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NOISE CONTROL FOR A BETTER ENVIRONMENT

The Port Noise Analysis and Control in Interreg Italy-France Maritime Programme

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ABSTRACT

In the North Tyrrhenian sea, port noise affects the development of harbour cities on both French and Italian coasts. Tourism, goods transportation and passenger traffic are increasingly limited by noise impact on port cities, which annoys residents and disturbs the sleep of the exposed population. Therefore, the EU has promoted a coordinated action to control and reduce port noise in the area through the IT-FR Maritime programme, with an investment of more than 11 M Euros. Organisations and public institutions from Tuscany, Sardinia, Corsica, Liguria and PACA are sharing this ambitious programme aiming to harbour noise control. Six projects have been funded to develop a recovery strategy and promote collaboration between port stakeholders. REPORT, RUMBLE, MONACUMEN, DECIBEL, LIST and TRIPLO are all projects covering different aspects of port noise in the framework of a coordinated policy over a specific area of the Mediterranean Sea. Each project addresses a specific goal, in accordance with an overall coordinated strategy: RUMBLE deals with large commercial ports, DECIBEL with small touristic harbours, LIST with noise from traffic generated by the ports, MONCUMEN with measurements and characterisation, REPORT with modelling and impact prediction, TRIPLO with reaction of the exposed population. The outcomes of these projects are expected to create a decisive turning point, both at territorial and technical level, with relevant benefits for the eligible area of the Maritime IT-FR programme and, more in general, for the whole of Europe.

Keywords: Port Noise Control, Port Noise Analysis, Noise Policy, EU Projects for Noise Reduction

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1. INTRODUCTION

Port noise is an element of criticality that contributes to limiting the development of commercial and tourist ports (marinas) [1], as well as negatively affecting the quality of life of the exposed population [2]. Despite numerous studies on this topic [3, 4, 5] and the great availability of technologies for acoustic containment [6, 7], a limited experience in the specific field of port noise makes it difficult to assess its environmental impact and to date, the effectiveness of possible improvement interventions.

Thanks to the funding received from the INTERREG Italy-France Maritime 2014-2020 European Cooperation Programme [7], a group of six projects related to the management and control of port noise is working together to achieve the common goal of more sustainable and environmentally friendly ports. These projects affect the area of the Northern Tyrrhenian Sea and involve Corsica, Sardinia, Liguria and the five provinces of the Tuscan coast, together with the French departments of the Alpes-Maritimes and the Var, located in the Provence-Alpes-Côte d'Azur (PACA) region (Fig. 1). A good 6.5 million people are potential beneficiaries of the actions of the programme, which is aimed at public bodies, equivalent public bodies, administrations, public or private local, regional, national or international public transport agencies, port authorities, public research centres and individuals, universities, companies, trade associations, shipping companies and harbour masters' offices.

In particular, the REPORT project [8] aims at the realisation of a joint multidisciplinary study, which acts as a link between the other five "sister projects" (DECIBEL, LIST Port, MON ACUMEN, RUMBLE and TRIPLO), each of which deals with a specific aspect of the port noise control theme. DECIBEL is aimed at the study of noise in marinas, LIST Port concerns the sound impact due to traffic induced by ports in neighbouring urban areas, MON ACUMEN deals with the measurement and assessment of port noise, RUMBLE deals with large commercial ports while the focus of TRIPLO is on the perception that the exposed population has of the phenomenon

Addressing a regulatory gap and suggesting common methods for the specific management of port infrastructure noise, the cross-border approach of the various projects will allow us to achieve results that are appropriate to a phenomenon that goes beyond frontiers and borders and whose social, economic and environmental impact is continuous growth. The results expected from a similar transnational action are many and range from the development of a numerical calculation model that can then be integrated into European legislation, the definition of best practices for the different port areas, up to the evaluation of the effects produced by port noise on the population and the consequences of an economic and social nature.

In the following, the INTERREG IT-FR Maritime programme is introduced first, followed by an examination of the characteristics, objectives and expected results for each project. The conclusions photograph the progress of the various projects and the first results achieved.

2. INTERREG ITALY-FRANCE MARITIME PROGRAMME

The Interreg Maritime Italy-France Programme 2014-2020 is a cross-border programme co-financed by the European Regional Development Fund (ERDF) in the framework of European Territorial Cooperation (ETC). The programme aims to achieve the objectives of the EU 2020 Strategy in the Central and Northern Mediterranean area, promoting smart, sustainable and inclusive growth. The programme takes into consideration the problems of the marine, coastal and island areas, but also addresses the internal ones, with specific risks of isolation. The main objective is to contribute to strengthening

