Land transport infrastructures servicing Ligury's ports: a potentiality analysis

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In this study, road, highway and railway infrastructures that are linked to the ports of Savona, Genoa and La Spezia are briefly presented. An estimate of the transport capacity of these infrastructures is developed, with the aim of comparing it with the forecasts of the increase of harbour traffic; this leads to assessing the residual potentiality in the period 2000-2010. Analysis results point out various critical situations, especially for what concerns road transport. Therefore, a gradual redistribution is proposed from road to rail mode that still offers a noticeable residual potentiality, despite of its extensive utilisation of some sections. Lastly, the role that a more strict integration of maritime ports, according to the harbour system concept, can have in enforcing the railway mode is mentioned.

1. Introduction

During the last few years, Ligurian harbours have been influenced by a maritime transport developing process, that had a particularly booming trend in the Mediterranean. Italian ports position grew stronger in world transport markets, thanks to a renewed competitiveness. Despite of the growing importance ascribed to transhipment and short sea shipping, the land forwarding of goods still represents a fundamental ring in the logistic chain. Consequently, the inadequacy of terrestrial transport systems can compromise the development of maritime ports; in particular, for what concerns Ligury, both highway and railway infrastructures seem to be inadequate to support the continuous raises of ordinary and heavy traffic, this fact being caused by the attitude to tourism of the region and by the unsatisfying profile and alignment of the communication ways, because of the complex orography of the territory.

2. A description of the three Ligurian ports

Ligurian main ports are Savona-Vado, Genoa and La Spezia, that are under the control of Port Authorities. Fig. 1 shows the behaviour of the goods that moved in the three Ligurian ports during the last five years. Hereafter we briefly describe the three maritime ports.

2.1 Savona-Vado

Savona-Vado complex is composed of two docks: in the west, the haven, with industrial plants and the new Vado harbour; in the east, Savona goods-station that has been active for 22 centuries.

Savona basin is provided with 60 hectares of protected stretches of water, about 39 hectares of land, 4012 linear meters of quays and 20 certified moorings, with shoals that range from 6.5 to about 16 meters.

Each area of the port has a precise destination; within custom's yard, a 14 floors parking has been built that can contain 2800 vehicles; it is currently used as a city park. A car terminal with a surface of 21000 m² is operative; a warehouse for cold-rolled and galvanised materials guarantees stocking of 15,000 tons of products. Two terminals and storehouses for cellulose and forest products are able to contain over 50,000 tons of products; a cable way is used for quickly unloading goods in bulk, that is composed of two 18 km long lines that can carry coal and minerals beyond the Appennini towards the great storehouse of San Giuseppe di Cairo; the cable way is provided with a covered warehouse; lastly, on Calata Boselli a cereal storage bin that can contain 60,000 m³.

The Darsena Alti Fondali (D. A. F.) is noticeable, since it is operative in the field of ro-ro and miscellaneous goods traffics and in the first places for what concerns berthing deepness.

In Fig. 2 the modal division of goods outward traffic relative to the port of Savona is shown [1]. The predominance of pipeline transport reflects the importance that liquid goods have in the moved goods categories.

