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Tool for the identification and assessment of Environmental Aspects in Ports (TEAP)

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ABSTRACT

A new tool to assist port authorities in identifying aspects and in assessing their significance (TEAP) has been developed. The present research demonstrates that although there is a high percentage of European ports that have already identified their Significant Environmental Aspects (SEA), most of these ports do not use any standardized method. This suggests that some of the procedures used may not necessarily be science-based, systematic in approach or appropriate for the purpose of implementing effective environmental management. For the port sector as a whole, where the free-exchange of environmental information and experience is an established policy of the European Sea Ports Organization's (ESPO) and the EcoPorts Network, developing a tool to assist ports in identifying SEAs can be very useful. This method has been developed in the framework of the PERSEUS research project, after analysing the strengths, weaknesses and challenges of the existing techniques, the recommendations from the Environmental Management System (EMS) standards and the advice of specialists. This is a computer-based tool (www.eports.cat) that provides a quick calculation and result, and it is designed to be as user-friendly as possible in order to facilitate its completion by the user (i.e. port environmental manager). This methodology comprises two main steps, firstly the identification of the major environmental aspects that may be generated in a port, and secondly, assessing their significance. This tool can be applied to any type of port but it provides specific results for each one.

1. Introduction

It has been widely reported that although ports around the world are major centres for the economic development of the areas where they are located, port and shipping activities also pose negative externalities and impacts to their surrounding natural habitats (e.g. Trozzi and Vaccaro, 2000; Gupta et al., 2005; OECD, 2011; Dinwoodie et al., 2012; Paalvast et al., 2012). It is, therefore, important for those with responsibilities for port environmental management to be aware of the issues that are at stake with regards to the environment in European ports (ESPO, 2012).

An effective port environmental management requires awareness and knowledge of its environmental aspects in order to know what is required to be properly managed from the environmental point of view (ESPO, 2011). According to ISO 14001 (2004), an environmental aspect is an element of an organisation's activities, products and services that can interact with the environment. Examples of them are the water discharges, emissions to air, waste generation or noise emissions.

Each port has different environmental aspects depending on activities that are carried out within the port area. It is highly recommended that port authorities select, from those, the most significant ones, called the Significant Environmental Aspects (SEA). Being aware of the SEA allows a port to focus its time, efforts and resources on those issues with major potential for environmental impact, providing the greatest assurance that the environment is protected (Puig, 2012). A SEA, as defined by the ISO 14001 (2004), is an environmental aspect that has or can have a significant impact on the environment.

It is important to differentiate an environmental impact from an

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environmental aspect. An environmental impact is any change to the environment, either adverse or beneficial, that result wholly or partially from the environmental aspects. The relationship between environmental aspects and impacts is one of cause and effect (ISO, 2004). For example, the combustion of fuel for the use of the port machinery is a port activity that generates air emissions, which is an environmental aspect. An effect of this aspect is the global warming, which involves a change to the environment, and therefore an impact.

In the process of identifying and evaluating environmental aspects, there are two steps that should be properly defined. The first one is the 'identification of environmental aspects', which is the process of detecting and recording all the aspects of an organization that interact with the environment. The second step is the 'assessment of the significance', which is the application of specific criteria to determine the significance through qualitative or quantitative systems of the previously identified environmental aspects. The procedure of 'identification of Significant Environmental Aspects' should include the identification of aspects, the definition of the evaluation criteria and the evaluation itself of the aspects, in order to determine those ones that may have a significant impact on the environment.

The process of identification and assessment of aspects should be an on-going, periodic review process. A port's activity profile may well change with time in terms of cargoes, port development and changes to port-area industry. Changes in legislation and the status of the environmental imperative may also change year-on-year. This means that although at a certain point in time some aspects may be considered not to be significant to an organisation, they should be periodically re-assessed since the current circumstances of the organisation may vary, and therefore, the significance too.

The research presented in this paper has been carried out within the EU-funded project PERSEUS: Policy-oriented marine Environmental Research in the Southern EUropean Seas. The overall scientific objectives of PERSEUS are to evaluate the dual impact of human activity and natural pressures on the Mediterranean and Black Seas. The main aim is to assess their impact on marine ecosystems and, using the objectives and principles of the Marine Strategy Framework Directive as a vehicle, to design an effective and innovative research governance framework, which will provide the basis for policymakers to turn back the tide on marine life degradation (PERSEUS, 2012). It is a very broad research project, involving more than 50 European research institutions.

Within the Work Package 2 of the project, called Pressures and Impacts at coastal level, research on the environmental performance and management of ports located in the Mediterranean and Black Sea was carried out. Although 84% of European ports have already identified their Significant Environmental Aspects (SEA) (ESPO, 2013), the research carried out within the PERSEUS project confirmed that most of them do not use a standardized procedure.

