



A short-sea-shipping system for Liguria coast: first analysis at local, regional and cross-border scale

Ilaria Delponte ^{1*}, Valentina Costa²

¹ Civil, Chemical and Environmental Engineering Department, University of Genoa, Italy

² Italian Excellence Centre for Logistics, Transport and Infrastructures, University of Genoa, Italy

Abstract

Maritime transport is a key-factor for economic and strategic development of Europe. Furthermore, similar activities have a very relevant impact on environment, climate, health and well-being of citizens. An updated version of the Combined Transport Directive is planned for the Third Quarter of the European Commission's activity, which supports transition from road freight transport to low-emission modes, such as inland waterways, maritime and rail transport.

Within this complex framework, present paper outlines first considerations coming from two projects currently taking place in Northern Italy, and more specifically within Liguria Regional context: "viAmare" and "Mobimart Plus". The shared aim is to develop short "seaways" solutions for passenger and freight on a local, regional and cross-border scale (Italy / France), starting from Genoese metropolitan area as a pivotal site. First outcomes of the research, after an initial phase of ports' selection according to boats general features, show the importance of verifying different economic service scenarios and connections of more performative quays with urban regeneration projects of the waterfront.

Keywords: Maritime transport, Short-Sea Shipping, Multi-modal transport integration.

1. Introduction

Maritime transport plays and will continue to play an essential role in trade and for world and European economy. In recent years, maritime sector has taken significant measures to reduce its environmental impact. Targeting an expected increase in sea transport globally, for the EU a new report reveals for the first time the full extent of the impact of this sector on the environment and identifies the main issues to be solved in order to achieve sustainable development (Waterbone, 2021; European Commission, 2019; Jovanović *et al.*, 2022).

European waterborne transport sector welcomes the European Green Deal (2019) and is committed to reaching its objectives. In particular, European maritime technology sector annually invests 8-9% of its turnover in RD&I and is fully committed to developing needed solutions and to invest accordingly. Moreover, the PNRR (Piano Nazionale di

* Corresponding author: Ilaria Delponte (ilaria.delponte@unige.it)

Ripresa e Resilienza-Italian name for Recovery and Resilience National Plan) provides in section 3.2 “Inter-modality and Integrated Logistics” three reforms regarding logistics’ digitalization procedures. Also the Decree-Law n. 59 of 2021, which assigned the resources of the complementary fund to the PNRR, allocated 800 million euros for the following purposes, aimed at improving the sustainability of maritime transport sector (200 million euros to increase the availability of alternative marine fuels; 520 million euros to renew the Mediterranean naval fleet with clean fuel vessels) (Perčić *et al.*, 2020). In addition to contributing to the sustainability objectives, the “maritime route” proves to be currently particularly interesting where motorways and railways networks are critically congested or not appealing to tourists.

In fact, congestion levels of motorway networks, together with consequent diseconomies in terms of transport times and costs, contribute to make the entire supply chain less efficient and stimulate research to investigate alternative and more competitive modes for the transfer of goods (Paixão Casaca and Marlow, 2009).

Similar background and considerations led Liguria Region and the Metropolitan City of Genoa to investigate sea-based transport alternatives to support motorway and railway networks, both for commuters and for goods. Considerable interest is then dedicated to the theme of tourism development and the opportunities for extending services on a cross-border scale.

There are two main reasons that led the local authorities to stimulate planning in this regard. In addition to the aforementioned sustainability goals, Liguria presents a relevant gap in the use of railway infrastructures partly due to the lack of modernization of the network; in part, due to the steepness which makes the accessibility of railway stations very weak and poorly connected with the numerous peripheral boroughs and widespread villages. Moreover, recent restructuring of motorway infrastructures has made evident the delays will be caused no longer only by unforeseen events but by a scheduled maintenance program, which - therefore - planning must try to mitigate (Autostrade per l'Italia, 2019).

This regional infrastructural criticality, together with sustainable development issues boosted initiatives aimed at creating a more multi-modal, integrate and redundant (therefore more resilient) mobility supply. Modal diversification has been seen as a relevant feature to make transport system more flexible, responsive and attractive in terms of facing future climate and territorial challenges and to support users’ modal shift from individual cars.