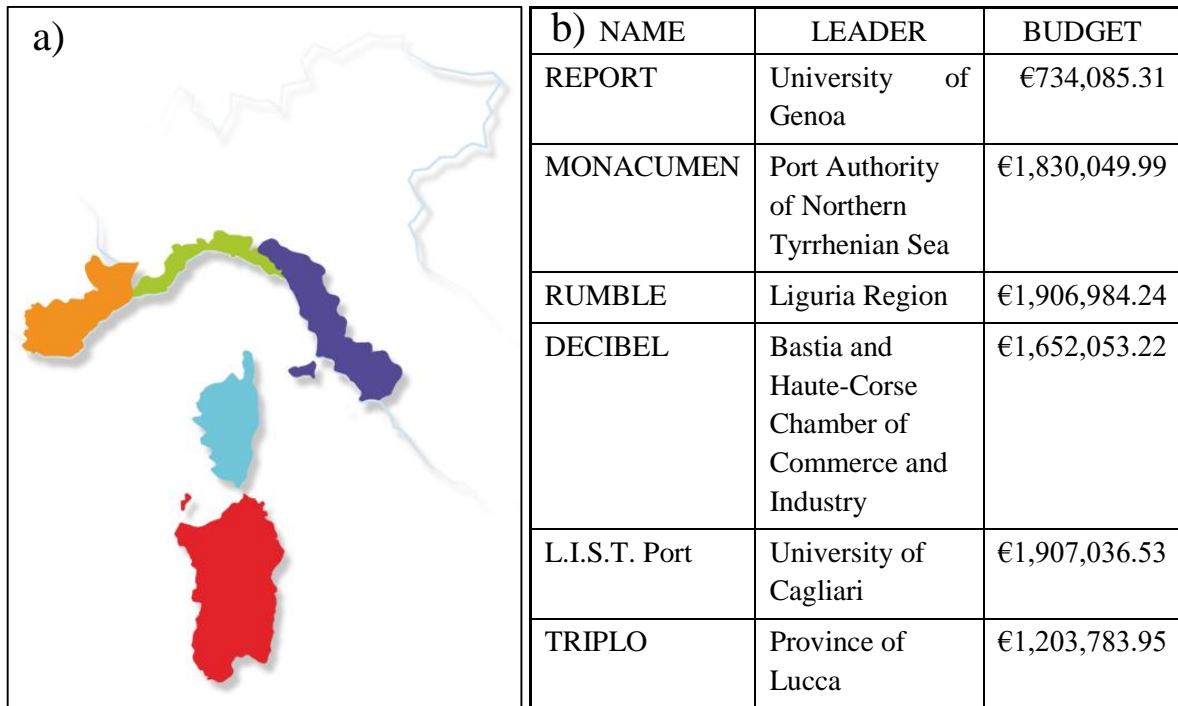


Fig. 1. Maritime IT-FR Programme: (a) eligibility area and (b) projects regarding port noise

cross-border cooperation between the designated territories to making this area a competitive, sustainable and inclusive area in the European and Mediterranean landscape. For the current planning phase, the Interreg Maritime Italy-France Programme 2014-2020 has a financial funding of €199,649,898.00

The INTERREG Maritime Programme 2014-2020 pursues its commitment to support cooperation between the territories of two member states (France and Italy): Corsica, Sardinia, Liguria and the five provinces of the Tuscan coast, as in the previous programming (2007-2013), to which were added the French departments of the Alpes-Maritimes and the Var, located in the Provence-Alpes-Côte d'Azur (PACA) region (Fig. 1). The main objective of the INTERREG Italy-France Maritime Programme is to contribute to strengthening long-term cross-border cooperation between the participating regions and to make the cooperation space a competitive and sustainable area in the European and Mediterranean panorama. In particular, Axis 3 of four priority axis making up the Programme, namely “Improving the connection of territories and the sustainability of port activities”, envisages contributing to the improvement of connections between secondary and tertiary cross-border nodes to the trans-European transport network (TEN-T), increasing the transport offer and the development of multimodality as an advantage for the population of the area, in particular citizens located in isolated areas-islands and inland areas. The same axis aims to improve the sustainability of the activities carried out in ports by reducing noise pollution and CO₂ emissions.

Within Axis 3, Lot 2 is centred on projects aimed at reducing noise pollution in commercial ports by defining common simulation and regulation models for noise reduction, the adoption of Intelligent Transportation Systems (ITS) for the management of intermodal traffic and the implementation of investments for small infrastructures and for monitoring in commercial ports and related logistics platforms. The Investment Priority is to develop and improve low-noise and low-carbon transport systems, in order to promote

sustainable regional and local mobility. The specific objective is to improve the sustainability of commercial ports and related logistics platforms, contributing to the reduction of noise pollution

The Axis 3 Lot 2 programme finances, for example, the following actions:

- identification in the cooperation area of the port and neighbouring areas most subject to noise caused by the movement of goods and the concentration of passenger and goods traffic;
- selection of good practices for application of ITS systems in contexts similar to those of the project;
- design and joint implementation of ITS systems for the integrated management of multimodal logistics and traffic in the port areas of the cooperation area;
- actions to sensitise administrators and port operators on the use of ITS systems.
- networks for monitoring noise pollution in port areas and surrounding areas most affected by traffic and port activities.

