). However, it should be noted that in recent years in the European and Mediterranean context the Ro-Ro sector has played a significant role (Fadda *et al.*, 2020).

The acronym Ro-Ro, as mentioned previously, means Roll on/Roll off, that is the loading and unloading of freight does not require the aid of cranes or other external mechanical means, because the goods are arranged on flatbeds or in containers, loaded and unloaded by self-propelled vehicles (trucks or articulated vehicles) or towed (ISTAT, 2022). Ro-Ro ships, therefore, are loaded and unloaded with horizontal manoeuvres through one or more loading ramps for the movement of wheeled cargo (Tadini, 2022a).

Ro-Ro terminals are designed to handle wheeled cargo that is driven on and off the ship on their own wheels (i.e. cars, trucks, semi-trailer trucks, trailers) or using a platform vehicle (i.e. a self-propelled modular transporter). These terminals require particular equipment: facilities to accommodate the (un)loading ramps of the vessels and generally large amounts of parking space (Van Koningsveld *et al.*, 2023).

#### 4. The classification of seaports

The port classification framework is not only useful for highlighting the background of the ports but can also be utilized in benchmarking comparing port systems (Othman *et al.*, 2019).

The development of ports is closely linked to the development of the economy since the port's functionality can vary depending on the differences in economic development. Therefore, the port classification is considered important to create a basis of comparison, where ports with similar and comparable backgrounds are identified and a comparison is made on their development and potential with those that have undergone the same conditions (Adhitama and Tan, 2009).

A clearly outlined port context, generated by a well-defined classification framework, can help to support future port development by guiding port operations towards their functional roles (Dwarakish and Salim, 2015).

Conventionally, a port is defined as a transit area, a place of contact between the land and maritime space, a node where sea and inland transport systems interact and a place of convergence for different transportation modes. Since maritime and inland transportation modes have different capacities, the port assumes the role of a point of load break where cargo is consolidated or deconsolidated (Notteboom *et al.*, 2022).

The term port refers to a complex of infrastructures that facilitates vessels to (un)load their cargo and cargo to be transferred from one mode of transport to another (Van Koningsveld *et al.*, 2023). Ports also manage a variety of loads for which they are specialized in (Roa Pereira *et al.*, 2013).

To understand the diversity of ports it is fundamental to highlight their typology classification.

A valid port taxonomy has to consider the complexity and variety of the port business at more than one level, in particular (Bichou and Gray, 2005):

- Physical and spatial differences: location, access, connectivity, available capacity, *etc.*
- Operational differences: types of cargo handled, ships serviced, terminals operated, *etc.*

Conventionally, ports can be categorised considering four dimensions, as follows (Notteboom *et al.*, 2022):

- Geographical attributes: refers to the main characteristics of the port site and situation; coastal and inland geography conditions create variety in the locational setting of port sites.
- Scale: refers to an assessment of port size in terms of its area, annual cargo throughput, the size of its hinterland and the number of shipping services it is connected to.
- Port functions: refers to the range of services offered by the port, such as cargo handling, logistics and distribution, industry and maritime services.
- Specialisation: refers to the type of cargo moved and to the methods of handling (conventional general cargo, liquid bulk, dry bulk; containers or Ro-Ro). Another specialisation concerns port-centric industries such as steel plants, energy plants, automotive, or chemical industries.

Ports can be distinguished by the type of cargo handled. However, as Van Koningsveld *et al.* (2023) stated, since most larger ports typically deal with multiple types of cargo, a useful distinction is the following:

- single-use ports (such as container ports, oil ports, *etc.*);
- multi-use ports (handling a variety of cargo types);
- industrial ports (usually serving a single factory or plant, such as a refinery, a power plant, a steel mill, *etc.*).

Several studies are presented to classify ports considering various port features.

The most common approach to categorizing ports is to use metrics based on the annual volume of goods. However, to describe ports as completely as possible, their categorization has to be focused also on facility types (Roa Pereira *et al.*, 2013). As Kiranoudi and Polemi (2023) stated, it is important to consider the type of supply chain service that ports operate.

The supply chain service that can be managed by a port depends on the infrastructures and the systems used.

A port complex may contain various cargo-specific terminals, including facilities for handling and storage of cargo. Many ports are cargo-specific, which enables them to optimise their infrastructure for handling a specific type of cargo and relative supply chain (Van Koningsveld *et al.*, 2023).