In this regard, two interesting initiatives carried out by CIELI (Centro italiano di eccellenza sulla logistica, i trasporti e le infrastrutture, Scientific Resp. Ilaria Delponte and Enrico Musso) in collaboration with the Ligurian territorial bodies may be worth mentioning. Both project refer to the definition of potential maritime transport schemes for Ligurian Regional context in Northern Italy. The first one is “viAmare” project which is a grant from the Metropolitan City which intends to develop an east-west crossing model of Liguria - precisely “viAmare” - as an integration to railway-based transport. For this reason, in this paper, we report the preliminary studies conducted so far and the related checks on the scales for the service, some reflections on its overall potential in terms of sustainability are drawn, as well.

The second initiative is a European Maritime Cross-border Interreg project (IT-FR) called Mobimart Plus, in which CIELI is the scientific partner of Ligurian Regional Administration: the aim of the initiative is to analyse the technical and economic feasibility of a cross-border maritime service, also from ticketing and info-mobility

operations point of view. Insisting on the same pilot area (starting from Metropolitan City of Genoa to a later extension to regional and cross-border contexts), several positive synergies between the two projects may be seen.

Both projects are currently ongoing, being the first one in the route definition stage and the second one taking the stakeholders' engagement step to define service pre-requisites. Present work has the aim to collect first outputs coming from both, considering them as complementary actions which contribute to set a comprehensive framework for terrestrial-maritime integrated transport within Ligurian context.

In the following sections, the paper provides a brief description of the geographical, demographical and social aspects of the region, the planning tools of the local context and the opportunities constituted by a more structured maritime transportation offer (section 2). In Section 3, the analytical approach used for the selection of quays is explained, started from available data and statistical assumptions. As in recent papers (Cerreta *et al.*, 2020; Di Natale *et al.*, 2022), conclusive remarks (section 4) are devoted to projects of urban regeneration related to the waterfront of the selected quays which can boost significantly sustainable mobility and healthy habits amidst commuters and tourists.

2. Territorial Surrounding

As previously mentioned, multiple maritime transport solutions are currently under analysis referring to Ligurian context, in North-Western Italy. To deepen local reasons why EU strategies have undergone a strong boost within this area, it could be useful to remark some of its main features in terms of geographical, demographical, economic and infrastructural asset, as well.

Being Liguria a thin land stripe linking the Alps and the Mediterranean, with a maximum width of just 30km, where mountains cover two-thirds of the region, and, apart from the shoreline, there are no lowlands, making only a small part of the region suitable for urbanization (only 6% of Ligurian territory is classified as urban, according to Territorial Coordination Landscape Plan for Liguria Region's classification), accessibility issues emerge.

This peculiar morphology where steepness and elevation hampered urban and infrastructural development led to a unique concentration of urban centres along the coast. A continuous linear settlement develops from the Western border with France to the Eastern coast towards Tuscany.

Most of the 1.5 million inhabitants of Liguria Region live along the coast -more than 75% (ISTAT, 2022), one third located only within Genova municipality (which is the capital of the Region). Evidently this uneven distribution translated into a highly concentrated transport demand not easy to be managed.

Territorial asset together with population spatial distribution, indeed, shaped a typical infrastructural system as well. Highways and railways run along the main axe along the coast and enter inner areas just in three points.

European E80 highway connects directly France to Tuscany, while in Savona and Genoa links respectively to Piedmont and Lombardy Region are present. Railway development is substantially overlapping.

Being infrastructures located mainly along the coast, mobility supply has acquired a specific structure in order to feed this coastal system with users coming from the inner areas, too.

Looking at road network this incoming flows are supported by national and provincial road system, that descend from the hills and bringing users directly to highway gates.

