NOISE POLLUTION MANAGEMENT IN PORTS: A BRIEF REVIEW AND THE EU MESP PROJECT EXPERIENCE

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Ports and harbors are characterized by several complex operations, especially if compared with other logistic nodes. In these scenarios, noise pollution analysis is complicated due to the presence in the same area of several types of sound sources with different characteristics. Noise from port areas comes not only from ferries, ships and trade but also from industrial and shipyards activities as well as auxiliary services. In this way, noise pollution can produce negative effects both to the natural eco-system and to the urban population.

To assess and manage the environmental port noise, the ENPI CBC Med project MESP (Managing the Environmental Sustainability of Ports for a durable development) addresses the reduction of pollution from port activities through the implementation of a multidisciplinary approach, which encompasses technological, regulatory and administrative solutions.

The MESP project, starting from an analysis of the “status quo” of current ports condition both in the Northern and Southern part of the Mediterranean basin, aims to reach the identification of best practices, methodologies, technologies and procedures adaptable and transferable in different Mediterranean port contexts which will be merged in certification processes for procedures and tools allowing to reach an higher level of sustainability and to decrease the pollution level, reinforcing, at the same time, competences of public-decision makers and local administrators.

Optimizing the noise characterization through environmental acoustical monitoring plans allows to identify, by means of sound level measurements and proper acoustic descriptors, the most critical noise zones, to recognize the causes producing them and to acoustically characterize sound sources (sound power, spectral characteristics, duration). Only in this way the activation of operative actions for the acoustical comfort improvement of critical areas can be successfully implemented. Therefore, management actions and intervention priorities against noise in port areas can be planned and developed by improving procedures, policies and tools.

1. Introduction

Port facilities are heterogeneous and complex scenarios and the activities carried out within the boundaries have significant environmental impact as relevant sources of pollution which have to be take in consideration for a sustainable development of harbors [1]. In this paper a brief review on the noise management of harbors have been conducted, with a global view on standard regulation, best practices and literature analysis.
According to the general objectives of the ENPI CBC MED Programme, MESP project (Managing the Environmental Sustainability of Ports for a durable development) aims to decrease pollution levels concerning air, noise and water deriving from port activities and give back to citizen, tourist and workers an healthier and usable environment. This can be possible by providing procedures and tools which allow objectively to value the sustainability of ports and thanks to the creation of practices and procedure easily applicable in the both sides of the Mediterranean Sea.

The MESP project target goals are the identification of best practice and procedures and the realization of pilot projects in different port in order to firstly assess the validation of the selected methodologies. In this way, these actions can help management authorities and port areas and infrastructures users in reaching a higher level of sustainability and in decreasing the pollution levels.

2. Noise pollution within port areas: a brief review

Many ports, especially in the Mediterranean basin, are in close proximity to the urban area, often as integral part of it, representing the most important and critical transit area between the sea and the city. The impacts of important commercial, industrial and construction activities concentrated into a strict coastal area, often on the border of the town centre, can take negative effects both to the sea eco system and to the urban population.

It is well known that port areas contain several noise sources in various sectors with different characteristics from each other, such as ferries, ships and trade operations, industrial and shipyards as well auxiliary services [2]. Such activities strongly impact the environment of the surrounding area and, as a consequence, local population, port workers and tourists as well as both terrestrial and marine ecosystems.

The European Sea Port Organization (ESPO) represents the port authorities, associations and administrations of the seaports of the Member States of the European Union and Norway with the aim to make the European port sector more efficient and environmentally sustainable. The organization, after the PPRISM (Port PeRformance Indicators: Selection and Measurement) project [3], delivered the first European Port Performance Dashboard in 2012. In 2013, ESPO produced the “ESPO Port Performance Review 2013” whose outcomes contributed to the second edition of the Port Performance Dashboard [4]. In this document ESPO presents the environmental priority of the sector issues rank changing in time from 1996 to 2013. As it can be seen in Fig. 1, noise impact reaches and maintains high ranking from 2004. In 2011, when the MESP project was submitted for the evaluation, it was considered as the top environmental priority by the European port sector as a whole, pointing out the issue related to noise annoyance on port workers and the surrounding population.