The presence of a single terminal dedicated to a goods category or the prevalence of the movement of one cargo terminal (compared to others present in the port) are the factors that determine port specialisation.

Due to the complexity of the modern maritime environment, it is important to note that the classification of ports (and consequently their specialisation) is not static and may change over time due to various factors; such as changes in the global economy, advances in technology and shifts in trade patterns (Othman *et al.*, 2023).

## **5. The Italian ports classification and specialisation: the emerging geography**

The Italian Law 84/94 (Reorganization of port legislation) suggests the classification criteria that constitute the reference parameters. In particular, they regard the size of global traffic and its respective components, the operational capacity of the ports deriving from the functional characteristics (therefore considering the equipment for both loading, unloading, maintenance and storage of goods as well as equipment and services suitable for the supply, maintenance, repair and assistance of ships), the level and efficiency of services connecting with the hinterland (Monceri, 2019).

Therefore, considering the Italian case, a classification on a dimensional basis is proposed, as suggested at European scale and in compliance with the indications of national legislation. From a methodological point of view, for the identification of threshold values that are representative of the phenomenon investigated, it was considered appropriate to rely on the observation of traffic data of 48 national ports relating to the eleven-years 2012-2022.

The classification of ports can be identified based on a dimensional criterion: the average value of overall traffic (in weight) in the period considered. Therefore, in the light of this methodological choice, the threshold values and the relative size classes of ports are as follows:

- small (up to 1 million tonnes): 10 ports;
- medium-small (between 1 and 5 million): 13 ports;
- medium (between 5 and 10 million): 9 ports;
- medium-large (between 10 and 20 million): 7 ports;
- large (over 20 million): 9 ports.

This classification is based on the “dimensional aspects” of the ports traffic, but the “qualitative aspects” of the activity carried out are also relevant.

In light of this, from a methodological point of view, data from 48 national ports were found, processed and analysed, considering the weight values of total port handling and those disaggregated by type of goods and load. The analysis of data allowed us to identify a taxonomy of port specialisation, considering the share of traffic by type of goods/cargo compared to the total volume handled by the port.

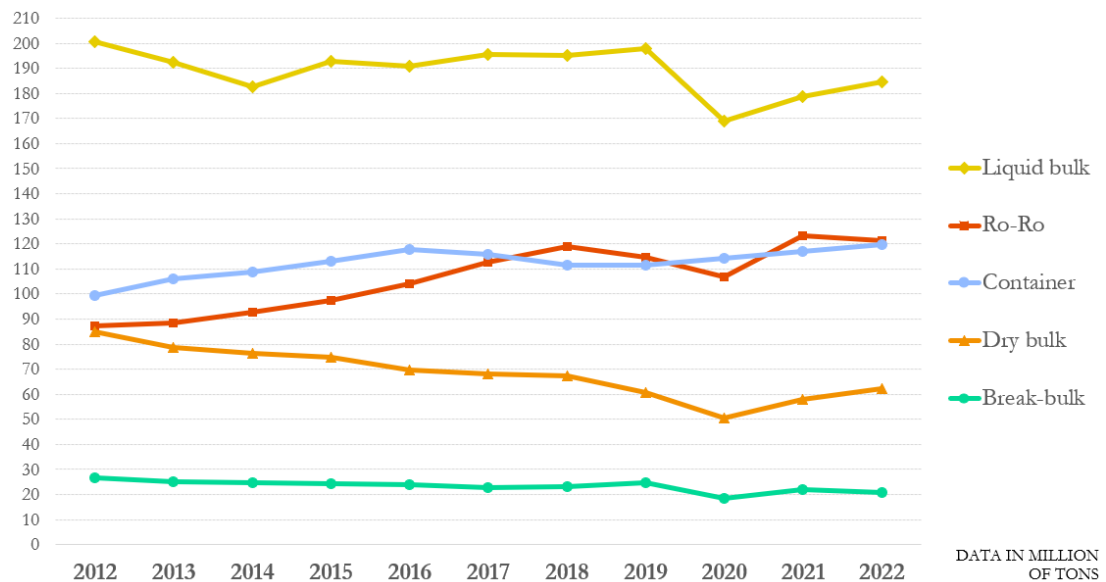
In particular, the following types of specialisation can be identified:

- Single-specialized bulk ports;
- Multi-specialised ports in bulk and break-bulk;
- Multi-specialised ports;
- Ports specialized in Ro-Ro;
- Ports specialized in containers.