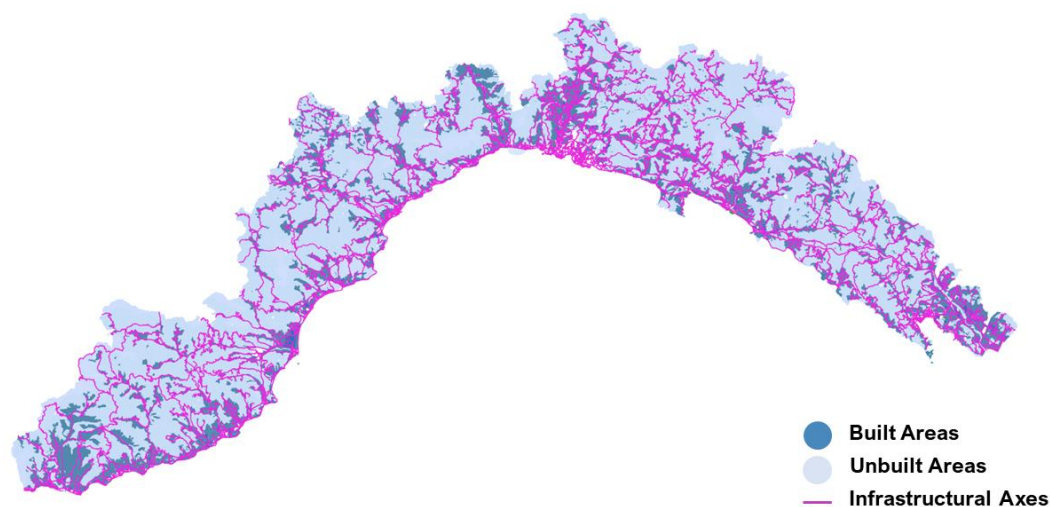


Figure 1: Urban and Infrastructural Asset in Liguria Region

Source: Territorial Coordination Landscape Plan, Liguria Region

Concerning Public Transport (PT) supply, historically this peculiar structure led to the development of a binary scheme:

- Road buses provide both urban connections in the main coastal centres and inner areas extra-urban links;
- Railway connects centres along the coast and links Liguria Region to the Northern Italian Regions, Piedmont and Lombardy above all.

Looking at daily flows, this scheme translates into a massive use of railway among PT users, especially when moving between different municipalities of within the extensive Genoese conurbation.

In 2019, Regional data said that 32% of people travelling for study and work reasons used PT services within Ligurian Region (ISTAT, 2022), that represents the highest share in Italy. In particular, looking at railway transport, 45.7% of Over14 population travel by train (second national region, following Bozen Autonomous Province), and approximately 120 000 passengers travel (Legambiente, 2019) on regional trains each day, also due to the strong attraction that Genoa plays towards bordering municipalities.

Work and school commuters and a-systematic travellers as well represent the lion's share looking at the main urban centres, nevertheless tourism plays a key-role within this region.

Globally, the Region counts more than 4.8 million arrivals and 15 million overnight stays each year (Osservatorio Turistico della Regione Liguria, 2019), two third of which take place in Genova and Savona Provinces (the central ones), while La Spezia and Imperia share equally the remaining part. Italians and foreign visitors are distributed almost equally in figures, with a slight prevalence of the first ones.

Italian tourists reach Liguria mainly by car (59,3%) or train (28,2%), while foreigners mainly flying (73,8%), by car (27,6%) or train (23,8%).

The main issue in terms of transport and mobility demand is indeed represented by seasonal distribution: more than 60% of tourist travels to Liguria in summer. This leads to a strong increase in traffic flows between June and September, thus making infrastructures' congestion even more critical.

Criticalities, though, are connected also to freight transport, that within Ligurian area are mainly transported by trucks, so that more than 20 000 freight vehicles travel across the Region on a daily basis (Liguria Region, 2020). Approximately one out of five only drives through Liguria, coming from external origin and with external destination.

They travel more in wintertime and on weekdays, thus reducing the potential overlapping with tourist flows, but they represent another critical element towards commuters and ordinary trips.

Moreover, it must be considered that massive use of road infrastructures, together with their age (Ligurian highways were mainly built in the '60s-'70s), translate into a frequent and constant need of maintenance interventions. Interventions that became even more urgent and undelayable after Morandi Bridge's collapse in 2018.

Maintenance and retrofitting interventions are mainly required by tunnels, which are heavily present within Ligurian highway network due to the hilly nature of landscape: 152 tunnels along the 747 km of regional highways. Evidently, roadworks cause restriction and limitations to ordinary traffic flows, and interventions are planned to continue for several years (Autostrade per l'Italia, 2019) so that driving through the Region becomes more and more difficult.

This brief overview enables to highlight some of the main features of Ligurian territorial, socio-economic, infrastructural and mobility context:

- Accessibility issues due to the hilly morphology and consequent poor infrastructure capillarity;
- Population, activities and facilities concentration along the coast;
- Relevant seasonal tourist flows;
- Congestion issues along the main highways, particularly during peak hours, weekends and tourist season;
- Long-term maintenance and retrofitting plan for highways, limiting nominal infrastructure capacity;
- Strong dependence from Genoese hub;
- Heavy use of Public Transport (especially railway component), though insufficient to ease congestions problems.

Looking at regional and strategic planning tools, mainly the Regional Territorial Plan (RTP) and the Integrate Regional Plan for Infrastructure, Mobility and Transport (IRPIMT), some punctual actions are planned to locally intervene on more congested hubs of the network, both for highways and network. Interventions mainly deal with faster connections towards Northern Regions for both passengers and freights or with the need to make more effective and efficient urban flows within Genoese area.

