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OPENING THE SOUTHERN DOOR OF THE ITALIAN INLAND WATERWAY TRANSPORT NETWORK

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Abstract:
This paper illustrates the main features of the Italian Inland Waterway System and the possible role of Ravenna port, which is a major commerical port of the Adriatic Sea, as the Southern door of such system, with possible development of new river-sea services for dry bulk goods.

Key words:
Inland waterway transport, river-sea transport, seaports, bulk cargo.

INTRODUCTION: THE MAIN ADVANTAGES OF WATERBORNE TRANSPORT

Waterborn transport for freight, carried by sea as well as natural and artificial inland waterways, shows low unit costs for users, compared to other transport modes. Indeed, waterborne transport requires low energy consumptions. For instance, 1 kW of power is capable of transporting 150 kg of goods by road and 370 kg of goods by rail, while the same amount of power can transport up to 3 tonnes of goods on water [1], [2].

The low energy consumptions are directly connected to another important advantage of waterborne transport, which is vital for the environment, i.e. the generation of low emissions of both greenhouse and polluting gases. The external costs of inland waterway transport are the cheapest ones among all transport systems, even considering the costs for the construction and maintenance of the infrastructures [6].

Safety is another point of strenght of waterborne transport: accidents are very rare, at least in the US and in the European Union. Studies confirm that the level of safety of this system is much higher than the level of safety reached by rail as well as road transport systems, when considering the number of accidents, injuries and deaths. For this reason, inland waterway systems are suitable also for transporting dangerous goods [7].

Both EU and US inland waterway systems show huge amounts of spare capacity and, therefore, could be a sound alternative, able to decrease the congestion that usually characterises road networks. Naturally, by definition, waterborne transport inherently requires multi-modal operations, in combination with road transport services and infrastructures, so that freight can cover the "last mile" and door-to-door services can be provided to clients [3].

1 THE ITALIAN INLAND WATERWAY SYSTEM

The Italian Inland Waterway System forms a network whose links show a total lenght of 957 km (Fig. 1.1), among which 812 km of waterways are currently open to traffic and 564 km are in operation for commercial purposes.

***Fig. 1.1** Map of the Italian Inland Waterway System and list of locks (source: www.navigaportinterni.it, with modifications)*

Po River, together with the Fissero-Tartaro-Canalbianco Canal, are the backbone of the Italian Inland Waterway System. After the new basin of Isola Serafini is completed, 37 km of new waterways will be added to the current network, linking Cremona to Piacenza. Over 60% of the works have been already performed and the new infrastructures are estimated to be put in operation by the end of year 2017.

The most important inland ports of the Italian Inland Waterway System are Mantua, Boretto, Porto Nogaro and the freight village of Rovigo, which combines waterborne with rail and road transport systems. In addition, all the major Italian seaports of the North Adriatic

Sea, i.e. Venice, Chioggia, Ravenna, Monfalcone and Trieste, are nodes of the Italian Inland Waterway System, being either connected or connectable to the main inland ports by regular river-sea services [4], [5].

The Italian Inland Waterway System is included in the TEN-T network, as defined by the EU transport policy initiatives, with particular reference to the following Corridors (Fig. 1.2):

- Baltic-Adriatic;
- North Sea-Baltic;
- Scandinavian-Mediterranean.