Before proceeding to outline the scenario of Italian port specialisation, it is necessary to illustrate the recent trend of national maritime traffic, divided by type of cargo and handling methods (Fig. 3).

In the period 2012-2022, the Italian port system handled approximately half a billion tonnes per year. National ports manage all types of goods (Fig. 3), with a prevalence of liquid bulk cargo (37.9% on average in the period), followed by containerized goods (22.5%), rolling loads (21.3%), solid bulk cargo (13.7%) and finally other goods (4.7%). Considering the ten-year evolutionary path, it emerges that total maritime traffic is stable on average, however there are significant differences depending on the type of cargo (Fig. 2). In particular, the average variations in traffic in the aforementioned period are increasing for rolling loads (3.4%) and containerized goods (1.2%), with a slight contraction for liquid bulk cargo (-0.8%) and in decline for other goods (-2.4%) and especially for solid bulk cargo (-4.1%).

As regards the detail of the movement of bulk cargo, it should be underlined that liquid bulk cargo continues to represent the main product category, although decreasing in the period 2012-2022, with an average value of just under 190 million tonnes (Fig. 3). Traffic, characterized by a clear prevalence of imports, is related to the demand for refining petroleum products and the energy demand to be satisfied. The market is characterized by large volumes of goods and ports configured as the destination of supply flows directed to refining plants, warehouses and coastal sorting hubs. Maritime traffic of liquid bulk in recent years has progressively reduced (it was over 200 million tonnes before the global crisis of 2008-2009) due to a decline in national energy demand, which is to be considered structural as it derives from the decrease in industrial production, energy efficiency and diversification policies, reduction of consumption and dependence on imports (MIT, 2015).



*Figure 3: Maritime traffic in Italy (by type of cargo and handling).  
 Source: own elaboration on Assoport, ISTAT, Port System Authorities data.*

Maritime container traffic in Italian ports has grown significantly since the second half of the 1990s. The strategic position in the centre of the Mediterranean, the new Italian legislation, port privatization and the investment choices of maritime operators have favoured this growth.

Since the early nineties, both in Italy and in Europe there has been a strong growth in intermodality and, consequently, in containerized maritime traffic. The evolution of containerized traffic recorded in Italian ports highlights how it has almost quadrupled, going from around 3 million TEUs in 1995 to over 11 million 500 thousand TEUs in 2022. However, if we analyse in more detail the historical series relating to the trend of goods transported in containers, it clearly emerges that growth was very strong in the first decade (from the second half of the nineties until 2004), while it was relatively modest in the last twenty years. This is due to multiple reasons, including increasing competition from other Mediterranean ports, the impact of the global economic crisis and the Covid-19 pandemic.

Despite this, container traffic is significant, on average second only to liquid bulk cargo. In the period observed, container traffic went from 99 million tons in 2012 to 119 million in 2022 (Fig. 3).

The Ro-Ro traffic of the Italian ports in the past was strictly limited to connections with the islands (via Ro-Pax ferries and only partially via Ro-Ro ships) while in the last twenty years, it has seen strong development. In fact, it's an alternative to road transport on long routes both as a result of traffic congestion and due to the policy of European and national incentives (the so-called Motorways of the Sea). Therefore, the goods handled in national ports via combined maritime-road transport have grown from just under 75 million tons in 2005 to over 121 in 2022 (Fig. 3), with a progress of 61% (Assoport, 2012, 2023).

Considering the average values recorded in the period 2012-2022, there are numerous ports characterized by this type of traffic (Tadini, 2022a).

The dry bulk market is characterized by significant volumes of goods managed mainly by some large nodes linked to specific activities (power plants, steel plants, grain

supply chain, etc.). These are accompanied by multiple flows of so-called minor bulk cargoes which are generally managed by specialized terminals (MIT, 2015). Over the years, solid bulk traffic has seen a progressive and continuous reduction in volumes traded (Fig. 3). The global crisis of 2009 and the recession of 2012 accelerated the process of contraction in volumes that was already underway (they were over 90 million before the global crisis), worsening the consistency of the decline (-4.1% on average). This trend of traffic reduction is mainly attributable to the industrial crisis of the steel and cement factories, closed or reconverted, as well as the conversion of some power plants; this has dragged down the movement of the dedicated terminals which have lost more than twenty-five million tons in ten years.