In addition, funding is foreseen for small infrastructures aimed at reducing noise emissions and monitoring noise pollution in the commercial ports of the cooperation area, also based on experiences and good practices already implemented.

Funding beneficiaries are public bodies, equivalent public bodies, administrations, public or private local, regional, national or international public transport agencies, port authorities, public and private research centres, universities, companies, trade associations, shipping companies and harbour masters' offices.

3. REPORT PROJECT

Ports overlooking the Mediterranean are often surrounded by densely populated urban areas impacting the noise generated by port sound sources. The long-term general objective of REPORT (*Rumore E PORTi* - Noise and Ports) is the mitigation of sound emissions from ports in the area of cross-border cooperation to make port infrastructures more sustainable in the eligibility area of the IT-FR Maritime programme [8]. This can be achieved through the creation of a specific approach to the correct management of noise that is currently missing in the regulatory system. This methodology, developed in a multidisciplinary manner thanks to the different skills of the organizations that make up the partnership, aims to be implemented and integrated within the 2002/49/EC Directive which does not specifically require an assessment of the noise emitted by ports but assimilates it to industrial noise without taking into account the characteristics and peculiarities of such realities, such as complex sound sources of different nature and characteristics, distribution of the sources themselves, peculiar characteristics of propagation (e.g. stretch of water in front of the infrastructures).

The definition of new algorithms and methodologies will delineate and define the best common and replicable cross-border strategies for the abatement of noise pollution, making it possible to tackle the port noise management aspect in a complete and therefore sustainable manner. The characterisation of the different specific sources operating in ports (vessels at anchor and at the quay, cranes of different characteristics, loading and unloading operations, heavy vehicle traffic, railway traffic, shipbuilding activities, etc.) constitutes an element of considerable interest and novelty to the current state of the art. In addition, an integration of the legislation from the point of view of the acoustic impact would complete the analysis of pollution by physical agents (already inclusive of approaches related to air pollution).

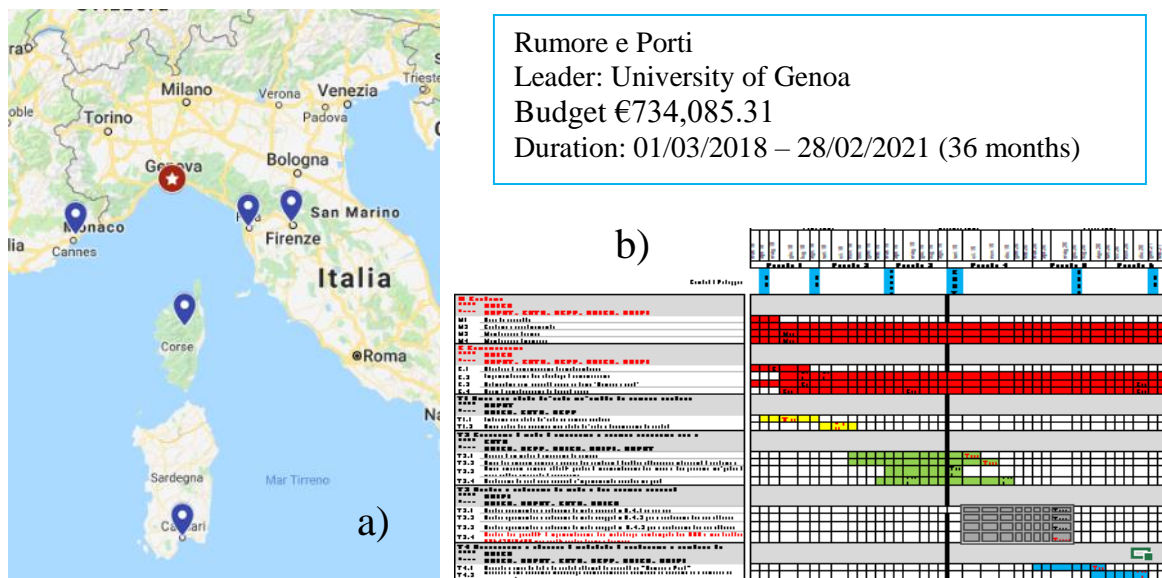


Fig. 2. REPORT: (a) location of the partners; (b) GANTT of the project

The numerical simulations and the new algorithms and methodologies designed to outline and define the best common strategies for the abatement of the noise pollution developed in REPORT are by their very nature general and therefore designed to be applicable and replicable in every port reality. This allows, therefore, to guarantee the sustainable development of commercial ports and associated logistic platforms, ensuring their growth and expansion, while at the same time limiting the impact on the surrounding urban population, whose sensitivity in the field of noise pollution is ever increasing. Scientific bodies and local public bodies will benefit from the project outputs in terms of greater awareness of the problem and the correctness and rigour of the methodologies designed to describe and deal with it successfully.