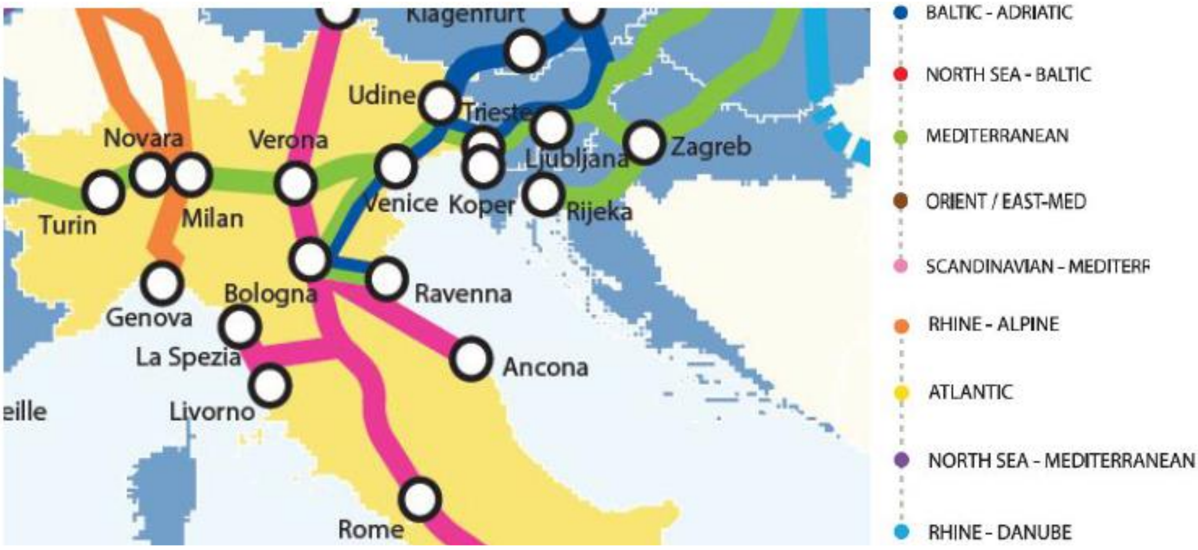

Fig. 1.2 *Map of TEN-T Corridors crossing the North of Italy (source: http://ec.europa.eu/transport/home_en)*

Commercial inland waterway services can be operated 360 days per year, along the Fissero-Tartaro-Canalbianco Canal, the Po di Levante Canal, the Mincio River, from Mantua to the Po River (via Governolo), and along Idrovia Ferrarese. On the other hand, commercial navigation is open for about 200 days per year along the Po River.

The number of days when sea-river navigation is possible to connect the inland ports of the Italian Inland Waterway System with the Adriatic seaports of Monfalcone, Trieste and Ravenna depends on the type of vessel in operation and its actual load factor.

Table 1.1 shows the main infrastructural characteristics of the Italian Inland Waterway System, with reference to the classification by the European Conference of Ministers of Transports (CEMT). The main links of the network fulfil the requirements for being included in the Class V by CEMT, with the following exceptions: Mincio River (CEMT Class III), Po River, from Piacenza to Cremona (CEMT Class IV) and Idrovia Ferrarese (CEMT Class IV).

Tab. 1.1 indicates that vessels with the following maximum dimensions can sail the main trunks of the Italian Inland Waterway System:

- 95-110 m of length;
- 11.50-12.00 m of width;
- 2.50-2.80 m of water draft;
- 5.25 m of air draft, which is enough for a double order of containers to be transported (only in some sections the maximum air draft is equal to 6.80 m, which is enough for a triple order of containers to be transported).

The most demanding constraints to be respected for operating commercial services are

- the air drtaft, for what concerns the navigation along Fissero-Tartaro-Canalbianco Canal;
- the water draft, for the navigation along Po River.

Tab. 1.1 *– The main infrastructural characteristics of the Italian Inland Waterway System (source: AIPO)*

Link	**Length (km)**	**CEMT Class**		**Draft (m)**		**Air Draft (m)**	
		Current Class	*After works*	*Current value*	*After works*	*Current value*	*After works*
Po River							
Piacenza-Cremona	37	IV	V	1.60	2.00	7.00	7.00
Cremona-Boretto	70	V	V	1.60	2.00	7.00	7.00
Boretto-Mincio outfall	59	V	V	1.80	2.00	7.00	7.00
Mincio outfall-Pontelagoscuro	71	V	V	1.60	2.00	7.00	7.00
Pontelagoscuro-Volta Grimana	60	V	V	1.80	2.00	7.00	7.00
Fissero-Tartaro-Canalbianco							
Mantua-Rovigo	86	V	V	2.50	3.00	5.25	5.25
Rovigo-Porto Levante	31	V	V	2.50	3.00	5.80	6.50
Porto Levante	18	V	V	2.50	3.00	7.00	7.00
Canale Po-Brondolo	19	V	V	2.50	3.00	4.70	6.50
Mincio River							
Mantua-Mincio outfall	21	III	III	2.00	2.00	5.75	5.75
Idrovia Ferrarese	70	IV	V	2.50	3.00	4.00	5.25
Cremona-Pizzighettone	14	V	V	2.50	3.00	6.50	6.50