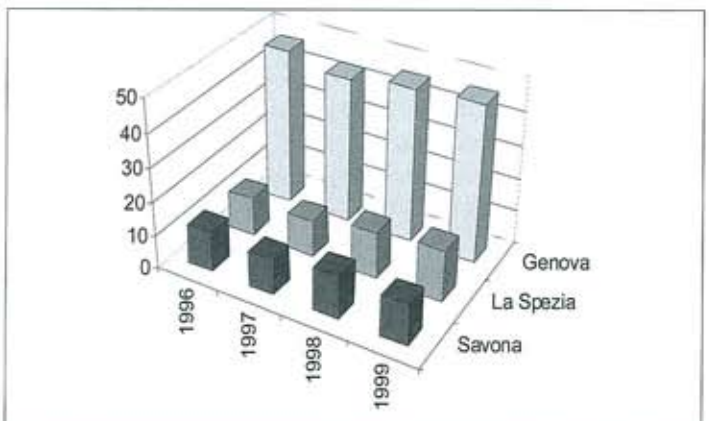

Figure 1 – Ligurian ports traffics trend in millions of tons

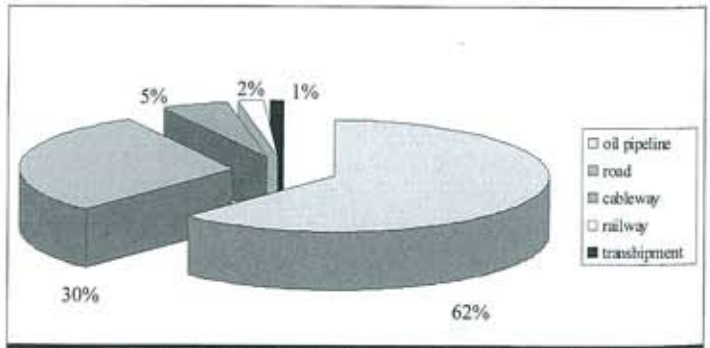

Figure 2 – Modal split of goods outward traffic relative to port of Savona

2.2 Genoa

Situated at Latitude 40° 24' 15" North and Longitude 8° 54' 20" East in the most protected basin of Ligurian Sea, the port of Genoa is situated onto an area of about 500 hectares, distributed on a coast of about 20 km. 18,000 meters of operative quays, draughts that go from 9 to 15 meters with a peak of 50 meters for VLCC are the main concerns of a maritime port that can handle every kind of ship or goods.

The Port is the natural sea outlet of Northern Italy most industrialised area and is situated in an ideal position to service the industrial device and the central-European markets. As for inter-continental trades, the ships that directly touch at Genoa shorten their path of more than 1,500 miles with respect to the lines that call at the ports of Northern Europe. This strategic position is ideal for the courses towards North Africa, towards countries facing the East Mediterranean basin and for all of the transhipment services. A growing number of regular lines links Genoa with every port of the world. The port is equipped with an internal 70 km long rail network and 50 km of roads. The main terminals are directly connected to the railway through links that avoid passenger stations.

Fig. 3 shows the modal distribution of outwards goods trade relative to the port of Genoa [2].

2.3 La Spezia

The particular location of the port of La Spezia denotes the fact that it is a natural port; it is situated at the extremity of a deep gulf, full of little inlets and directed on an axis North-West/South-East.

Inside of a haven of about 1,500 hectares, the port of La Spezia is provided with 5,100 meters of quays and 575,000 m² of available areas; there are 17,000 meters of railways and 3,500 meters of cart-ways; the haven is protected by an outer breakwater of about 2,200 meters that insures port's everyday operation. The maximum draught is 14 meters, thus allowing the berthing of the newest containerships. The terminals are provided with cranes that can lift up to 100 tons and covered warehouses with a surface of 13,000 m². Two container terminals, three multipurpose terminals, a coal terminal, a GPL terminal, two cereal terminals, one alimentary oils terminal, a bulk terminal and two cement terminals are active, together with specialised equipment.

Fig. 4 shows the modal distribution of outwards goods trade relative to La Spezia port [3].