The expected duration of REPORT is 36 months. The total funding of the project amounts to €734,085.31. The partnership consists of: the University of Genoa (project leader), ARPA Tuscany, the University of Pisa, the Université de Corse, CSTB and the University of Cagliari (Fig. 2).

4. MON ACUMEN PROJECT

The MON ACUMEN (*MONitorage Actif Conjoint Urbain-MaritimE de la Nuisance* – Joint active maritime noise monitoring) project focuses on the development of a methodology of detection, data collection and analysis of effective noise emissions and improving the current in order to allow significant planning and control in the commercial ports of La Spezia, Livorno, Cagliari and Bastia; indeed, these sites present numerous residential neighbourhoods close to significant noise sources. The project has as its strong point that of sharing and cooperation between France and Italy, which has as its goal the development of detection tools compliant with national and European standards, the production of information useful for transport policy in both countries and uniformity in monitoring. MON ACUMEN therefore intends to make up for the lack, so far found, of a common approach since it is necessary to make cross-border relations homogeneous in compliance with the provisions of 2002/49/EC Directive which requires methods of shared determinations among member states on exposure analysis to noise..

MON ACUMEN has realised the first network of monitoring and control of noise pollution generated by ports in cross-border areas. This network consists of investments in devices installed in commercial ports and the related software part of environmental monitoring systems. Through a preliminary analysis of the port activities and their acoustic

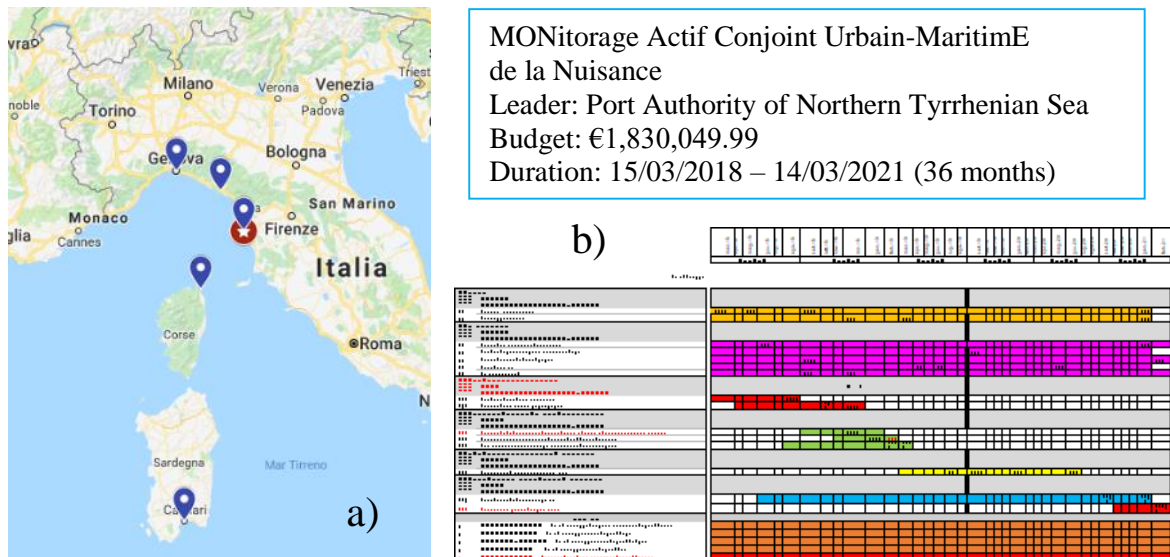


Fig. 3. MON ACUMEN: (a) location of the partners; (c) GANTT of the project

impact, we arrive at definition of the site to be monitored continuously. The cross-border dimension of investments allows a set of interventions not otherwise obtainable in the local dimension alone and a depth of analysis that measures different types of activities according to the characteristics of each port. This allows real-time knowledge of the impact of noise sources and also the possibility of identifying and predicting critical situations that inevitably trigger residents' protest actions. Citizens therefore constitute a primary target for the implementation of effective and shared monitoring systems, supported and assisted indispensably by the target group of universities, research centres and regional environmental protection agencies.

The planned activities are inserted into this framework because starting from collection and analysis of the data already available, they provide a set of specific port-related information of usefulness and address for all the ports in the cooperation area and also for those not directly involved in the project. MON ACUMEN carries out projects of acoustic monitoring systems based on common specifications that are transferable and adaptable to the various realities with detection units and highly-usable sensors. For the first time, a unique validation of the systems has been carried out, certifying that the results correspond to the requirements of European legislation and national and regional regulations.

Coordinated by the Port Authority of the Northern Tyrrhenian Sea (which manages the ports of Livorno, Piombino, Portoferraio, and Capraia), the project involves the Port System Authority of the Sea of Sardinia, the Port Authority of the Eastern Ligurian Sea, the University of Genoa, the Regional Environmental Protection Agency of Tuscany and the Bastia Chamber of Commerce and Industry. The total funding of the project amounts to € 1,830,049.99. The project started on 15 March 2018 and will last until 14 March 2021 (Fig. 3).