On one hand, the Italian Inland Waterway System shows a set of infrastructural parameters that could regularly serve relevant volumes of traffic. On the other hand, the number of motorships and barges belonging to CEMT IV and V classes, which are currently in operation along the network, are less than 5. Indeed, at the time being, the Italian Inland Waterway System is served by:

- a few convoys, composed by a towboat and a barge, with a deadweight of 1000-1200 tonnes;
- a dozen of small motorships for the transport of construction aggregate along Po River.

Tab. 1.2 shows the most recent traffic data, which are available and refer to year 2014. They indicate that the Italian inland waterway traffic has significantly decreased, reaching a value of approximately 260000 tonns of goods in 2014. This drop in traffic is mainly due to the difficulties faced by the Italian economic and industrial system, with particular reference to the building sector.

The main categories of goods, which have been transported, in recent years, along the Italian Inland Waterway System, are chemical products, cereals and other agricoltural dry bulk cargo, construction materials, exceptional industrial loads.

Despite containerised traffic has decreased to 10000 TEUs in 2014, the most important nodes connected to the Italian Inland Waterway System appear to be the ports of Venezia and Chioggia, while no sea-river traffic has been registered at Ravenna port in recent years.

Table 1.2 *Traffic data registered in the inland ports and quays of the Italian Inland Waterway System, from 2011 to 2014 (source: AIPO; acknowledgments: Ing. Ivano Galvani)*

Unloaded/loaded goods (tonnes)	**2011**	**2012**	**2013**	**2014**
Port of Rovigo (via Fissero)	13767 (flour)	/	121892 (flour)	45000 (flour)
Chioggia (via Brondolo Canal)	/	/	/	2500 (various goods)
Port of Mantua-Valdaro (via Fissero and Po River)	83250 (flour) 46000 (steel coils and containers)	22525 (flour) 70000 (containers)	75000 (flour) 40000 (containers)	45000 (flour) 25000 (urea) 10000 (containers)
Private industrial quays in Mantua (via Fissero and Po River)	9848 (fuel) 8747 (exceptional loads)	19054 (fuel) 3446 (exceptional loads)	17510 (fuel) 4014 (acetone) 4000 (exceptional loads)	31000 (acetone) 4500 (exceptional loads)
Quay of Viadana (via Po River)	49919 (methanol)	30188 (methanol)	9780 (methanol)	30000 (methanol)
Port of Cremona (via Po River)	19000 (flour) 7026 (ferrous materials) 2534 (exceptional loads)	7020 (flour) 1063 (exceptional loads)	2664 (exceptional loads)	/
Quays in the area of Mantua (°)	160000 (aggregates)	126000 (aggregates)	120000 (aggregates)	70000 (aggregates)
TOTAL (§)	400091	279296	394860	263000

(§) The data presented in this table do not take into account the aggregates transported by private industries along Po River, which were equal to: 1 million tonnes in year 2011, 800000 tonnes in 2012, 300000 tonnes in 2014 (no data are available with reference to year 2013).
(°) Estimates of loaded/unloaded goods at: Roncoferraro (via Fissero), San Benedetto Po and Revere (via Po River).

2 THE PORT OF RAVENNA

The port of Ravenna is an Italian seaport located in the Adriatic Sea (Lat. 44° 29' North and Long. 12° 17' East of Greenwich, Fig. 2.1). Port quays are located along Canale Candiano, i.e. a canal whose length is equal to 14 km through the inland (Fig. 2.2). Freight traffic at the port of Ravenna registered a rapid growth immediately after the Second World War, as a consequence of the settlement of a large petrochemical pole.