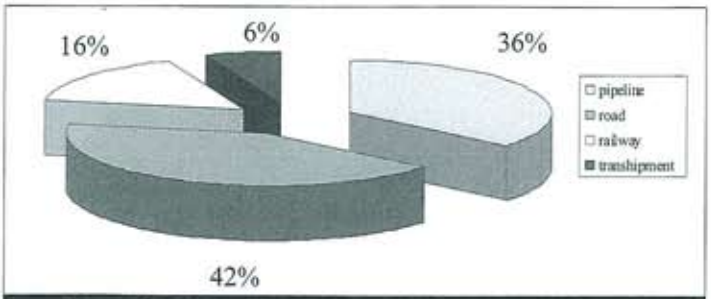

Figure 3 – Modal distribution of outwards goods trade relative to Genoa port

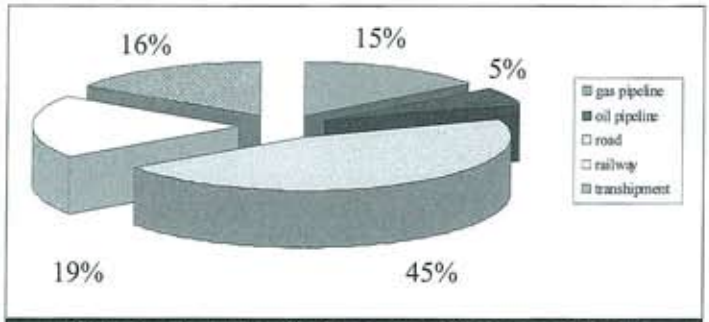

Figure 4 – Modal distribution of outwards goods trade relative to La Spezia port

3. Transport infrastructures for Ligurian ports

3.1 The highway

Highway infrastructures that are connected to the ports of Genoa, Savona and La Spezia are composed of the following sections:

- Highway A6: section Savona - Torino
- Highway A26: section Voltri - Alessandria
- Highway A7: section Genova - Serravalle Scrivia
- Highway A15: section La Spezia - Parma
- Highway A10: section Savona - Ventimiglia
- Highway A10: section Savona - Genova
- Highway A12: section Genova - Sestri Levante
- Highway A12: section Sestri Levante - Pisa

Fig. 5 schematically represents Ligurian highway network and the sections to the hinterland.

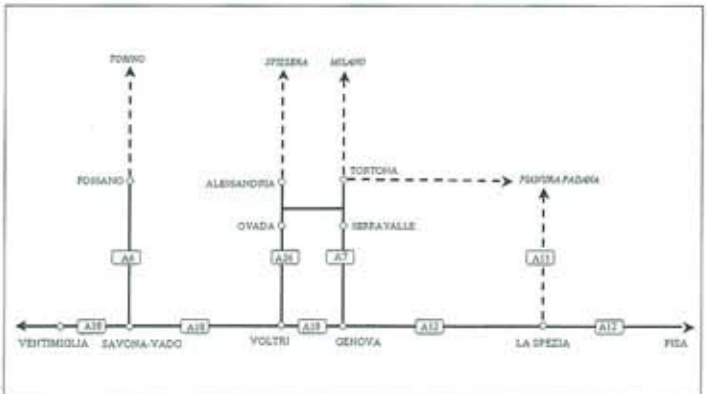

Figure 5 - Ligurian highway network

	1995	1996	1997	1998	1999
Savona - Torino	635	680	720	740	781
Genova Voltri - Alessandria	1487	1496	1497	1613	1667
Genova - Serravalle Scrivia	1349	1352	1402	1395	1448
La Spezia - Parma	1029	1014	1079	1114	1147
Savona - Ventimiglia	1240	1270	1323	1390	1466
Genova - Savona	2254	2297	2387	2428	2473
Genova - Sestri Levante	2073	2084	2159	2176	2260
Sestri Levante - Pisa	1435	1440	1527	1577	1654

Table 1 - Theoretical average numbers of vehicles per hour relative to the considered road sections

In Tab. 1 the theoretical average numbers of vehicles per hour relative to the considered road sections are reported. These information have been provided by AISCAT (Association of Italian Societies dealing with Highways and Tunnels Concessions) and have been obtained from a new elaboration on the actual number of running vehicles [4]. The theoretical vehicle number represents the amount of vehicles that ideally, running along the whole highway, generates a vehicle¥km product equal to those effectively occurred along different portions of the considered highway.