The high percentage of ports that have conducted a SEA identification demonstrates that the sector is committed to the environmental protection and is aware of the role of the management of SEAs in the pursuit of continual improvement of the quality of the environment. However, this research overview confirmed that generally there is little or no consistency across the sector in terms of methodology to identify SEAs, and that few of the methods applied are, in fact, made public. This observation prompted the notion of the development of a method that would assist ports to perform this task in a more reliable manner. Therefore, a new tool has been developed and it is presented in this paper. This method, called Tool for the identification and assessment of Environmental Aspects in Ports (TEAP), includes two steps, the 'identification of environmental aspects', and the 'assessment of their significance'. This tool is available on-line at the website www.eports.cat.

2. Importance of SEAs identification

There are several reasons that justify the importance for identifying environmental aspects and assessing their significance. The key driver is the need for port authorities to be in compliance with the legislation and regulations for which they have liability and responsibility. This fundamental requirement is non-negotiable and an inventory of SEAs is a component *sine qua non* of any credible Environmental Management System (EMS). Another major reason, often overlooked or misunderstood, is the fact that in a court of law a port authority may be deemed to be in a position 'to bring influence to bear' on its operators and tenants in its role as landlord – it may not have direct liability or responsibility but should be aware of the aspects occurring in its estate. Other reasons for identifying SEAs include their role in developing programmes for the continuous improvement of the environmental quality, responding to the concerns and the issues of their stakeholders, and the production of evidence-based environmental reports. The whole process is part of the port authority's activities in terms of obtaining and retaining its 'licence to operate'. The process of identifying aspects has to be carried out in a rigorous way in order to be credible, meet the demands of different interested parties and execute effective internal work procedures (Zobel et al., 2002).

As mentioned, the establishment of a procedure for the identification and assessment of environmental aspects is one of the requirements and essential tasks for the development and implementation of an Environmental Management System (EMS). This process is actually recognized as one of the most complicated parts in establishing an EMS (Lundberg et al., 2007). An adequate identification and compilation of aspects is a crucial step since the decisions taken in this stage may not only affect many other components of the system (Zobel et al., 2002) but it also may determine the focus and scope of the whole EMS (Zobel and Burman, 2004). Fig. 1 shows that the identification and assessment of aspects is directly associated with several elements of a management system.

Based on the previous table, the relations between aspects and other components of the environmental management are the following:

- The analysis of the aspects and activities of the organisation may conduct to the identification and description of environmental impacts that are generated.
- Once the significant aspects have been identified, an updated environmental policy should be defined. A suitable policy has to be aware of the SEA of the port.
- The significant aspects together with the policy form the basis for establishing environmental objectives and targets.
- Environmental aspects also contribute to establish the procedures that define the monitoring needs.
- The aspect identification is also the starting point for the establishment of Environmental Performance Indicators (EPIs), which may contribute to evaluate the port environmental performance.
- Finally, the significant aspects are helpful in determining which issues should be included in the environmental training of the port workers.

There are three main standards to achieve an environmental management certificate within the port sector, namely the International Organisation for Standardisation (ISO) 14001 (ISO, 2004), the Port Environmental Review System (PERS) (ESPO, 2011) and the Eco-Management and Audit Scheme (EMAS) Regulation (EC, 2009). All these three standards state that any organisation willing to achieve an EMS should establish, implement and maintain a