5. RUMBLE PROJECT

The main objective of the RUMBLE (*Réduction du bruit dans les grandes villes portuaires dans le programme maritime transfrontalier* - Noise reduction in large port cities in the cross-border maritime programme) project is to improve the sustainability of commercial ports by contributing to the reduction of noise pollution in the Maritime programme cooperation space. With the project we intend to respond to a deeply felt environmental problem in the area of cross-border cooperation, where there are many ports

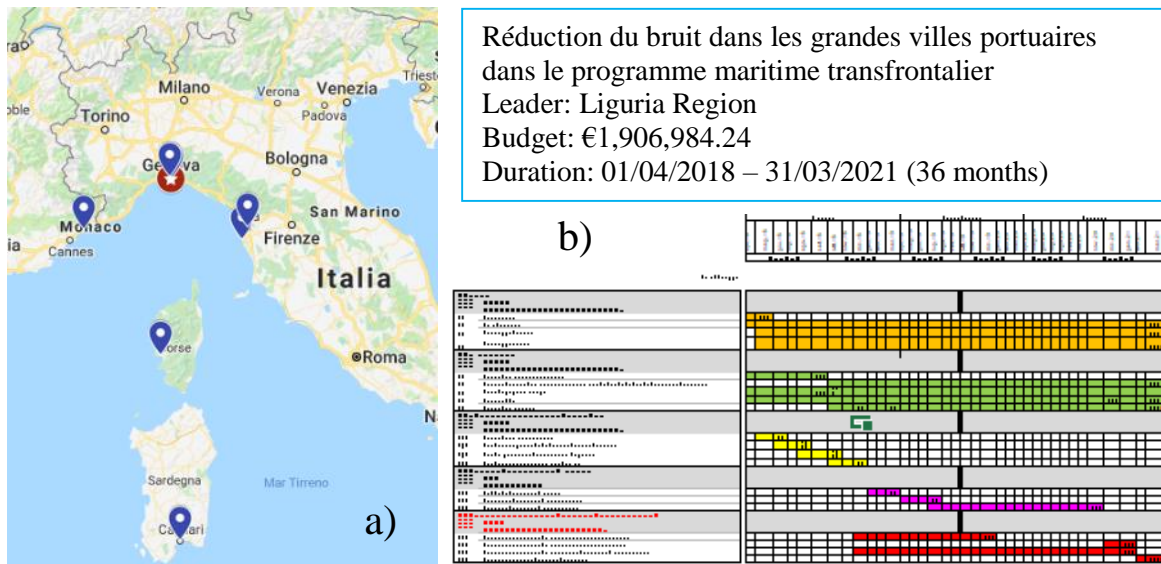


Fig. 4. RUMBLE: (a) location of the partners; (b) GANTT of the project

inserted in the urban context. RUMBLE is also part of a network of maritime noise projects that develop a complementary and integrated approach to the issue.

The specificity of the project is to aim at the control and reduction of noise coming from the large commercial ports, in this case Cagliari, Genoa, Nice, and Livorno. Due to the nature of the activities carried out and the strong generation of vehicular and railway traffic, these ports are extremely significant sources of noise and impact heavily on the surrounding territory. The project aims to improve the monitoring of sound sources due to noise pollution in commercial ports and to deploy small infrastructures to try to reduce the main sources of disturbance for the population living in neighbouring urban areas.

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- road haulage of heavy vehicles generated by port activities;
- the mooring of vessels;
- work on the docks (mobility of materials, use of buzzers ...).

The project initially envisaged the implementation of an acoustic climate survey to identify the most critical areas and activities. Subsequently, small noise mitigation interventions were carried out, which were to be monitored in itinere and ex-post. The first year of the project was therefore dedicated to reconstructing the state-of-the-art picture on the noise generated by large commercial ports in the area of cross-border cooperation. The next project period will instead be dedicated to checking the impact of the infrastructures implemented.

The University of Pisa and the University of Genoa are involved in an investigation work at the port facilities and local administrations aimed at understanding if and to what extent the noise emissions are studied and monitored; to characterise the noise and its sources; to identify the mitigation solutions implemented. The survey is carried out through a bilingual questionnaire addressed to citizens and institutions involved in various ways in the problem.

RUMBLE is a 36-month-long project financed with 1.9 million euros. The partnership consists of: the Liguria Regional Authority (project leader), the University of Genoa, the Port Authority of Genoa and the University of Pisa (Fig. 4)

6. DECIBEL PROJECT

The DECIBEL project (*Dépollution acoustique des centres portuaires urbains et insulaires* - Acoustic remediation of urban and island port centres) responds to the challenge of improving the connection of territories and the sustainability of port activities. DECIBEL also aims to improve the sustainability of commercial ports and logistics platforms as it is to reduce noise pollution. The particularity of the DECIBEL project is therefore to act on tourist ports (marinas), even small ones, to evaluate the noise impact and what strategy to adopt to contain it. This is a highly innovative topic and has not been analysed so far. It is commonly believed that the small size of the port corresponds to a limited sound pollution; this is contradicted by reality, since very often in the case of marinas the urban fabric is immediately close to the port area, with a greater interaction and disturbance. On this condition the project intends to intervene, defining which are the best acoustic remediation measures for this situation.