3.2 National road system

Ligurian national road network is distributed on the coast. It is composed by the S.S.1 "Aurelia" and a certain number of links from this to the hinterland. The main links are relative to the three ports; Savona is linked with the S.S.29 "Colle di Cadibona" that is connected also with the provinces of Alessandria, Torino and Cuneo, across the Appennino. From Genoa, both the S.S.35 "Dei Giovi" and the S.S.456 "Del Turchino" lead to Alessandria province. Finally, from La Spezia the S.S.62 "Della Cisa" provides a link to Emilia. The difficult orography of the territories that are crossed by the mentioned roads strongly reduces their use. On the other hand, the S.S.1 represents the main non-highway road; it has an inter-regional importance too. On the whole, it presents uniform characteristics, without sudden changes in slope or roadway width, so that it allows to be smoothly run along. This national road has been enlarged and straightened in some parts; during the past years, these improvements gave a boost to the performance.
However, the great number of crossed towns and the intense local traffic reduce the potential of this road in being used for the medium and long distance traffic.

3.3 Railway network

Ligurian railway network is composed by these lines:
- Genoa - Savona - Ventimiglia
- Genoa - La Spezia
- La Spezia - Pisa
- La Spezia - Pontremoli - Parma
- Genoa - Ronco Scrivia - Arquata Scrivia - Torino (- Milano)
- Genoa - Ovada
- Savona - S. Giuseppe di Cairo (via Ferrania e via Altare)
- S. Giuseppe di Cairo - Ceva
- S. Giuseppe di Cairo - Acqui Terme (- Alessandria)
- Ventimiglia - Cuneo

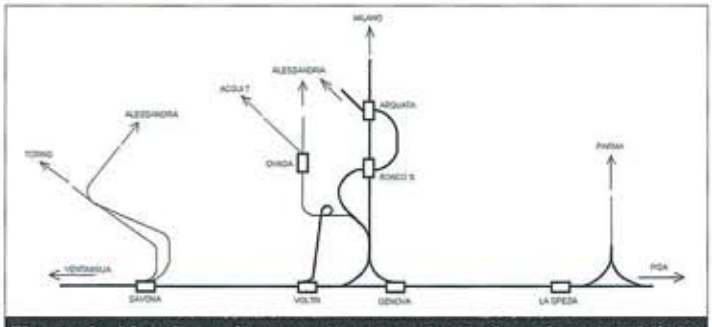

Figure 6 - Ligurian railway network and relative hinterland links

All of the lines use the electric traction (3000V dc) with the exception of the last one, that uses Diesel traction; all of these can be divided into three groups:

1. coastal railway
2. lines that link Genoa with the provinces beyond the Appennino, in Piedmont
3. links between Savona and its hinterland
4. links from La Spezia

The international railway of Ventimiglia-Cuneo, characterised by a layout partially situated in France, is less important in respect to the most important Ligurian traffics. The excessive slope, the poor alignment and the lack of electrification reduce this line potentiality.

4. Study of the potentiality of the links between ports and hinterland

4.1 Highway network

On the basis of the data collected in Tab. 1, some traffic expectations have been calculated using a linear regression model. Results are displayed in Tab. 2.

	2000	2002	2004	2006	2008	2010
Savona - Torino	817	888	958	1028	1098	1169
Savona - Ventimiglia	1509	1624	1738	1853	1967	2081
Savona - Genova	2538	2652	2766	2880	2994	3107
Voltri - Alessandria	1695	1790	1886	1981	2077	2172
Genova - Serravalle Scrivia	1461	1510	1558	1606	1654	1702
Genova – Pisa						
Genova - Sestri Levante	2290	2383	2477	2570	2663	2756
Sestri Levante – Pisa	1699	1814	1929	2044	2159	2274
La Spezia – Parma	1177	1245	1312	1379	1446	1513

Table 2 - Expected vehicles per hour in each road section

The residual capacities estimate process that is suggested in the Highway Capacity Manual [5] is based on the computation of the service levels and consists of the following steps:

1. division of the highway in sections, characterised by almost uniform capacity conditions.
2. determination of the capacity for each section, using the formula:

$$c = 2000 * N * f_w * fh_v * f_p$$

where:
- c = capacity (number of vehicles, mixed total traffic in one direction)
- N = number of lanes
- f_w = correction factor that takes into account for the lane width and lateral obstacles distance
- f_{hv} = heavy vehicles factor (takes into account for the percentage of heavy traffic in the traffic flow)

f_p = correction factor that considers the presence of habitual, sporadic, week-end drivers and some facts connected with rush-hours.