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Figure 1. ESPO Top-10 environmental priorities of the European port sector over time [4].
Thus, noise pollution is proved to produce negative impact both on the natural eco-system and to urban population, causing harmful effects and damages on human health [5] (hearing and cardiovascular disturbances, high blood pressure, sleep disturbance, reduction in efficiency, annoyance, mental stress, lack of concentration).

The EU Environmental Noise Directive (2002/49/EC) [6], in accordance with ISO standards, includes noise provides a basis for measures development aimed to reduce noise emitted by the major sources, including ports within sites of industrial activity. Actually, as port infrastructures present highly complex situations, no specific regulations addressed to noise control and management within harbor areas has never been enacted. Several surveys have been conducted in the past as a base for future regulations [6] but the legislation still now turns out incomplete concerning noise pollution in harbors. Several tools and recommendations/policies have been since now implemented, helping the noise control and reduction both inside and outside the port areas [8].

ESPO presents periodically the “ESPO Green Guide” publications [9] to address its member ports in establishing and developing further their environmental management programs, to trigger port authorities to be proactive towards sustainable development and to benchmark their performance (“EcoPort” status). Moreover, it provides, as well, exemplary response options and good practices that are in place in European ports and overviews on the most significant EU legislation that influences the environmental management of port areas.

Another relevant initiative is the NoMEPorts (Noise Management in European Ports) project. As a results of the activities, the partnership a structured approach for the mapping and management of noise in seaports area has been developed and the “Good Practice Guide on Port Area Noise Mapping and Management” [10] provides guidance and examples of best practice on noise management in ports to be used by other ports in order to implement noise management systems.

A number of studies have been then conducted in order to analyze the noise impact, exposure and control in port areas. Generally, the global approach to the evaluation and reduction of noise within harbor environment has been investigated considering -and identifying- the large number of noise sources [11], often dynamically distributed in space and time [12], terminal uses [13], classifying the general activities (standard or non-standard procedures for noise measurement, related risk assessment calculation) [14] and implementing noise control system [15].

Noise generated by ships impacting both on crew workers and passengers (inside the ship) as well as the surrounding areas (emission in air), represents an issue increasingly analyzed and considered over time. The assessment of the impact is currently difficult due to the lack of specific standard instrument and indicators able to characterize and control the ship noise type [16].

In order to evaluate ships sound power levels, different tools have been investigated and presented in literature, both as mobile (ship under way) or stationary sources (ship berthed at wharf); therefore different approaches can be found. The use of cognitive tools, such as acoustic measuring techniques and information on the water traffic control network, have been considered in order to describe and characterize vessel emissions and to elaborate a noise control strategy [17]. Experimental and theoretical researches have been carried out to assess the airborne noise propagation from merchant [18] as well as moored ships [19] and procedures for predicting noise impact of moored cruise vessels have been developed and improved [20]. Moreover, since ships are complex sources (varying in dimensions, engine power and number of on board noise sources) there is a lack in commercial simulation software for vessel noise module and libraries. The outdoor noise propagation of multipurpose ships has been modeled recreating the geometry as a combination of punctual, linear and area sources [21].

In order to avoid important environmental and social-economic impacts, it is necessary to take immediate actions, involving the most experienced European and international professionals, local authorities, port managers and research entities.
3. MESP project

The protection of the environment and the prevention of pollution scenarios are important competitive features for the whole Mediterranean basin. In fact, the intensification of maritime traffic, both in terms of goods and passengers, needs to be accompanied by an environmentally sustainable management of port areas aimed to reduce unsafe consequences for local populations.

According to the general objectives of the ENPI CBC MED Programme, MESP project (Managing the Environmental Sustainability of Ports for a durable development, Grant Agreement contract number 10/2263) aims to reduce air, noise and water pollution due to port activities, ensuring environmental -both natural and urban- sustainability of harbour activities and a high level of life quality in surrounding territories.