Its objectives are therefore:

- studies and diagnostics of noise emissions in tourist ports(marinas) in the cooperation area.
- definition of a common strategy and a common action plan to reduce noise pollution.
- implementation of transferable pilot actions.
- creation of a guide to good practices and their extension to remote areas.

Specific actions of the project are:

- studies and diagnostics of acoustic emissions, as well as possible solutions for the realisation of a joint model for the reduction of noise pollution: the project has the specific objective of carrying out specific studies and analyses in the case of ports that will identify the sources and the nature of the noise.

- reduction of acoustic pollution in ports through lasting and transferable pilot actions: DECIBEL aims to reduce noise pollution in an appropriate, articulated and innovative way in all the project partners. This reduction will be carried out on the basis of pilot actions which will result in small infrastructures consistent with the joint action plan that has been elaborated under the project.

- enlargement of the problem to the peripheral areas of the ports also subjected to noise pollution caused by the maritime activity: the DECIBEL project will allow us to associate the managers of the peripheral areas to the port (city, roads ...) also responsible for the noise pollution in the area.

The specificity of the project is represented by the attention to small ports, such as Ajaccio, Ille Russe, Olbia, Portoferraio or Giglio. Even though the traffic of boats and vessels is less important in these ports, their small size still sees them exposed to disturbing noise levels. In detail, the CSTB (Scientific and Technical Centre for Building) was selected following a call for tender issued by the Bastia Chamber of Commerce and is in charge of

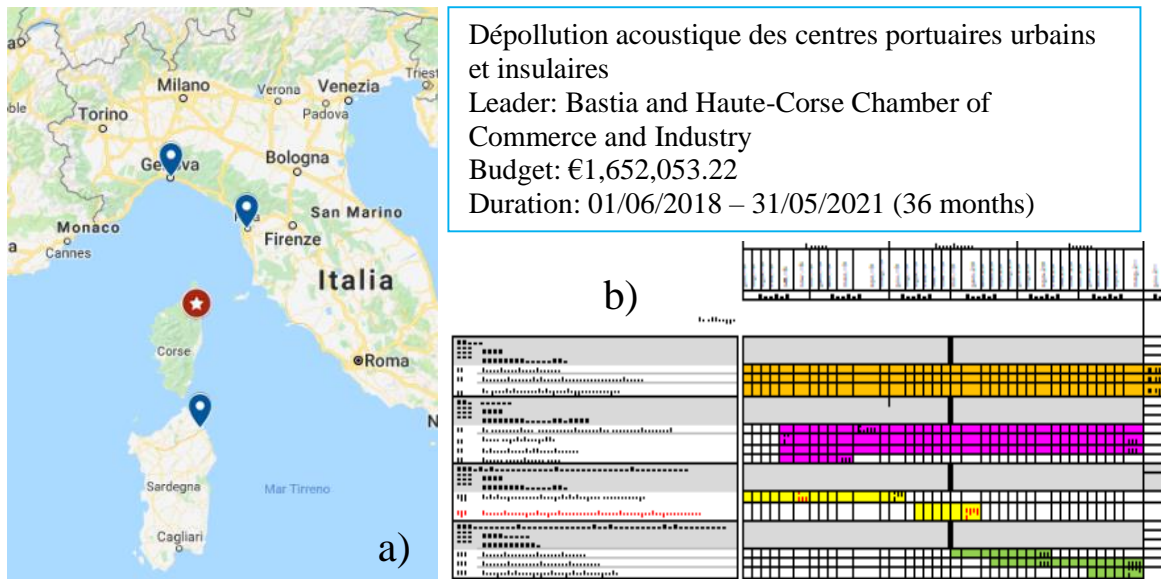


Fig. 5. DECIBEL: (a) location of the partners; (b) GANTT of the project

studying the French ports (Bastia and Ile-Rousse). UNIGE (University of Genoa) will carry out the same study for the Italian ports of Giglio, Portoferraio and Olbia.

The DECIBEL project has a duration of 36 months starting from June 2018. The amount financed is €1,652,053.22. The partners are: the Bastia and Haute-Corse Chamber of Commerce and Industry (project leader), the Municipality of Olbia; the National Association of Italian Municipalities (ANCI) Tuscany Region Section and the University of Genoa (Fig. 5).