Nevertheless, it is clearly highlighted that radical solutions cannot be found being territorial asset particularly complex and limited, so that infrastructures enlargement and empowering cannot represent the only answer.

Modal shift indeed, for both passenger and goods, must be the key-element.

To target this aim, most suitable solution was to be found in the enforcement of PT supply, being Ligurian and Genoese users particularly keen on collective transport alternatives. Nevertheless, congested and limited infrastructures both in road and railway components suggested to pursue original ways to support PT network enlargement -being

traditional bus and trains networks critical to be widened. EU goals and strategies, as well as the presence of a similar maritime services (with consequent resources in terms of know-how and operational experience) currently ongoing within Ligurian context led to see in Public Transport and maritime accessibility the pivotal answers (Medda and Trujillo, 2010).

In this direction, favourable hints could be derived indeed from previous experience within local context. Liguria indeed has already an important background of maritime local transport. In particular, two case-studies could be mentioned:

- Navebus: a PT service by the Metropolitan mobility provider (AMT), sailing within Genoa municipality. It represents an important link for both commuters and tourist traveling from the Western side of the city to the urban centre. It provides 40 minutes' rides, structured into 4 round trips a day;
- Tourist services: several private companies provide services connecting Genoa urban centre to the main tourist spots as the Tigullio Gulf (Camogli, Portofino and Santa Margherita Ligure municipalities) and the Cinque Terre.

To develop a new maritime urban and regional transport could indeed represent an efficient way to:

- Meet a concentrated, linear and coastal mobility demand, which proved to be extremely difficult to manage only through terrestrial supply;
- Reduce car-use through the introduction of an effective and efficient transport alternative;
- Ease congestion issues on local road network, without relying further on railway regional system;
- Decrease transport-related polluting emissions;
- Offer tourist a pleasant way to travel across Liguria Region, without worsening traffic conditions.

Together with EU above mentioned inputs and actions, these premises led to the local initiatives (on a Regional and Metropolitan level) to investigate whether a sea-based transport could be designed to meet both passenger and freight transport demand, both commuters and tourist as a sustainable, effective, innovative and pleasant way to move across the Region (and further).

3. Service scenarios for a sea-based transport in Liguria

“ViAmare” project initial aim, following a detailed context’s analysis step, was to define level of service to be implemented in order to shape a maritime transport alternative able to compete with terrestrial ones. Consequent activity was to develop three different scenarios then, framing transport demand features at urban, metropolitan and regional/cross-border levels and, consequently, potential yards’ localisation on the basis of travel time and accessibility considerations.

As far as the third scenario is considered, first outputs coming from “viAmare” project contributed to shape the preliminary framework to develop mobility services and ticket integration schemes between Liguria and PACA Regions for both terrestrial and maritime components within Mobimart Plus Interreg Project activity.

Together with Metropolitan City of Genoa’s administration, three service scenarios were initially introduced:

- Urban Scenario: this alternative represents somewhat an extension and enlargement of the Navebus experience. It lays mainly within Genoa municipality (only one stop is outside the administrative borders). It should provide frequent rides, being distances quite short (40 km on land-side);



Figure 2: Urban Scenario routes

Source: Authors' elaboration

- Metropolitan Scenario: it is a mid-scale service, it covers a wider area, from the city of Savona in the bordering province on the Western side of Genoa to the Eastern border of its Metropolitan Area. It should provide strategic and faster connection between the airport, Savona and Genoa cruise terminals and main tourist location in Tigullio's Gulf as well;

