

31st International Congress on Sound and Vibration



CAPITALIZING PORT NOISE MITIGATION STRATEGIES: THE CLUSTER PROJECT

Johan Augusto BOCANEGRA CIFUENTES¹, Davide BORELLI¹, Elisa FRACCHIA², Emanuela PALLAVIDINO¹, Juliana PESHKU¹, Jonathan ROBERTS¹, Corrado SCHENONE^{1*}

¹*Department of Mechanical Engineering, Energetics, Management and Transportation (DIME), University of Genoa, Via all'Opera Pia 15/A, 16145, Genova, Italy*

²*Italian Centre of Excellence in Logistics, Transport and Infrastructure (CIELI), University of Genoa, Via Francesco Vivaldi 5, 16126, Genova, Italy*

**e-mail: corrado.schenone@unige.it*

Port noise pollution is an increasingly sensitive problem and a serious issue for the population which lives in the surroundings of the infrastructure. Ports in the Mediterranean Sea are generally surrounded by urban areas which are impacted by the noise generated by port activities. In this tangled context, the CLASTER (CompatibiLitÀ e SostenibiliTà rumorE poRtuale - Port noise Compatibility and Sustainability) project, funded within the framework of the cross border Interreg Italy-France Maritime 2021-2027 programme, aims to capitalize the experience and the knowledge gained by the "port noise" cluster in the previous 2014-2020 programming (REPORT, MON ACUMEN, L.I.S.T. PORT, RUMBLE, DECIBEL, TRIPLO projects), to demonstrate how the technical-knowledge base previously developed can be applied to new realities. This will improve the environmental sustainability of ports, both through the implementation of small customized noise mitigation interventions, and through the experimentation and development of new integrated digital systems for acoustic governance and planning at port, municipal and regional levels that can be replicated throughout the cooperation area.

Keywords: port noise, ship noise, traffic noise, noise impact, environmental noise mitigation

1. Introduction

Ports in Europe serve as essential gateways to the world and play a central role in supply chains, making them a crucial part of national infrastructure. However, the substantial economic contributions of ports are accompanied by noteworthy environmental challenges. The European Sea Ports Organisation (ESPO) emphasizes that noise pollution is the fourth place among the most pressing environmental issues facing the sector [1-5]. The propagation of noise from port-related sources, such as ship operations, cargo handling, and auxiliary machinery, ship and vehicle traffic, poses significant challenges to the acoustic environment. Moreover, along the Mediterranean coastline, densely populated urban environments are present. The increasing sensitivity of urban populations to environmental noise has elevated the issue on both regulatory and technical agendas, leading to public opposition to port development and modernization initiatives [6]. In this sense, socio-economical studies regarding the impact of the port noise on residents and the willingness to pay for reducing it were conducted by Lopez et al [7] and by Ciucci et al [8].

1.1 Interreg Italy-France Programme

In response to prevailing concerns regarding the noise pollution, the Interreg Italy-France Maritime Programme 2021-2027 supports cooperation between Italy and France among specific regions of Italy and France, aspiring to bolster sustainability and enhance market performance across the Mediterranean basin.

The programme prioritizes integrated strategies in areas such as eco-sustainability, territorial connectivity and the harmonization of cross-border regions, while the intervention domains encompass research and innovation, climate resilience, sustainable transport systems, and inclusive socio-economic growth. Specifically, the programme allocates funding across five Priorities [9]:

- Priority 1: An attractive cross-border area of intelligent and sustainable modernization (total funding: 42525135 €).
- Priority 2: A resilient and resource-efficient cross-border area (total funding: 85539548 €).
- Priority 3: A physically and digitally connected cross-border area (total funding: 24935194 €).
- Priority 4: A cross-border area efficient in social capital and distinguished by the quality of its human capital (total funding: 28878435 €).
- Priority 5: Better cross-border governance (total funding: 11597765 €).

The Interreg programme encapsulates a transnational initiative aimed at fortifying synergies between the coastal territories of Italy and France. Its overarching goal is to stimulate long-term regional development by enhancing economic performance and promoting environmentally responsible practices across the Mediterranean.

2. CLASTER - Port noise Compatibility and Sustainability

CLASTER project is a capitalization project of 36 months being part of Priority 3 (commencement date 01/03/2024 and conclusion date 28/02/2027) that seeks to ameliorate the acoustic environment in urban areas adjacent to ports by mitigating the noise impact emanating by various port-related sources. The principal goal of CLASTER is to enhance the quality of life for residents residing near port areas, as well as for the stakeholders inside the port area, through the execution of diverse activities, primarily segmented into two components.