7. LIST-PORT PROJECT

The acronym L.I.S.T. Port corresponds to “*Limitazione Inquinamento Sonoro dal Traffico nei porti commerciali*” (Traffic Sound Pollution Limitation in commercial ports) and aims to improve the sustainability of commercial ports and related logistic platforms, contributing to the reduction of noise pollution. Therefore, the challenge of LIST-PORT is to improve the “Acoustic Climate” of port cities through the use of integrated ITS systems of traffic management: the general objective is to evaluate how these systems affect the reduction of traffic volumes and therefore of sound pressures in the port and urban area.

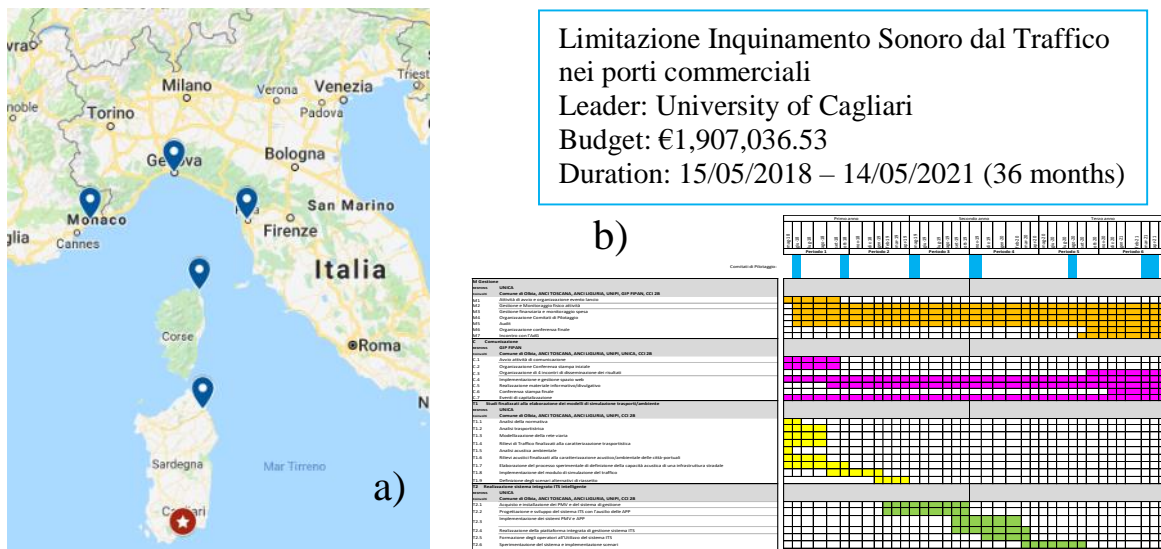


Fig. 6. L.I.S.T. Port: (a) location of the partners; (b) GANTT of the project

Initially the traffic and noise levels will be monitored in the ports and in the main road arteries; then the road networks will be modelled, in order to have a virtual model capable of simulating new network scenarios. After assessing the criticalities and comparing with the already calibrated sound capacity levels, alternative solutions of distance and/or access to ports will be identified, to be introduced through the use of ITS systems based on info-mobility platforms (PMV or APP) able to provide information to drivers in real time. An ex-post evaluation will measure the decrease in traffic and sound pressure following the introduction of these ITS systems, also identifying any corrective measures.

The common challenge for LIST-Port partners is to identify, through a common approach and system, the most effective actions to mitigate traffic noise generated and attracted by the port node. The final beneficiaries will be residents and visitors in the port cities, while the second level will be the port operators who can count on optimal management of access to the port and a more effective management of internal traffic.

The project is based on a cross-border approach, where the results obtained in the experiments in the four pilot cities will be evaluated and compared with the different urban, orographic and territorial configurations, to define a methodological standardisation and modelling and their subsequent replicability in other contexts. The project will develop two different ITS systems: the first based on the user interface with PMV, while the second with the user interface based on APP for smartphones and tablets. Both systems provide information to the user on the basis of processing carried out with traffic models, which, according to the instantaneous detected vehicle flows, evaluate in real time the system's acoustic and environmental state, and, if the latter signals impact limits above threshold, rationalises and reassigns the flows in the network, through the automatic sending of info-mobility messages that lead users to change routes for all those generated/attracted by the port node.

The LIST-Port project, with an expected duration of 36 months, has a total budget of €1,907,036.53. The partnership consists of: the University of Cagliari (project leader), Municipality of Olbia, Bastia Chamber of Commerce, National Association of Italian Municipalities (ANCI) Tuscany, GIP FIPAN Nice, National Association of Italian Municipalities (ANCI) Liguria and the University of Pisa (Fig. 6).

8. TRIPLO PROJECT

The focus of the TRIPLO (*TRasporti e collegamenti Innovativi e sostenibili tra Porti e piattaforme LOGistiche* - Innovative and sustainable transport and connections between ports and logistic platforms) project is the improvement and sustainability of commercial ports and related logistics platforms, through the reduction of noise pollution. The specificity is therefore attention to the induced acoustic impact of the port and in particular of the back-port logistics areas or connected to the ports; such logistic systems, although often separate, are a source of disturbance, no less than the ports themselves and therefore deserving of specific attention and specific analysis. What is more, the acoustic remediation actions must be targeted and adapted to the characteristics of the source.