3. determination of the flow-capacity ratio, based on the flow values displayed in Tab. 2.
4. determination of the service level using the flow diagram curves, to be read using the flow-capacity ratio values calculated at the last step.

The results of this method are contained in Tab. 3 that reports the evolution of service levels in a time domain; they are ranked from A to F where A represents the best road condition and F the worst one.

	2000	2002	2004	2006	2008	2010
Savona – Torino	C	C	C	D	D	D
Savona – Ventimiglia	C	C	C	C	C	C
Savona – Genova						
Savona – Varazze	D	D	D	D	D	D
Varazze – Voltri	B	B	B	B	B	B
Voltri – Genova	D	E	E	E	E	E
Voltri – Alessandria	B	B	C	C	C	C
Genova - Serravalle Scrivia	D	D	D	D	D	D
Genova – Pisa						
Genova - Sestri Levante	C	D	D	D	D	D
Sestri Levante - La Spezia	B	B	C	C	C	C
La Spezia – Pisa	B	C	C	C	C	C
La Spezia – Parma	C	C	C	C	C	C

Table 3 - Expected service levels on highways

This table suggests various potentially critical situations; in fact, level D represents a condition that is close to unstable flow (likely slowdowns, freedom to manoeuvre restricted) and level E corresponds to the maximum exploitation of the theoretical capacity, with possible instability and periodical stops.

4.2 National road systems

In order to estimate the residual capacity of non-highway roads, the following methodology has been exploited:

1. for the critical sections of each road (indicated by the Ligurian Region [6]), the theoretical service flow Q has been calculated. Q is relative to the level E and depends on the ideal road capacity Ci and other factors such as overtaking free visual, presence of obstacles to continuous flow, lane and footpath width.
   The used formula is:

$$Q_s = C_i\,(Q/C)_i * f_1 * f_2$$

where:
- C_i is the ideal capacity, chosen to be 2800 vehicles per hour
- $(Q/C)_i$ is the ratio between service flow and ideal capacities as function of service level, overtaking free visual and kind of road
- f_1 is the correction factor that depends on lane and footpath width
- f_2 is the correction factor that depends on the presence of inconveniences to uninterrupted flow.

2. rush hour and average day-time saturation coefficients S_{hp} and S_d are calculated using the following formulas:

$$S_{hp} = F_{hp} / Q_s$$

where:
- F_{hp} is the rush hour measured flow
- Q_s is the theoretical capacity, set equal to the service flow $S_d = F_d / Q_s$ being F_d the average per hour day-time flow.

Service levels LS_i	*Saturation coefficient* S_i
A	0,15
B	0,27
C	0,43
D	0,64
E/F	> 0,64

Table 4 - Service levels as function of saturation coefficients

3. The values previously calculated are compared to those in Tab. 4, thus giving the service level LS_{hp} that is relative to rush hour and also LS_d, relative to the average day-time conditions.

LS_d	LS_{hp}	*Congestion risk*
A - C	A - C	Low
A - C	D - F	Medium
D - F	D - F	High

Table 5 - Connections between service levels and congestion risk

4. comparing the values of the two service levels previously calculated, the congestion risk of each section can be derived as in Tab. 5.