The first component (Component 1) regards the implementation of cross-border interventions for the reduction of the acoustic impact of ports, while the second one (Component 2) aims the implementation of integrated systems for port acoustic planning (cloud systems and App systems).

The partnership in CLASTER comprises public bodies distributed across all the territories of the cooperation area: University of Genoa (Lead Partner), Regional Environmental Protection Agency of Tuscany (ARPAT), Université de Corse Pasquale Paoli, Liguria Region, Territorial Chamber of Commerce and Industry of the Var, Municipality of Pisa (Tuscany) and Municipality of Porto Torres (Sardinia). The project has a budget of 1666087.63 € of which the 1332870.10 € from the European Regional Development Fund, ERDF [10]. The project Logo is shown in Figure 1.



Figure 1. Project LOGO

In particular, the CLASTER project aims to capitalize the experience and the knowledge gained by the "port noise" cluster of the 2014-2020 Interreg programme (REPORT, MON ACUMEN, L.I.S.T. PORT, RUMBLE, DECIBEL, TRIPLO projects). Such capitalization aims to reproduce such successful actions on four different ports (La Spezia, Toulon, Porto Torres and Marina di Pisa), both touristic and commercial.

2.1 Component 1

The objective of Component 1 is to implement pilot actions for the mitigation of noise emissions through the capitalization of the results achieved during the previous programming period. Even the communication activities have a crucial role: citizens, public and port authorities must be involved during the whole activities and partners must inform them about the innovations performed in ports.

The Component 1 is characterized by four main activities, as listed below:

- Activity 1.1: state of the art analysis and evaluation of critical issues arising from noise pollution inside and outside ports.
- Activity 1.2: planning the acoustic mitigation measures.
- Activity 1.3: implementation of the mitigation measures inside and outside port areas.
- Activity 1.4: monitoring and evaluation of implemented port noise mitigation works.

Activity 1.1 focalized on understanding the noise emissions generated by specific port activities, characterizing noise pollution resulting from vehicular traffic to and from the port and measuring the social costs borne by residents due to high levels of noise pollution in areas adjacent to the ports using the Choice Experiment methodology, which enables the identification of the most affected areas, also through a cost-benefit and environmental sustainability assessment. Furthermore, these analyses also facilitate the determination of the actions and interventions to be implemented to reduce noise pollution emissions attributable to each involved partner.

The primary outcome of the Project Output 1.1 focuses on pilot actions by capitalizing the previous results and knowledge. Particularly, the primary action consists in reducing the port's environmental impact by developing and installing monitoring systems to evaluate the road traffic on the main roads near the ports (ITS and App systems) and the noise coming from other sources inside the port areas (noise monitoring stations). The investments will be performed in the touristic port in the Municipality of Porto Torres (Investment 1.1), in the touristic port of Marina di Pisa by the Municipality of Pisa (Investment 1.2), in the touristic and commercial port of Toulon by the Territorial Chamber of Commerce and Industry of the Var (Investment 1.3) and in the commercial port of La Spezia, through the partner Liguria Region.

2.1.1 *Investment 1.1 – Porto Torres and Investment 1.2 – Marina di Pisa*

Investment 1.1 consist in the capitalization of results obtained in the L.I.S.T. Port Interreg Maritime project.

In particular, in Porto Torres actions consist in the development of two different operations near the port, along a critical urban road artery adjacent to the port.

In fact, in the city of Porto Torres, urban facilities arise near the port (see Figure 2), that is characterized by an extensive ferry traffic, especially in summer season. In this context, the first objective is developing a traffic management system known as ITS (Intelligent Transportation System). This system must be coupled with an informative application, called App, aiming to inform citizens about alternative road routes, to reduce vehicle queues that causes both environmental and acoustic impacts on citizens. The second planned action in Porto Torres port consists in the usage of a sound absorbing asphalt, aimed in reducing the acoustic impact of light and heavy vehicles circulating in the areas of interest.