The project stems from a common problem: the high level of noise pollution that affects the areas between ports and logistics platforms. The general objective is to develop a cross-border strategy to reduce noise pollution in these areas by adopting models for the regularisation of traffic flows to be applied to the movement of goods on land. In fact, noise pollution in these areas does not only derive from port activities, but also from related logistics activities.

TRIPLO will tackle the noise management challenge focusing on the areas between the ports and the logistic platforms connected to them, which represent the most populated areas and therefore those most exposed to the risk of noise pollution. The project intends to



TRasporti e collegamenti Innovativi e sostenibili
tra Porti e piattaforme LOGistiche
Leader: Province of Lucca
Budget: €1,203,783.95
Duration: 01/03/2018 – 31/08/2020 (30 months)

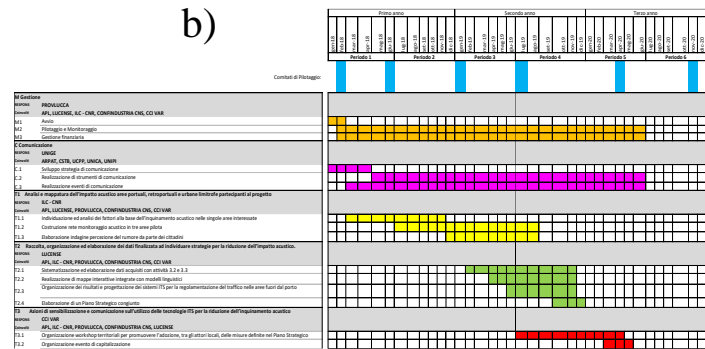


Fig. 7. TRIPLO: (a) location of the partners; (b) GANTT of the project

propose an innovative approach. In addition to a preliminary analysis, which will serve to identify the most critical areas, specific linguistic parameters will be detected through questionnaires and interviews to assess the perception of the phenomenon by the exposed population. In addition, the physical parameters will be acquired, thanks to the implementation of a monitoring network with low-cost sensors in three pilot areas for real-time acoustic data detection and the production of live noise maps, which will be integrated with the linguistic data. On the basis of the data collected, the most appropriate ITS solutions and other complementary measures to reduce noise pollution will be identified. These measures will then be merged into the Joint Strategic Plan. Finally, through four workshops, one per territory involved, organised by the institutional project partners, possible governance models will be outlined for the implementation of the measures identified in the Strategic Plan. These groups, made up of public-private entities, can activate, on the basis of the measures shared in the Plan, projects of a public and/or private nature for the implementation of the measures themselves.

The TRIPLO project has a duration of 30 months: start of project 1 March 2018 - end of project 31 August 2020. The financing amounts to €1,203,783.95. The partnership is made up of: the Province of Lucca (project leader), Livorno Port Authority, Lucense Scarl, the National Research Council (CNR) of Liguria, Confindustria Centro Nord Sardegna and the VAR Chamber of Commerce and Industry (Fig. 7).

9. CONCLUSIONS

Under the INTERREG programme, funded by the European Regional Development Fund, the Italy-France maritime cross-border programme 2014-2020 aims to achieve the objectives of the Europe 2020 strategy in the North Mediterranean area by promoting smart, sustainable and inclusive growth. In particular, the specific objective of Axis 3 - Lot 2 of the programme is to improve the sustainability of commercial ports and logistics platforms to reduce noise pollution.

The REPORT project and the sister projects LIST-Port, DECIBEL, RUMBLE, MON ACUMEN and TRIPLO, are tackling the issue of port noise reduction from different points of view (technical, management, socio-economic) and at different levels (commercial ports, tourist ports or marinas, port cities). We have now reached a certain development of the different projects, which, after a first start-up phase, are now achieving the first results.

Measurement campaigns have been launched, as well as the implementation of the interventions defined during the planning phase. At the same time, we are working on developing knowledge of the phenomenon and adequate databases and calculation algorithms.

As surprising as it may seem, the amount of information available on the subject of noise and ports has proved to be inadequate according to various aspects, both quantitative and qualitative. This has complicated the first phases of activities of the different projects, making at the same time the realisation of a shared database that can contain in an organic and usable way both the data available in literature or documents, and those gradually acquired during the implementation of the different projects.

At the end of the various activities envisaged, a concentration of skills and activities in the field of port noise will be achieved, such as to represent a unique case at an international level. Therefore, the significant funding provided by the EU can be capitalised on two levels: by promoting acoustic remediation actions in an area with a high intensity of ship traffic; facilitating the development of specific knowledge, able to last beyond the end of the project and constitute a permanent core of knowledge at the service of the territory and of the whole EU.

10. ACKNOWLEDGEMENTS

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