MESP project, started in June 2012 for a total duration of 36 months, is developed by 6 partners from four countries both from the Northern and Southern part of the Mediterranean basin: Italy, Greece, Lebanon and Jordan. These countries are historically representative of the area [22], having important ports and remarkable values of their maritime potential index [23] (the ratio between a country’s fleet size and its population, i.e. the gross register tonnage per capita [24]) since the end of the Second World War [25].

The partnership is composed of: the Research Centre in Town Planning and Ecological Engineering (CRUIE) from the University of Genoa, Italy (as the Beneficiary); the Physical Oceanography Marine Science Station (MSS) from the University of Jordan, Aqaba, Jordan; the Port Authority of La Spezia, Italy; the Al-Manar University of Tripoli (MUT), Lebanon; the Department of Environment and Sustainable Development from the Patras Municipal Enterprise for Planning & Development S.A. (ADEP), Greece and the Exploitation Office of Port of Tripoli (OEPT), Lebanon.

To achieve these targets MESP aims, through a multidisciplinary approach, to identify the best practices and procedures useful to define common strategies applicable in different territorial and local realities throughout the Mediterranean area. This not only allows reaching higher sustainability and decrease pollution levels giving back to citizens, tourists and workers a healthier and usable environment, but also aims to help in preventing a heterogeneous development of port infrastructures in the Mediterranean basin and enable the entry of new methodologies which can facilitate work activities and environmental pollution abatement actions.

In order, then, to assess all the procedures, validation tests will be carried out through the application of the selected methodologies to different real cases. For any sector two different ports for demo intervention have been chosen. To have an overall overview of improvements, pilot interventions on all the three sectors (air, noise and water) will be implemented in the Port of Tripoli, as well as in Patras for noise sector, in La Spezia for air and in Aqaba for water.

4. The project activities

MESP activities have been articulated in 5 Working Packages (WPs) as shown in Fig. 2. Besides the transversal WP1 on Coordination and Management and WP5 on Dissemination and Communication, WP2 (Knowledge sharing), WP3 (Tool’s implementation) and WP4 (Pilot Projects) represent the real project core in which the real scientific development has been implemented.

Through these activities, a real scientific development have been then implemented in order to reach results and output able to be applied to different local realities (Fig. 3). After a first step on the state of the art collection and sharing, WP3 activities have been finalized to the formulation of a common tool for procedures and tools allowing to improve the sustainability of ports through an appropriate approach and procedures. From the result of such analysis, the document “Roadmap on Sustainability Criteria: Guidelines for Port Environmental Management” have been then redacted as
Figure 2. Schematic overview of the MESP Work Packages.

a roadmap on methodologies, good practices and measurements assessment for the environmental sustainability of Mediterranean harbour areas.

The applicability of the selected strategies will be then checked in different ports and urban realities through the realization of pilot projects. In this way the true project goals will be tested as a guarantee for project proposals.

The purpose of the state of the art survey is a collection of documents concerning laws and regulation, significant experiences and best practices at international level, procedure and innovative technologies about pollution abatement local management tools and monitoring systems. The analysis of already tested methodologies and procedures has been a base for the MESP activities as a guarantee of the developed efficacy and the quality of practices.

In particular, the considered subjects have been classified in:

- Management tools
- Methodologies, tools, significant experiences and technologies for pollution reduction, abatement and monitoring tools
- Laws and standards
- Meaningful experiences and expertise (best practices), with specific focus on innovation, impact, sustainability and transfer capacity

The gathered documents have been then transferred and shared among the partnership as a reciprocal exchange of information in order to create a common and homogenous base as a starting point for the conception of a single management tool for the pollution abatement in ports.

In order to define the starting point for the built up of the guideline, the detailed study on real port situations and surrounding urban context appeared to be significant. In this way, specific analyses of the four MESP ports territorial areas (Aqaba, La Spezia, Tripoli and Patras) have been conducted, collecting information particularly on trade, logistic, transport, mobility and future territorial planning.