The port of Ravenna is characterised by:

- a total area of 2050 hm^2;
- a maximum draft of 10.50 m;
- 24 km of docks with 163 mooring points;
- 26 cargo terminals, among which a container terminal with a capacity of 300000 TEUs per year;
- 7 passenger terminals;
- a total area of 140 hm^2 available for storage of goods;
- a total area of 2800000 m^2 of covered warehouses;
- a total volume of 1340000 m^3 for the storage of dry/liquid bulk in tanks;
- a total length of 205 km of railways.

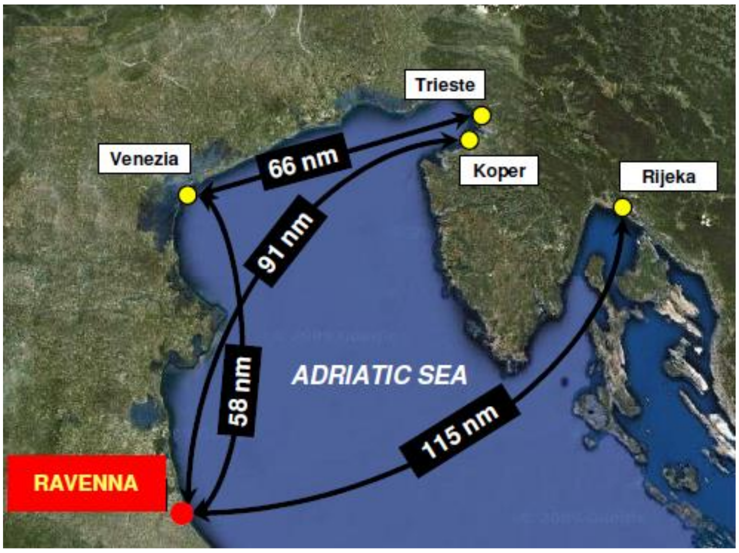

Fig. 2.1 *The port of Ravenna and its location in the North Adriatic Sea (1nm = 1 nautical mile = 1852m; source: Port Authority of Ravenna, with modifications)*

Figure 2.2 *Aerial view of Ravenna port (source: Port Authority of Ravenna)*

The port of Ravenna is located in one of the most urbanised and economically dynamic areas of Europe, i.e. Pianura Padana, which corresponds to its main inland catchment area. On the other hand, the most important international market of Ravenna port corresponds to the cluster of the Eastern Mediterranean and Black Sea ports, with possible prosecution to India and the Far East.

Ravenna port is classified by the EU as a "core port", in the framework of Trans-European Transport Network (TEN-T, Fig. 1.2), and it represents the Southern door of the Italian Inland Waterway Systems. Indeed, Ravenna port can be connected to Po River and Fissero-Tartaro-Canalbianco Canal, through river-sea transport services sailing a route of 75 km along the Adriatic Sea (via Porto Levante).

To date, Ravenna is one of the most important ports in Italy, for what concerns the transport of cereals, fertilizers, animal feed and raw materials for ceramic industry. It also represents an important seaport for unitised and various goods, such as timber and metallurgical products, and for Motorways of the Sea lines (ro-ro traffic mainly, to/from Sicily and Greece).

During 2014 and 2015, the port of Ravenna has exceeded 24 millions of tonnes of annual handled goods (Fig. 2.3), with a value of more than 20 millions of tonnes referred to unloaded goods. Indeed, imported goods at Ravenna port are much more than exported goods.