It should also be highlighted that the movement of general cargo (break-bulk) is smaller but is vital for the logistics chains of various industrial districts. This kind of cargo over time has reduced its importance share (also due to the partial replacement with containerized cargo) but equally plays a strategic role. In particular, for project cargo Italy has a position of absolute importance on the international scene, with an evolution linked to the specialisation of operators and the export of technology and know-how (MIT, 2015). General cargo demand, which on average stood at around 23 million tonnes in the period 2012-2022 (Fig. 3), by its nature is very varied in terms of types of goods and origins/destinations and is often linked to industrial supply chains directly related to the port.

After outlining the recent configuration of national maritime traffic, it is possible to proceed to define the scenario of Italian port specialisation.

In particular, considering the taxonomy previously illustrated, the resulting port specialisation is configured as follows:

- Ports single-specialized in liquid bulk: 5;
- Ports single-specialized in solid bulk: 3;
- Multi-specialised ports in bulk and break bulk: 15;
- Multi-specialised ports: 17;
- Ports specialized in Ro-Ro: 8;
- Ports specialized in containers: 2.

The cartographic representation of dimensional classification and of this specialisation (Fig. 4) allows us to better outline the scenario of the national port geography.

The largest port category is that of multi-specialized ports (17 ports), followed by that of multi-specialized bulk ports (15 ports).

Multi-specialisation is a distinctive feature of national ports: in fact, those attributable to this typology are numerous and characterize both the North and the Centre-South of the country, both the Tyrrhenian and the Adriatic coast as well as the insular context of Sardinia. The largest ones are Trieste, Genoa, Cagliari, Livorno, Venice, Naples, Salerno, Civitavecchia, Brindisi and Ancona. In these ports there are high volumes of bulk cargo, accompanied by significant container handling and/or relevant Ro-Ro traffic.

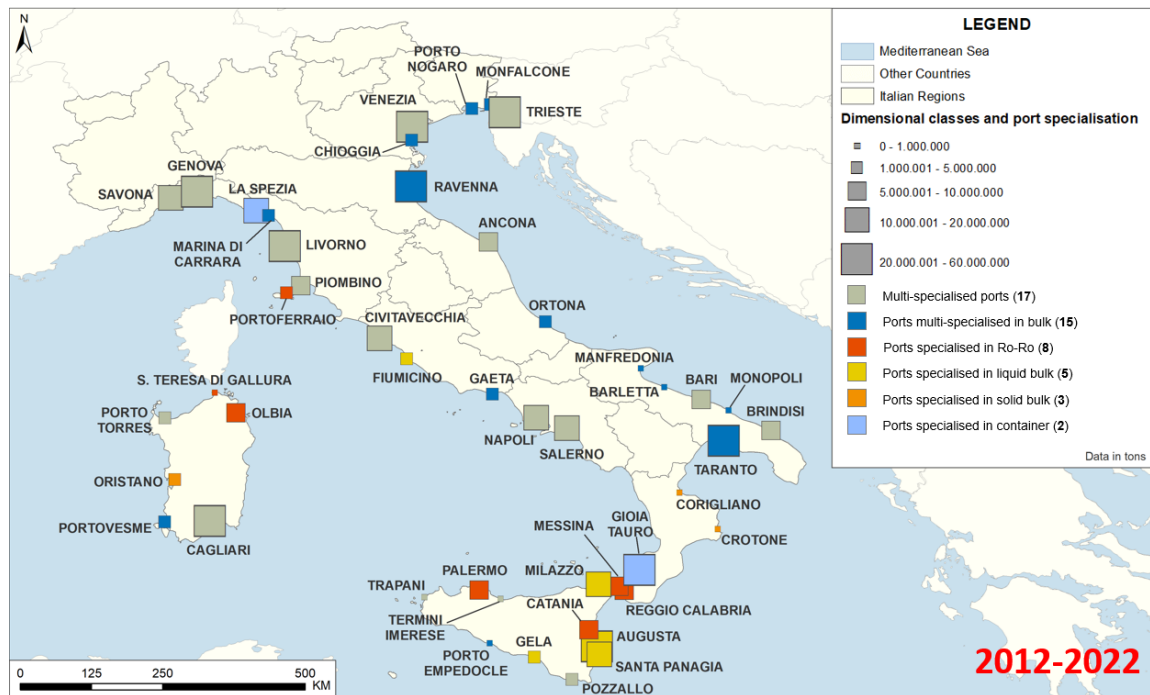


Figure 4: Italian ports specialisation.