The results of this method are resumed in Tab. 6; it appears that the situation is already difficult for many sections. We particularly point out the critical situations of Vado Ligure and Savona sections, that are the accesses to the province from West and East respectively, and the section of Cairo Montenotte that is a crucial point in the area Savona - Bormide. In the metropolitan area of Genoa the worst situation is present on one of the most important roads such as the Aurelia in the Eastern Coast, where the service level keeps on being low both in day-time and in rush hours. The situation of the S.S. 45 along the Trebbia valley is bad too; on this road the service level is really low during rush-hours. Finally, for the area of La Spezia the most evident problems are present on the roads of Lerici and of Cisa; the last in particular the service level is dramatically low and tends to saturation both in rush and in day-time hours.
Highway infrastructures have been analysed using a forecast of the future traffics, while, as far as national roads are concerned, this kind of prevision has not been considered because it would not have added any useful information to those already known.
Considering the current data, it is evident that the main infrastructures that characterise the strategic junctions relative

to the ports of Genoa, Savona and La Spezia are highly overloaded and, mainly in rush-hours, they are likely to be saturated.
In conclusion, it can be carried out that road network does not offer a good alternative to highway, as its average congestion level can confirm.

State Road	*Denomination*	*Survey locality*	LS_d	LS_{up}	Congestion
S.S. 456	Del Turchino	Campoligure	*B*	*B*	*Low*
S.S. 1	Aurelia	Voltri	*B*	*C*	*Low*
S.S. 1	Aurelia	Bogliasco	*E/F*	*E/F*	*High*
S.S. 35	Dei Giovi	Mignanego	*B*	*B*	*Low*
S.S. 35	Dei Giovi	Ronco Scrivia	*C*	*C*	*Low*
S.S. 45	Della Val Trebbia	Genova	*C*	*D*	*Medium*
S.S. 1	Aurelia	Vado Ligure	*D*	*E/F*	*High*
S.S. 1	Aurelia	Savona	*E/F*	*E/F*	*High*
S.S. 29	Colle di Cadibona	Quiliano	*B*	*B*	*Low*
S.S. 29	Colle di Cadibona	Cairo Montenotte	*D*	*E/F*	*High*
S.S. 339	Di Cengio	Cengio	*A*	*B*	*Low*
S.S. 1	Aurelia	Riccò del Golfo	*A*	*A*	*Low*
S.S. 1	Aurelia	La Spezia	*C*	*C*	*Low*
S.S. 330	Di Buon Viaggio	La Spezia	*C*	*C*	*Low*
S.S. 62	Della Cisa	Sarzana	*E/F*	*E/F*	*High*
S.S. 331	Di Lerici	Lerici	*D*	*E/F*	*High*

Table 6 - Congestion of road sections

4.3 Railway network

All of the three Port Authorities are willing to raise the railway share of outwards goods trade. On the basis of this consideration and of the expected port traffic growth, it is possible to compile Tab. 7, that resumes the raises of the train numbers that the Port Authorities think necessary for each of the three Ligurian ports [7].

Savona		*Genova*		*La Spezia*	
1999	*2010*	*1999*	*2010*	*1999*	*2010*
5	10	40	125	23	78

Table 7 - Increase in the number of trains per day towards and from the ports

Traffic capacity of railway lines, expressed in trains per day in both directions can be calculated using the FS (Italian State Railways) formula:

$$P = \left[N + \frac{T - t - nV(p+1) - nM(p'+i)}{(p'+i)} \right] \cdot K$$

where:
N = total ordinary scheduled trains number (N = nV + nM)
T = 24h - hours expressed in minutes
t = daily service stop for line verify purpose, set equal to 90 min.
nV = number of ordinary passenger trains
nM = number of ordinary on time goods trains
p, p' = average run time of passenger and goods trains on the critical section
i = idle time, to be added to the run time, caused by go-ahead signal wait
K = reduction coefficient that takes into account for particular operation conditions, technical line equipment and the possibility of receiving of stations.

The formula has been applied to the considered lines, giving the data resumed in Tab. 8.
In some sections, the current traffic exceeds the theoretical potentiality; this is due to the fact that the FS formula provides a round down estimate. Consequently, for what concerns the rail links to the hinterland, that are the most critical, the residual potentiality analysis has been done using a more precise computer simulation. By combining the simulation results with the data already mentioned, the diagram shown in Fig. 7 has been obtained.