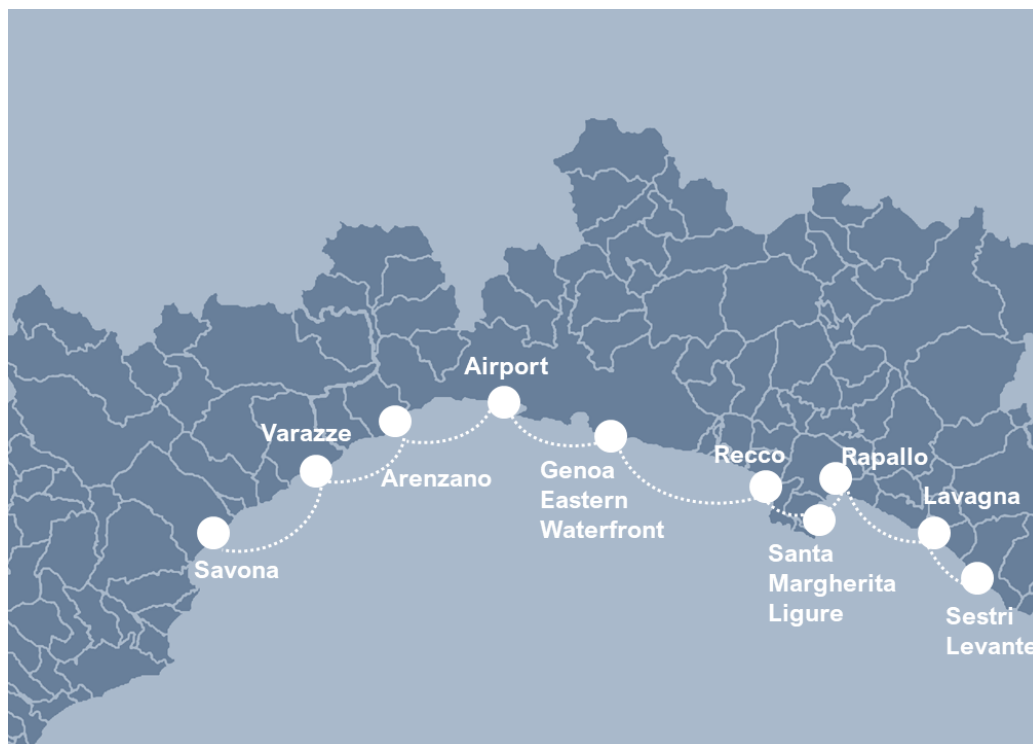


Figure 3: Metropolitan Scenario routes

Source: Authors' elaboration

- Regional Scenario: it a large-scale service, dedicated to both freight and passengers to link La Spezia Province, on the Eastern part of the Region to Imperia or directly beyond French border towards Marseille or Toulon cities and port. This third option should guarantee to bypass Ligurian road network, thus reaching directly Cote D'Azur. In this direction, Mobimart Plus activities in terms of stakeholders involvement and ticket integration design would prove particularly relevant.

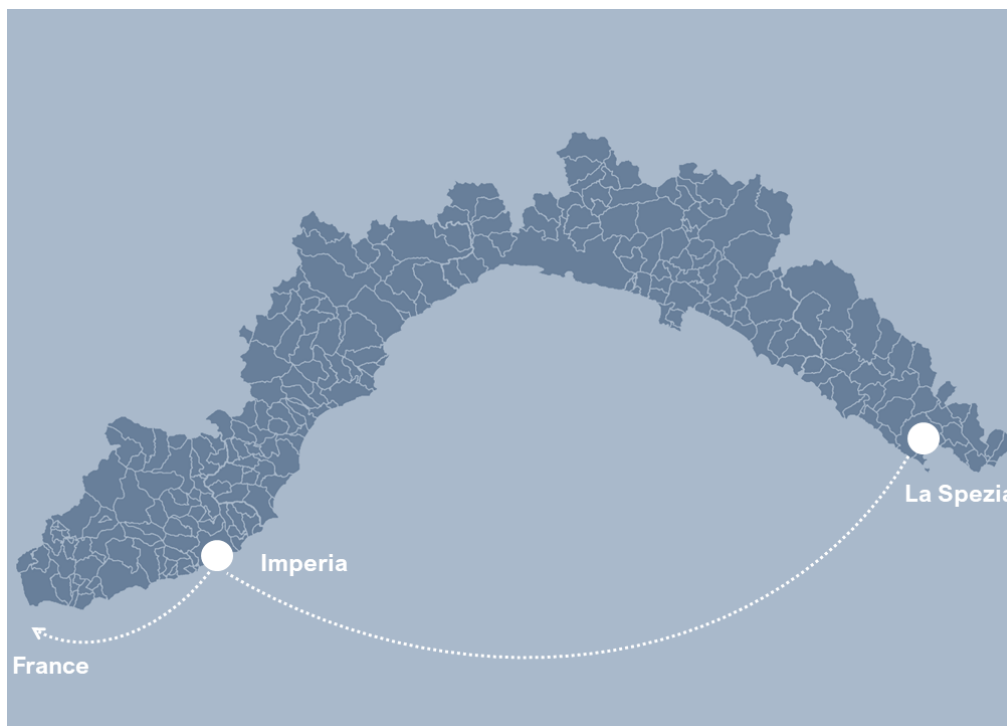


Figure 4: Regional Scenario routes

Source: Authors' elaboration

Each of the presented scenarios has its own features, targets and requirements. Nevertheless, they share some common features:

- Boats will be designed to be hybrid fuelled, thus reducing polluting emissions (Di Natale *et al.*, 2022);
- Stops will be selected in order to exploit existing yards without the need of further soil consumption and preserving Ligurian coastal environment;
- Quays' number and localization will be identified in order to balance the need for a widespread service and the will to design a competitive alternative to private cars in terms of time, fare and comfort.