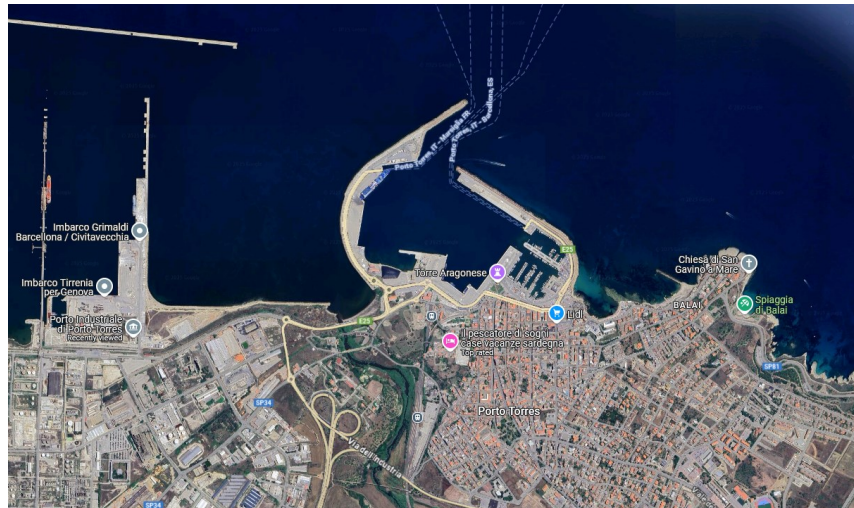


Figure 2. Porto Torres Port - Deliverable D1.1.2

Such asphalt must be optimized as a function of the spectrum of frequencies to be reduced and, for this reason, a careful analysis of the noise must be performed.

As for Porto Torres, Investment 1.2 in Marina di Pisa consists in the implementation of the ITS system. Prior to the ITS system developments, it is imperative to conduct comprehensive traffic monitoring activities particularly during peak summer periods. These analyses will map traffic patterns across both pilot sites, necessitating the installation of vehicle counting systems along the principal access routes to the urban port area (Figure 3).

The crucial importance of the actions is clearly noticeable; a careful management of the traffic will reduce the incidence of traffic congestions, promoting an increase in quality of life of neighbouring inhabitants and port stakeholders. In fact, the ITS system aims to identify traffic scenarios, along with vehicles type (cars, heavy vehicles), as required by the European Union (CNOSSOS) [11].

The Investment 1.1 is managed by Municipality of Porto Torres with a founding of 257292.00 €, while the Investment 1.2 is managed by Municipality of Pisa, with a founding of 212877.00 €.

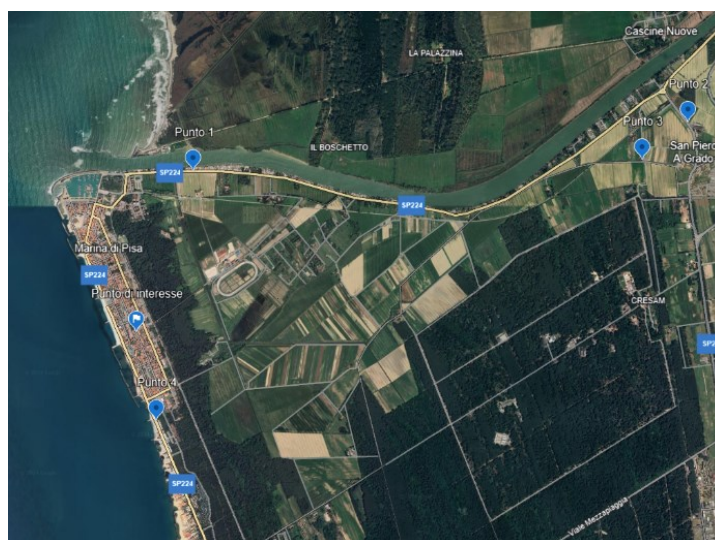


Figure 3. Monitoring Points in Marina di Pisa - Deliverable D1.1.1

2.1.2 Investment 1.3 – Toulon

Investment 1.3 in Toulon encompasses three distinct activities aiming the reduction of noise pollution through the implementation of an optimized speakers system, noise monitoring systems and the installation of viscoelastic supports, partially capitalizing the Interreg Maritime DECIBEL project.

The adoption of an optimized speakers system consists in the replacement of a single large speaker with smaller speakers, in order to reduce the volume of messages transmitted to passengers inside the port terminals. This action represents an important innovation in ports that can be capitalized in other ports inside the cooperation area or in other applications, as for instance in railway stations.

The long-term monitoring system involves the installation of monitoring stations consisting of sound level meters coupled with photovoltaic panels for continuous power. The monitoring stations will provide detailed information on the acoustic performance of the commercial terminals, enabling the Port Authority to monitor noise levels in real time at the monitoring points, assessing the effectiveness of the mitigation measures implemented and identifying any areas requiring further intervention.

The third action entails the installation of viscoelastic supports at points where ferry ramps engage with the dock during the boarding and disembarkation of vehicles.