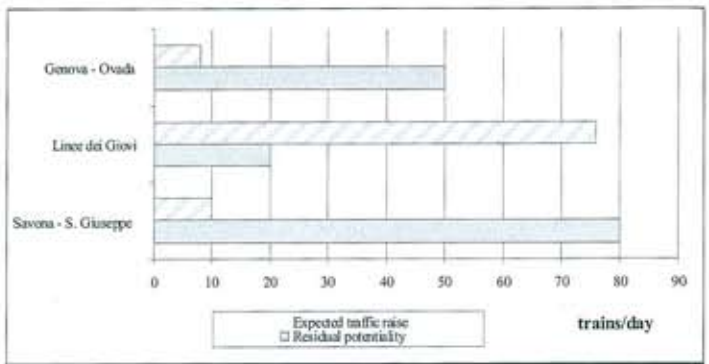

Figure 7 - Residual potentialities and expected traffic raises for railways from coast to internal regions

These results have been obtained by considering that one of the two lines "dei Giovi", the older one through Busalla, can be used by goods trains downwards only, because of the high gradient; moreover, considering the two lines between Savona and S. Giuseppe, it has been supposed to use the one via Ferrania for upwards traffic and the one via Altare for the downwards one, because of the more consistent gradient of the latter.
From the examination of the results it can be observed that the lines "dei Giovi" are already overloaded and provide very low residual potentiality margin, while for the other lines from coast to internal regions the situation is less critical. As far as La Spezia is concerned, it is interesting to notice that the doubling of the Pontremolese railway, currently in progress, will give it a great traffic capacity when completed.

5. Future scenarios and possible projects

It has been shown that ordinary viability is not capable to satisfy the transport demand of Ligurian ports. On the other hand, the highway network too seems to be inadequate to burden further traffic raises, especially for the sections connected to Genoa. Therefore, it is necessary to gradually move the traffics from roads to railways. Unfortunately, this aim is hindered by the low residual potentiality of some railway sections. In particular, from this study it is possible to forecast the future saturation of the two Giovi lines from Genoa to its hinterland, that can only bear a traffic increase of 20 trains per day, while the expected traffic increase in the

Sections	*Potentiality*	*Passenger trains*	*Goods trains*	*Total*
Pontremoli - La Spezia	60	30	12	42
Livorno C.le - La Spezia	180	100	58	158
La Spezia - Sestri Levante	180	108	53	161
Sestri Levante – Genova Nervi	180	125	53	178
Genova Nervi - Genova Brignole	180	164	53	217
Genova Brignole - Genova P.P.	200	197	69	266
Ge Brignole. - Ge Sampierdarena (underground)	90	86	3	89
Genova P.P. - Ge Sampierdarena	180	133	22	155
Ge P.P. - Ronco S. (via Mignanego)	180	112	89	201
Ge Sampierdarena - Ronco S. (via Busalla)	100	46	18	64
Ronco S. - Arquata S. (fast way)	180	111	76	187
Ronco S. - Arquata S. (via Isola)	160	34	33	67
Arquata S. – Tortona	180	64	42	106
Arquata S. - Novi Ligure	180	85	67	152
Ge Sampierdarena - Ovada	80	24	3	27
Ge Sampierdarena – Voltri	180	142	38	180
Voltri – Savona	180	105	18	123
S. Giuseppe - Savona (via Altare)	60	23	3	26
Savona - S. Giuseppe (via Ferrania)	60	43	5	48
Savona – Ventimiglia	90	71	20	91