In terms of yards' localization and selection, starting from the existing ones, an accessibility analysis was conducted in order to investigate how potential maritime service could be integrate land-side mobility supply, specially referring to:

- Park and Ride facilities;
- Bus network;
- Railway stations.

In particular, journey time from the nearest railway and park facilities were considered, both walking or using local bus network (where present).

Table 1: Time-Accessibility of the selected yards

<i>Yard</i>	<i>Railway</i>	<i>Railway</i>	<i>Park and Ride</i>	<i>Park and Ride</i>
	<i>Station-Yard</i> <i>Walking</i>	<i>Station-Yard</i> <i>By Bus</i>	<i>facility-Yard</i> <i>Walking</i>	<i>facility-Yard</i> <i>By Bus</i>
Savona	23'	5'	2'	-
Varazze	5'	-	-	-
Arenzano	14'	11'	14'	11'
Genoa Pra'	7'	-	7'	-
Genoa Pegli	6'	5'	1'	-
Genoa Sestri Ponente	22'	9'	20'	-
Genoa Old Harbor	16'	5'/9'	16'	5'/9'
Genoa Eastern Waterfront	25'	20'	25'	20'
Genoa Nervi	11'	8'	11'	8'
Recco	6'	-	6'	-
Santa Margherita Ligure	11'	4'	19'	4'
Rapallo	13'	11'	13'	11'
Lavagna	10'	7'	30'	-
Sestri Levante	19'	-	10'	7'
			19'	-

*red figures refer to approved projects of new Park and Ride facilities that are currently under construction.

Concerning these raw data, some considerations could be drawn:

- Railway and Bus Network integration is quite relevant, only few spots (Varazze, Recco and Sestri Levante) lack of bus links; these stops indeed (except Sestri Levante) are reachable from the nearest railway station within 10-11 minutes by foot;
- Bus connections between yards and railway stations usually take time shorter than 11' (except Genoa Eastern Waterfront); while walking distances mainly take less than 20 minutes;
- Looking at Park and Ride facilities, globally they overlap railway stations configuration, being usually located approximately within the same area (with few exception: future parking area in Pegli locates along the local yard- the last one because of the existing Navebus service- while Sestri Ponente, Recco and Rapallo parking were thought as dependent from local highway gate, far from the railway station, though.

Journey time were later translated into colour gradient -from dark green (< 5') to red (> 20')- to make accessibility conditions clearer and easier to be interpreted, and to assess potential priorities in terms of interventions needed to support new maritime service's implementation.

Table 2: Time-Accessibility of the selected yards

Yard	Railway	Railway	Park and Ride	Park and Ride
	Station-Yard Walking	Station-Yard By Bus	facility-Yard Walking	facility-Yard By Bus
Savona	Red	Green	Green	Green
Varazze	Green			
Arenzano	Yellow	Yellow	Yellow	Yellow
Genoa Pra'	Light Green	Green	Green	Green
Genoa Pegli	Light Green		Light Green	
Genoa Sestri Ponente	Red	Light Green	Orange	Green
Genoa Old Harbor	Orange	Green	Orange	Green
Genoa Eastern Waterfront	Red	Orange	Red	Orange
Genoa Nervi	Yellow	Light Green	Yellow	Light Green
Recco	Light Green		Light Green	
Santa Margherita Ligure	Yellow	Green	Yellow	Green
Rapallo	Yellow	Yellow	Yellow	Yellow
Lavagna	Light Green	Light Green	Light Green	Light Green
Sestri Levante	Orange		Orange	

Legenda	t < 5'	5' < t < 10'	10' < t < 15'	15' < t < 20'	t > 20'
	Green	Light Green	Yellow	Orange	Red

Once accessibility pre-conditions were deepened and highlighted, so that spatial layout was somewhat defined, following step concerned journey time. As previously mentioned, trains represent nowadays the main public alternative to private cars on a regional level, being bus networks not fully integrated among different municipalities and provinces, as well as not-competitive in terms of travel time and comfort. New sea-based service must be then designed in order to offer competitive timing and higher comfort levels (Krčuma *et al.*, 2018; Tanko *et al.*, 2019).