The investment 1.3 is managed by the Territorial Chamber of Commerce and Industry of the Var with a founding of 294500.00 €.

2.1.3 Investment 1.4 – La Spezia

Investment 1.4 in the port of La Spezia consists in the capitalization of actions conducted in previous Interreg Maritime projects DECIBEL and MON ACUMEN.

The actions aiming the reduction of noise pollution by the usage sound absorbing asphalt and the installation of a monitoring station along a road section within the port area, that falls under the jurisdiction of the Eastern Ligurian Sea Port Authority.

Specifically, the monitoring action involves measuring the sound emissions produced on the road segment by heavy vehicles' tires transiting through the port area. By capitalizing results obtained in touristic ports in project Interreg RUBLE, a noise-reducing asphalt will be used (Figure 4).

The investment 1.4 is managed by Eastern Ligurian Sea Port Authority, owner of the site, while Liguria Region is project partner with a founding of 182700.00 €.

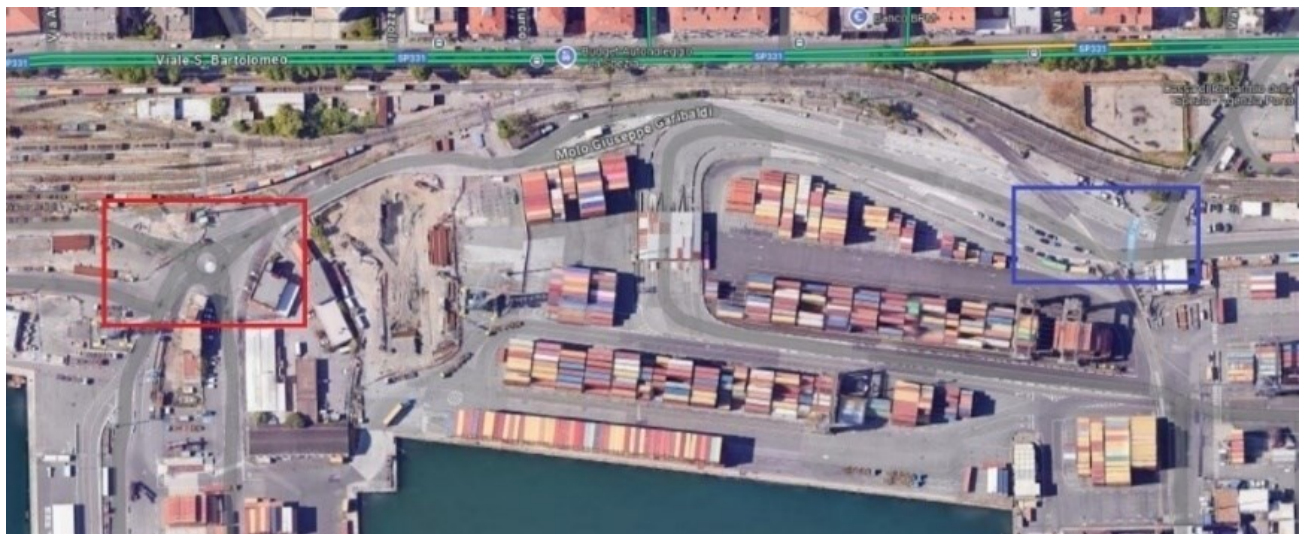


Figure 4. Port of La Spezia (Liguria). Red and blue frames represent the potential areas where the sound absorbing asphalt could be used.

2.2 Component 2

The objective of component 2 of the CLASTER project is the implementation of integrated systems for port acoustical planning. The ultimate goal of this component is the reduction of noise pollution within the cooperation area by the traffic regulation near ports.

To achieve this objective, communication is also extremely important: introducing the new governance systems and traffic monitoring applications to citizens and stakeholders will be essential in presenting the results achieved to the target groups involved.

The Component 2 is characterized by three main activities, as listed below:

- Activity 2.1: Development of a joint cross-border integrated system for port noise characterization based on Cloud and App technologies.
- Activity 2.2: Development of an integrated cross-border ITS system for noise and mobility information based on an App.
- Activity 2.3: Development of a cross-border mapping that correlates the population's perception of noise pollution with objectively measured pollution levels.

Mainly, the project outputs are two. Output 2.1 consists of two parts: the first one regards the development of cross-border integrated system for port noise characterization based on cloud within the activity 2.1, while the second one regards the development of an application to use and query the database. The second output, named Output 2.2, regards the system ITS and the data elaboration to develop a cross-border mapping of the pollution levels.