Table 8 - Current traffic and theoretical traffic capacity of railway sections

year 2010 will be 76 trains per day.
Consequently, there will be the problem of distributing the remaining 56 trains on the other lines linking Ligurian coast to northern regions of Italy.
This residual demand might be satisfied by the Genoa - Ovada or the Savona - S. Giuseppe lines; obviously the most natural line is the one passing through Ovada, whose better position with respect to the port of Genoa is a great advantage. Therefore, these expected 56 trains per day can be mostly directed on the Genoa - Ovada line (42 trains/day), while the remaining part of them can use the Savona - S. Giuseppe line. The only drawback to this solution could be the transit of these trains on the Genoa - Savona line that in its first section, the Sampierdarena - Voltri, is already fully exploited; otherwise, the following section, which is the Voltri - Savona, is characterised by a residual potentiality of 57 trains per day (FS data), that should guarantee the transit of the mentioned traffic. Moreover, if we consider that the passenger traffic between Genoa and Savona is mainly distributed over day hours, during night time there are consistent potentiality margins to be exploited.
In conclusion we can state that the railway system of Savona and Genoa can support port generated goods traffic increments until the year 2010, without the necessity of building new infrastructures but only through a division of the traffic flows, accordingly to the general principles here exposed and solving the problem connected with the Giovi lines. Probably, the considered period of time (until 2010) represents a limit that should not be exceeded when considering the realisation of new infrastructures. In this sense it appears necessary to decide the future of the "Terzo Valico" (i.e. third railway from Genoa to Piedmont) project, that was strongly requested by the Region and the industrials, but continuously delayed for what concerns its realisation.
The scenery here depicted would need a certain coordination from the three ports, when considering the railway stimulation strategies, as far as terrestrial goods forwarding is concerned. This would be made easier by a better integration level between the Ligurian Port Authorities. In this sense it could be useful to create a superior Authority with the aim of

coordinating the investments, according to a precise organisation and programming in conformity with the port system concept, that was moreover assimilated by the PGT (Italian General Transportation Plan). This new Authority's work would be distributed over a long-term period of time; during this period the planning would be gradually put into effect, without any sudden change that could only upset the Ligurian basin, from a both organisational and economical point of view. From a transports point of view, the biggest advantage would come from the flows planning; in fact, the coordination of ports would allow to more or less uniformly distribute them among the forwarding infrastructures.

From this analysis it is evident that the railway is really poorly used as far as Genoa (16%) and Savona (2%) are concerned.

With a regional programming it could be possible to re-estimate the role of the railway, being the railway much more suitable for a planning than lorry-based transports.

As far as planning is concerned, La Spezia can be considered as a separate problem, because of the fact that the highway level will still be stable in the 2010 and the doubling of the "Pontremolese", currently in progress, will help from the railway point of view, too.

By the way, the highway section that goes through La Spezia is not a valid alternative to the "Giovi" section because of the excessive distance from Genoa and the even bigger distance from Savona; moreover the port of La Spezia is mainly servicing the traffics directed towards Emilia Romagna and Pianura Padana, while Genoa and Savona are dealing with Piemonte, Lombardia and the north-occidental Alps region.

A preliminary integration could be set up between the ports of Genoa and Savona. From a port system and a planning point of view, it could be possible to redirect a part of the highway traffic that burdens the A7 (Genoa - Serravalle, Milano direction) on the A26 (Voltri - Gravellona, Alessandria and possibly Milano direction); on the other hand, if we consider the multimodal traffic, the highway can be used to link Voltri with Savona (with a necessary improvement of the Varazze - Savona section) and consequently the Savona - S. Giuseppe di Cairo railway section can be exploited to have a link with the Lombardia via Alessandria. The last mentioned railway section has recently been adapted to the high-cube containers transport too.

6. Conclusions

In this study we have analysed the residual potentialities of the terrestrial transport infrastructures that are connected with the three main Ligurian ports, using forecasts of the traffic increase. Road and highway networks do not seem to be adequate to provide a sufficient capacity to service the goods flows during the next years. Therefore a more intense railway transport exploitation has to be programmed. Railway network is sometimes congested on some sections but presents a meaningful overall residual potentiality that need a planning effort in order to be extensively used.

Finally, we can conclude that, from the better coordination of the three ports, a more precise and programmed flow redistribution on the forwarding infrastructures can be obtained; this has the clear advantage to put off the chance of saturation and consequently the new infrastructures constructions that are always questionable from the point of view of environmental approval.

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