In building the document “Roadmap on Sustainability Criteria: Guidelines for Port Environmental Management” specific cross-cutting criteria have been chosen in order to approach the environmental and sustainable improvement and management suitable for all ports areas. In fact, beyond the peculiarities of the different pollution fields, there are actually some essential key concepts at the basis of the procedures in common among all, such as simple attitude, methodologies and indicators in order to have a general scenario, correct identification of the laws and standard to be followed and interference with port activities normal operation. These criteria, indeed, relate to the general approach to the pollution issue and can be applied a priori to any port context.

After this step, then, a deeper analysis of the criteria selected in the previous actions has been carried on. Through this action the most suitable methodologies, approaches and tools, finalized to the reduction of environmental impacts, have been identified and implemented by the different scientific competences. Their implementation aims to reach the target goal of the outcomes reproducibility and the consequent replication in the different Mediterranean ports background. The method-
ologies chosen within the activities has been addressed to the methods, skills and processes and to the approach to pollution problems by following the procedure outlined in Fig. 4.

After an overview on the general approach to pollution reduction specific key element has to be focused on the analysis of different aspects such as:

- definition of the most significant indicators to be considered and evaluated
- basic measurement equipment to use in order to carry on proper measurement campaign
- technical standard and procedures of measurement to be followed
- measurement methodologies to adopt for the pollution sources identification
- individuation of the most critical sources
- reports containing information on the collected data

As the main outcome of the WP3 (Tool’s implementation), the “Roadmap on Sustainability Criteria: Guidelines for Port Environmental Management” document represents the synthesis of the criteria and methodologies previous selection process and is intended to globally provide directions and advices for correct use and application of improvement methods to all Mediterranean Ports wanting to ensure a higher environmental impact of port activities and significantly improve life quality of the local populations.

Addressed to professional figures, in scientific, operative and technical field related to environmental pollution and scientific experts of the territory’s governance and common development strategies, the report aims to provide regulatory systems and procedures for environmental local port governance processes. Moreover it offers simple and best-practice approaches to a sustainable management of harbours and efficient methodologies and technologies for the environmental pollution reduction.

Once the prescriptions towards a port sustainable management have been defined and developed into the Guidelines document, the validation of the identified tools applicability and transferability will be carried on through the application of formulated criteria to several real scenarios. In this way, besides research activities, taking into account not only technical, environmental and regulatory parameters, but also the territorial and cultural context of different Mediterranean Countries, MESP project foresees the realization of demonstrative actions in order to test the applied methodology.
5. Conclusions

Noise pollution within port areas is a complex issue due to different causes, affecting both harbor workers and the population living in the surrounding territories. It certainly represents an actual and evolving subject; in fact, several authors are studying it from different points of view regarding environmental impact, control, management, emission evaluation and propagation models.

MESP project joins the debate proposing, through a first identification of best practices, methodologies and procedures, an approach aimed to the reduction of air, noise and water pollution deriving from port activities adaptable to different Mediterranean port contexts.

Future foreseen activities of the project before its conclusion on May 2015 will consist in the implementation of the demonstration actions. Results from the comparison between measurement before and after improving intervention will assess the effectiveness and the applicability of the selected methodologies in real port scenario. At the same time, dissemination activities are being undertaken through the participation of MESP partners to public events, meetings and congress and the connection to projects on similar topics. This allows to transmit MESP target goals and results and to arise awareness on people, local authority and stakeholders on pollution abatement in ports.

Possible upcoming progress could be represented by the project development in different sectors such as safety, waste, energy, land use management, electromagnetic emissions and chemical risks. MESP project, in fact, started with a partial view on pollution in ports (on air, noise and water sectors) but a wider-ranging overview on harbor scenario could certainly allow a better sustainable environmental management of quality within ports, compounded infrastructure in continuous development.

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