2.3 Project results

The CLASTER project is characterized by a Result indicator “RCR 104 - Solutions taken up or up scaled by organisations”. This indicator highlights the number of actions or solutions adopted or improved during the project or after one year from the end of the project. Actions will be performed by the continuous cooperation of partners and will positively affect the quality of life of citizens living near ports.

3. Conclusions

The noise generated by port activities and the vehicular traffic around port hubs represents significant challenges that can hinder the growth and efficiency of commercial port infrastructure and the welfare of citizens and stakeholders. Its assessment is particularly complex due to the wide range of contributing sources.

On the other hand, thanks to the previous support from the Interreg Italy-France Maritime 2014-2020 Programme, the capitalization of the results obtained by past projects on the topic can now be performed within the framework of the 2021-2027 Programme.

At one year after the launch of the CLASTER project, capitalization activities have begun, with the first installations of monitoring stations in the port of Toulon and with measurements and mapping along the roadways adjacent to the touristic ports of Porto Torres and Marina di Pisa, in preparation for the installation of ITS systems.

Moreover, the other pilot activities such as paving with sound absorbing asphalt in La Spezia and Porto Torres and the application of viscoelastic supports in Toulon are currently being implemented.

The expert partnership across different sectors that already operated in the previous programme will exploit the knowledge gained from past experiences ensuring a successful capitalization of the results in the ports involved.

ACKNOWLEDGEMENTS

This work has been developed in the framework of the EU cooperation project CLASTER (Compatibilità e Sostenibilità rumorE portuale). This project has received funding from the European Union's INTERREG IT-FR "Marittimo" Programme 2021-2027, CUP D37G23000370006.

REFERENCES

- 1 ESPO, 2024. [online, accessed 15/04/2025] <https://www.espo.be/publications/annual-report-2023-2024>
- 2 Borelli D., Gaggero T., Rizzuto E., Schenone C. Measurements of airborne noise emitted by a ship at quay (2015) 22nd International Congress on Sound and Vibration, ICSV 2015, Code 121474. Florence, Italy, 12-16 July 2015.
- 3 Borelli D. Maritime airborne noise: Ships and harbours (2019) International Journal of Acoustics and Vibrations, 24 (4), pp. 631, DOI: 10.20855/ijav.2019.24.4E94
- 4 Fredianelli L., Bernardini M., D'Alessandro F., Licitra G. Sound power level and spectrum of port sources for environmental noise mapping (2024) Ocean Engineering, 306, art. no. 118094, DOI: 10.1016/j.oceaneng.2024.118094
- 5 Bernardini M., Fredianelli L., Nastasi M., Del Pizzo L.G., Fidecaro F., Licitra G. Variability in airborne noise emissions of container ships approaching ports (2024) Ocean Engineering, 309, art. no. 118492, DOI: 10.1016/j.oceaneng.2024.118492
- 6 Schenone, C.; Pittaluga, I.; Borelli, D.; Kamali, W.; El Moghrabi, Y. The Impact of Environmental Noise Generated from Ports: Outcome of MESP Project. Noise Mapping 2016, 3. <https://doi.org/10.1515/noise-2016-0002>
- 7 Lopez, M.; Adams, M.; Walker, T.R. Cost-Benefits Analysis of Noise Abatement Measures in the Port of Halifax, Nova Scotia, Canada. *Transp Res Interdiscip Perspect* 2024, 24, 101057. <https://doi.org/10.1016/j.trip.2024.101057>
- 8 Julien Ciucci; Claudio Detotto; Corinne Idda; Dominique Prunetti The Impact of Port Noise on Residents' willingness to Pay. In Proceedings of the 27th International Congress on Sound and Vibration 2021 (ICSV27); Carletti, E. et al., Ed.; International Institute of Acoustics and Vibration (IIAV), 2021.
- 9 Interreg Marittimo priority. [Online, accessed 15/04/2025]. <https://Interreg-Marittimo.Eu/Priorit%C3%A0>.
- 10 Interreg Marittimo CLASTER project. [Online, accessed 15/04/2025]. <https://Interreg-Marittimo.Eu/Web/Cluster>
- 11 Kephalopoulos, S.; Paviotti, M.; Anfosso-Lédée, F.; Van Maercke, D.; Shilton, S.; Jones, N. Advances in the Development of Common Noise Assessment Methods in Europe: The CNOSSOS-EU Framework for Strategic Environmental Noise Mapping. *Science of the Total Environment* 2014, 482–483. <https://doi.org/10.1016/j.scitotenv.2014.02.031>