Source: own elaboration on Assoport, ISTAT, Port System Authorities data.

The multi-specialized bulk ports that handle the largest quantities are two:

- Ravenna: petroleum, chemical and gas products (liquid bulk); agricultural products, foodstuffs, minerals, fertilizers, cement (solid bulk); metallurgical products and timber (general cargo);
- Taranto: petroleum products (liquid bulk); iron, coke and rubber (solid bulk); coils, tubes and sheets, towers and wind turbines (general cargo).

Five other ports handle significant quantities of bulk cargo:

- Monfalcone: cereals, coal, kaolin, metallurgical products (solid bulk); plant engineering, production for the aeronautical industry, timber, cellulose and paper rolls (break-bulk);
- Marina di Carrara: metallurgical products and marble (solid bulk); project cargo and stone minerals (break-bulk);
- Gaeta: refined petroleum products (liquid bulk); coal, minerals, wood pellets, fertilizers (solid bulk); components of the oil & gas sector, fruit and vegetables (break-bulk);
- Portovesme: chemical products (liquid bulk); coal, metallurgical products, chemical products and minerals (solid bulk);
- Porto Nogaro: iron and steel, sand, minerals and salt (solid bulk); project cargo, MDF panels and timber (break-bulk).

Considering the importance of the tons handled of liquid and solid bulk in our country, the number of ports specialized in liquid bulk (8) and those specialized in solid bulk (3) is not surprising.

Among the ports specialized in liquid bulk, the Sicilian ports dominate the national scene: Augusta, Milazzo, Santa Panagia and Gela. For these ports, traffic is configured

as a service to the nearby petrochemical hubs. The significant role of the port of Fiumicino, which serves the nearby refinery as well as the airport, should also be highlighted.

Ports specializing solely in solid bulk cargo are fewer in number and also handle smaller quantities of goods. These are in particular Oristano (cereals, foodstuffs, minerals) and two Calabrian ports (Crotone and Corigliano Calabro) for which relations with the biomass processing and cement industries are important.

Demonstrating the importance of Ro-Ro traffic in Italy, there are 8 ports with this prevalent specialisation. These ports are intuitively the island ones (in particular Catania, Palermo, Messina, Olbia and Portoferraio) and the continental ones (Reggio Calabria and Villa San Giovanni) which guarantee connections with the main islands. Finally, there are only two ports specialized exclusively in container traffic: Gioia Tauro, where the transshipment activity from larger ships to smaller ships for national or Mediterranean cabotage is significant, and La Spezia, where the connections with the production systems of the Po Valley are well developed.

## **6. Conclusions**

In recent decades there has been a significant increase in maritime container traffic and this trend has also affected Italy. However, it should be highlighted that the national port economy has its real strength in diversification.

For this reason, we chose to investigate the recent trend of Italian port traffic, considering the different types of goods (diverse bulk option) and handling methods (Ro-Ro and container).

The analysis carried out in the paper enables to assess the consistency and evolution of maritime traffic in Italian ports in the period 2012-2022, highlighting several specialisations and the resulting port geography. Furthermore, it consents to underline the centrality of the port nodes for their intermodal service function along the logistics chain, highlighting the strategic importance of bulk handling – even if characterized by a decline in movements – in light of its links with the coastal and hinterland production. In particular, the attention paid to port specialisation has highlighted how many ports play a key role in supporting specific supply chains. For the Italian territory, the strategic nature of maritime traffic is confirmed due to its service function to the national production fabric; incoming to allow the supply of raw materials and semi-finished products and outgoing to guarantee adequate support for the export of Italian production. This confirms the focal role of the port as an intermodal hub of the logistics chains of various product sectors, considering not only the movements of containerized goods and rolling stock but also the more traditional ones of bulk cargo. The recent escalation of the crisis in the Middle East and the consequent Houthi attacks in the Red Sea are penalizing the Italian production system. In particular, this geopolitical scenario is causing a reduction in the supply of essential products for Italian manufacturing and a slowdown in the export of national products, worsening the already declining trend in international trade.

Therefore, the impacts on maritime traffic (both containers and bulk) of the Italian ports are significant today and unfortunately are expected to increase in the coming months.



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