To this aim train travel time between potential yards were registered.

Table 3: Journey Time between potential yards

Yard	Journey Time	Journey Time
	By Train	By Ferry
Savona	0	0
Varazze	12'	15'
Arenzano	10'	20'
Genoa Pra'	10'	*
Genoa Pegli	5'	8'
Genoa Sestri Ponente	4'	8'
Genoa Old Harbor	18'	35'
Genoa Eastern Waterfront	8'	15'
Genoa Nervi	20'	20'
Recco	24'	25'
Santa Margherita Ligure	9'	35'
Rapallo	5'	6'
Lavagna	12'	15'
Sestri Levante	0	10'

*not relevant value: this stop is present only as starting point of Urban Service, it is absent though within Metropolitan Scenario, so that travel time are not concerning for users.

Clearly, train journey time can represent an ideal benchmark to design a competitive service thus balancing the need to reach a higher number of spots and the will to offer a fast, effective and comfortable connection. Nevertheless when ferry alternatives are concerned two elements need to be highlighted: travel time may be deeply affected by vehicle choice and longer travel times -usually due to the need of entering strongly regulated port areas- are often connected to higher comfort levels compared to urban trains.

In the previous lines analysis were conducted considering both Urban and Metropolitan Scenarios. As Regional Scenario is concerned -mainly targeted through Mobimart Plus Interreg Project- routes and stops are currently under definition because of the greater challenges represented by a cross-border service and the complex needs in terms of multi-modal integration with both Italian and French mobility supply.

EU strategies and initiatives evidently pave the way for trans-national sea-borne services, as proven by Mobimart Plus Project. An Italy-France Maritime Interreg Project aimed at the design and consequent test of an integrate and intermodal cross-border ticketing system to support multi-modal connections between secondary and tertiary network to TEN-T infrastructures.

Fare and Modal integration represent indeed the most relevant challenge to be faced to up-scale sea-borne transport project from a local level, where accessibility and integration could be quite easily granted (as previously showed referring to Genoa metropolitan area) to an interregional and trans-national level.

In this direction, Regional Scenario, being Liguria a privileged area bordering directly to France territory, could represent a pivotal case-study and Mobimart Plus could represent a key-opportunity to develop integrated fare and ticket system to be later enlarged to a wider area.

Cross-border transport integration is currently targeted by this Interreg Project through the involvement of relevant stakeholder acting within the transport sector to define main challenges and system pre-requisites that should be considered in designing new operational service scenarios.

4. Conclusion

Results of the research show that today a "short-sea-shipping" service in Liguria is still an embryonic prospect.

Main checks needed are those concerning the effective sustainability of the service and the integration between the alternative to terrestrial travel proposed by the "sea route" and the urban and coastal places in which this service is provided (Cerreta et al, 2020). Moreover, future steps will deploy a benchmark analysis to define on which grounds a definitive advancement of the project could be made.

As already addressed by other scholars in European Transport Journal (Sitzimis, 2022; Carlucci *et al.*, 2020), main competitive point of the service is the attractiveness of towards users -due to the beauty of the coast-, but which has only a marginal impact on saving costs in producing the service. Nevertheless, according to international, EU and national goals, the need to support multi-modality through sustainable mobility options able to ease urban traffic congestion and to create more resilient and modular transport system, suggests to investigate similar solutions. Undoubtedly, initiatives of this kind may represent also interesting booster from a tourism-oriented point of view.

Although service's overall sustainability will have to be investigated, though, it shows definitely worth assessing potential impacts and added value for territorial contexts coming from similar initiatives. Terrestrial-Maritime relation may prove to be a key-element for sustainable development of coastal areas responding both to mobility and urban asset regeneration's issues.

In particular, in the future, in order to represent an effective opportunity for both commuters and tourists, integration will play a pivotal role for these services twice: in terms of timing and schedule, to support seamless transfer among different transport vectors and hubs of urban mobility chain; and, secondly, in terms of matching with other urban services, not only transport-related ones, but tourism-oriented ones as well, thus constituting incentives and booster for the wellbeing/entertainment of the city as a whole.

Crucial in this sense, is the link with the several present (or programmed) urban regeneration projects which are currently active in Liguria (Eastern Waterfront in Genoa, but also in Rapallo, Chiavari, La Spezia,...). A general improvement in accessibility of these leisure places could stimulate the demand of travel in comfortable conditions.