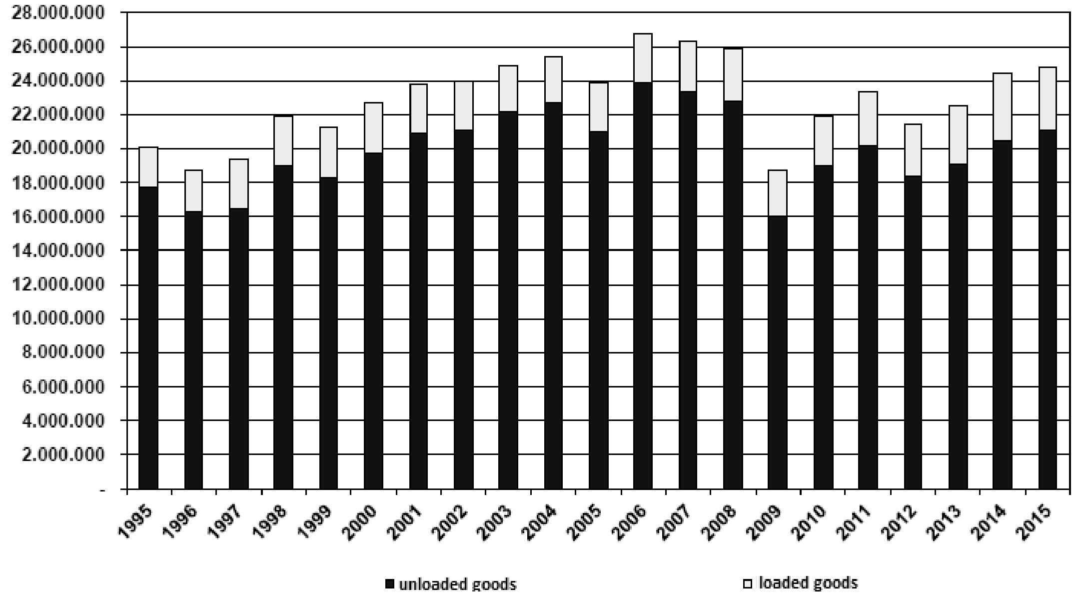

Fig. 2.3 *Freight traffic at Ravenna port from 1995 to 2015, in tonnes of goods loaded and unloaded (source: Port Authority of Ravenna)*

Table 2.1 shows freight traffic data at Ravenna port, classified by category of goods and with reference to year 2015. Dry bulk traffic in 2015 exceeded 10 million of tonnes. Containers loaded and unloaded largely exceeded 2 million of tonnes (in terms of mass), corresponding to 245000 TEUs. In 2015, rolling stocks reached the value of 70000 unities.

Tab. 2.1 *Freight traffic data, registered at the port of Ravenna in 2015 (source: Port Authority of Ravenna)*

Thousands of tonnes of unloaded and loaded goods (year 2015)		
Liquid bulk		4228
Dry bulk		10092
Various goods	In container	2531
	Ro-ro	1592
	Other	6297
	Total of various goods	10420
Grand total		24739

Recent studies co-financed by the EU in the framework of the “Adriatic Gateway” project, show a significant potential of growth for the North Adriatic ports, with particular reference to containerised traffic. Such studies present a forecast of a total amount of 33.75 millions of tonnes of freight loaded and unloaded at Ravenna port in year 2030 (*source: NAPA, www.portsofnapa.com*).

3 POTENTIAL FOR THE DEVELOPMENT OF RIVER-SEA CARGO SERVICES AT RAVENNA PORT

Tab. 2.1 indicates that, in year 2015, more than 14 millions of either dry or liquid bulk cargo were handled at Ravenna port. Such types of goods, generally speaking, are suitable to be transported from/to the inland nodes by river-sea services.

As an estimate, in 2015, at least 250 weekly trips were performed by trucks, from Ravenna to the areas close to Mantua city, along a road distance of 180 km (for a one-way trip, via Ferrara or Bologna) carrying agricultural dry cargo. Under a purely technical point of view, the latter (only-road) trips could have been replaced, in their main leg, by a regular river-sea service operated, twice a week, by suitables CEMT Class V barges, along the following itinerary:

- a sea route from Ravenna to Porto Levante (75 km of length);
- an inland waterway route from Porto Levante to Mantua-Valdaro inland port (135 km of length, along Fissero-Tartaro-Canalbianco Canal);
- a road “last-mile” leg, from the port of Mantua-Valdaro to the final destinations, (25 km of length, on average).