Finally, looking at fare and modal transport integration, a greater feasibility and attractiveness of the service could be reached through its insertion into a wider transport management system as MaaS (Mobility- as-a-Service) as the one targeted by Mobimart Plus initiative, as well.

References

- AutoStrade Per l'Italia ASPI, Interventi programmati in Liguria, <https://www.autostrade.it/it/programmi-di-intervento>
- Carlucci F., Corcione C., Giordano R., Trincone B. (2022) "Short Sea Shipping: Evidence from Campania, Southern Italy", *Trasporti Europei*, Issue 88, Paper n° 1, ISSN 1825-3997
- Cerreta, M., Giovane di Girasole, E., Poli, G., Regalbuto, S. (2020) "Operationalizing the circular city model for Naples' city-port: A hybrid development strategy", *Sustainability*, 12(7), 2927.
- Di Natale, F., Carotenuto, C., Cajora, A., Sippula, O., Gregory, D. (2022) "Short-sea shipping contributions to particle concentration in coastal areas: Impact and mitigation", *Transportation Research Part D: Transport and Environment*, 109, 103342.
- European Commission, Green Deal Europeo, 2019, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_it
- ISTAT (2022). Popolazione residente. <https://demo.istat.it/app/?i=POS&l=it>
- ISTAT (2022). Trasporti e Mobilità. https://www.istat.it/storage/politiche-sviluppo/Trasporti_mobilita.xls
- Jovanović, I., Vladimir, N., Perčić, M., Koričan, M. (2022) "Effect of potential autonomous short-sea shipping in the Adriatic Sea on the maritime transportation safety", https://www.bib.irb.hr/1212213/download/1212213.Effect_of_potential_autonomous_short-sea_shipping.pdf
- Krčuma, M., Plazibata, V., Ivošević, S. (2018) "Valuation of Transport Service Characteristics Relevant for the Establishment of Fast Inter-City Lines in Sea-Borne Passenger Traffic", *Transactions on Maritime Science* 7(02):174-183 DOI:10.7225/toms.v07.n02.007

- Legambiente (2019), Rapporto Pendolaria. <https://www.legambiente.it/wp-content/uploads/2020/02/Rapporto-Pendolaria-2019.pdf>
- Liguria Region (1990). Territorial Coordination Landscape Plan. <https://www.regione.liguria.it/homepage/territorio/piani-territoriali/piano-territoriale-di-coordinamento-paesistico.html>
- Liguria Region (2020). Integrate Regional Plan for Infrastructure, Mobility and Transport, <https://www.regione.liguria.it/component/publiccompetitions/document/45266.html?view=document&id=45266:dgr-1165-2020&Itemid=8147>
- Medda, F., Trujillo, L. (2010) “Short-sea shipping: an analysis of its determinants”, *Maritime Policy Management*, 37(3), 285-303.
- Osservatorio Turistico Regionale della Liguria (2020). Rapporto Annuale 2019, <https://www.ge.camcom.gov.it/it/elementi-homepage/notizie/allegati-e-immagini/200922-rapporto-annuale-2019-liguria.pdf>
- Perčić, M., Vladimir, N., Fan, A. (2020) “Life-cycle cost assessment of alternative marine fuels to reduce the carbon footprint in short-sea shipping: A case study of Croatia”, *Applied Energy*, 279, 115848.
- Paixão Casaca, A.C., Marlow, P.B. (2009) “Logistics strategies for short sea shipping operating as part of multimodal transport chains”, *Maritime Policy Management*, 36:1, 1-19, DOI:10.1080/03088830802652254
- Sitzimis I. (2022) “Economies of scale in Greek coastal shipping. A survivor analysis”, *Trasporti Europei*, Issue 88, Paper n° 7, ISSN 1825-3997
- Tanko, M., Cheemakurthy, H., Hall Kihl, S., Garme, K. (2019) “Water transit passenger perceptions and planning factors: A Swedish perspective”, *Travel Behaviour and Society*, Volume 16, 2019, Pages 23-30, ISSN 2214-367X, <https://doi.org/10.1016/j.tbs.2019.02.002>.
- Waterbone TP (2021) “Strategic research and innovation agenda for the partnership on zero-emission waterborne transport”, https://www.waterborne.eu/images/210601_SRIA_Zero_Emission_Waterborne_Transport_1.2_final_web_low.pdf