For such a kind of river-sea service, a CEMT Class V convoy, composed by a towboat and two barges could be operated. The towboat (Fig. 3.1) could push (along the inland waterway leg) and pull (along the sea route) the two barges along the whole itineray between Ravenna and Mantua-Valdaro ports, by using a power equal to 1.0-1.2 MW and providing a total hold capacity of about 1000-1200 m^3.

Such a type of convoy could sail sea waters, from Trieste to Ravenna, within 3 nautical miles from the coast (that are equivalent to 5.55 km) under the following weather conditions, which can be estimated to be satisfied for a time interval of about 300-310 days per year:

- a wind not stronger than grade 3 of the Beaufort scale;
- 1 meter of maximum wave height;
- adequate visibility, in case of fog.

Figure 3.1 *An example of towboat that could be used to connect Mantua and Ravenna port by river-sea transport (property: River Service s.r.l)*

A one-way trip from Ravenna to Mantua-Valdaro port, operated by a convoy of the type described in this paragraph, would take a total duration of 21 hours, because of:

- 6 hours of maritime navigation, from Ravenna to Porto Levante (75 km);
- 15 hours of inland navigation, from Porto Levante to Mantua-Valdaro (135 km).

Overall, a round trip would take 56 hours to be completed, including the time to be spent at the nodes for transport operations, so that up to two weekly round trips could be operated between the port of Ravenna and Mantua-Valdaro, given the availability of one convoy.

Instead of a convoy, a self-propelled sea-river vessel could also be rented by the European market and put in operation, provided that it could be characterised by a maximum air draft value of 5.25 m.

4 CONCLUSIVE REMARKS

In recent years, freight traffic along the Italian Inland Waterway System has shown a significant decrease and the CEMT Class V vessels available in Italy for river and river-sea services are now reduced to a very small number of units. On the other hand, the EU transport policy promotes the implementation of initiatives in order to shift traffic from only-road to green modes, such as waterborne transport

In addition, the port of Ravenna, which is the Southern door of the Italian Inland Waterway System, handles a lot of bulk products, with particular regard to agricoltural goods, whose origins and final destinations see the surroundings of the city of Mantua as important nodes. Indeed, these types of goods are very well suited for river-sea transport services.

At the time being, the unit price of a river-sea link from Ravenna to Mantua (with transhipment of goods onto trucks for covering the "last mile") is still higher than the unit price of the only-road solution. However, this difference can be estimated around 2 €/tonnes of dry bulk goods, on average.

In this framework, if the government (either at national or at regional level) could extend the "Marebonus" and "Ferrobonus" subsidies, which are currently activated or under study for the Motorways of the Sea and the rail cargo services, to the inland waterway transport, this price differential will probably be eliminated. In the latter case, it will be possible, to activate economically viable and environmentally sustainable river-sea services from Ravenna to Mantua, with possible re-activation of investment processes regarding the Italian inland waterway fleet.

Basically, the main obstacles that currently prevent a significant modal shift from road to river and river-sea transport in Northern Italy appear to be mainly related to lack of investment regarding fleet, to organisational/administrative bottlenecks and to unfair competition by road transport, while waterways can provide huge reserves of under-utilised capacity.

In brief, the following key points can be considered to be very important, in order to promote relevant modal shift from the road to the Italian Inland Waterway Network:

- to support financial instruments capable of sustaining the development of a renewed fleet of CEMT Class V river-sea vessels, characterised by low energy consumptions and low air emissions, as well as compatible with the local infrastructural constraints;
- to overcome the administrative bottlenecks, which cause a lot of disadvantages in terms of costs, compared with other modes of transport;
- to make the competition between road and waterway transport systems fairer, through the implementation of effective measures for checking the full respect of drive rules by truck operators and the compensation of the higher external costs caused by road transport, compared to river-sea transport.

Shifting goods from road-only to inland waterway services is higly desirable, as this means promoting a cheap and "green" mode of transport, which can lead to relevant savings for the collectivity, in terms of external costs related to transport operations.

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