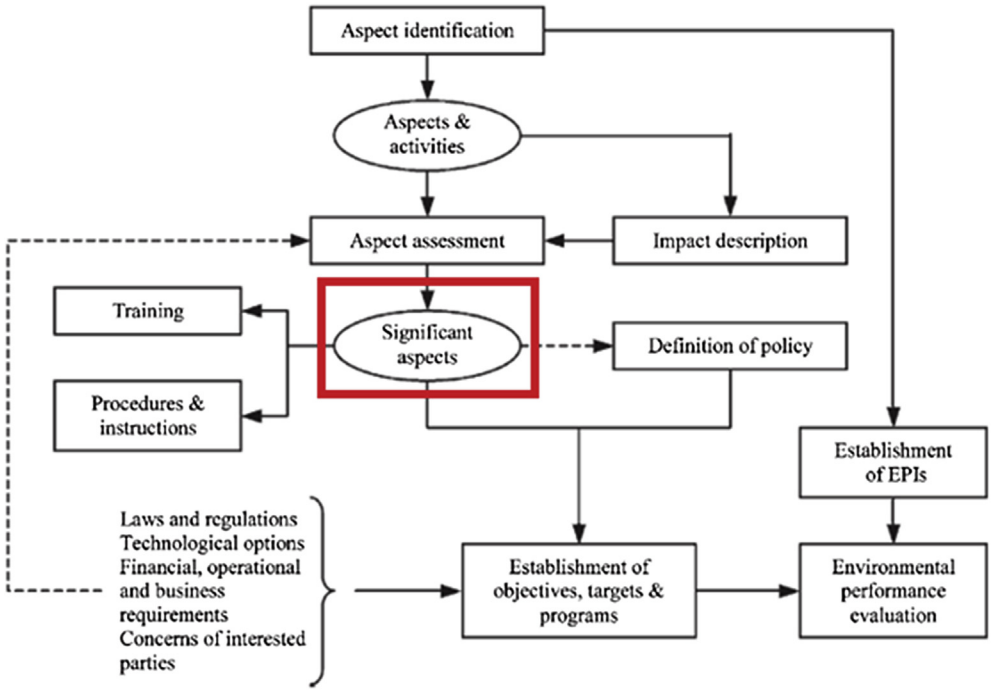

Fig. 1. Interactions between environmental aspects and other EMS components.
Source: Zobel and Burman, 2004.

procedure to identify the environmental aspects of its activities, products and services. It is also stated that the organisation should determine those aspects that have or can have significant impacts on the environment; in other words, the Significant Environmental Aspects of the port.

Although these standards provide some advice and criteria to follow in the selection, they also recognise that there is no single, standardised procedure for identifying environmental aspects. Since it is recognized that each port is unique and that each organisation has its own characteristics and distinctive features, the standards do not establish a specific methodology for the identification and assessment of the environmental aspects. In other words, even though the requisites are defined, the means for achieving them are not. Therefore, it may be difficult for some ports to identify and select aspects in a credible and scientific way. Each Port Authority should identify its Significant Environmental Aspects in line with the types of its activities, products and services that better fit to the reality, characteristics and circumstances of the port.

This observation gave further encouragement for the development of a standardised tool. However, before designing it, a research was conducted to examine the methodologies that are present or have been developed within the port sector with this aim. They are presented in the following section.

3. Existing methods for the identification and assessment of environmental aspects in ports

Although a procedure for the identification and assessment of environmental aspects is required by any EMS standard, there are few recognized methods or guiding principles in the literature on how and how often the identification should be performed. The majority of published studies about the procedures for identifying environmental aspects focus on organizations of the industrial sector (Zobel et al., 2002).

Within the port sector, in Europe there exist two generic procedures for the identification and assessment of aspects, both used by several ports and created as a result of two major research projects. The first one was an outcome of the research project *ECOPORT: Towards an Environmentally Friendly Port Community* (1998–2000) and the second one as a product of the project *ECOPORTS: Information exchange and impact assessment for enhanced environmental conscious operations in European ports and terminals* (2002–2005).

Within the framework of the research project ECOPORT, leaded by the Port Authority of Valencia, a first method was developed. For the identification of aspects, a matrix was created, containing the list of the possible environmental aspects in the columns and the operating conditions in the rows (See Fig. 2). The aspects were assessed by following three criteria: i) frequency or probability, ii) control of the impact, and iii) severity (risk and/or quantity) (Valenciaport et al., 2003).

The second procedure was called Strategic Overview of Significant Environmental Aspects (SOSEA), which aimed at helping port managers to identify and rank the SEA (Darbra et al., 2005) and consisted of three sections. Initially, a matrix of environmental activities and aspects, modified from the Leopold matrix (Leopold et al., 1971) was provided (See Fig. 3). When an activity generated an aspect, a tick was placed in the corresponding box. The aspect with the highest number of ticks was taken as a reference; the aspects having 50% or more of the reference score were regarded as significant. The second section comprised questions on the current management of the Significant Environmental Aspects identified previously. These questions concerned the existence of relevant regulations, the body responsible for their fulfilment, the opinion of port stakeholders and their possible complaints, and the environmental monitoring actions carried out by the port. Finally, the information gathered before was summarized on the table 'Strategic Aspects Overview'. In this table, the reasons why the previously selected SEA are of interest for the port were presented.

Activity, Product o Service:					
Environmental aspects	*Operating Conditions*				
	Normal	Cleaning	Maintenance	Incidents	Emergencies
Air emissions					
• Combustion gases					
• Volatile products					
• Refrigerating gases					
• Welding gases					
Deposits to water					
Waste generation					
• Hazardous					
• Inert					
• Urban					
Spills and escapes					
• Escapes from underground deposits					
• Spills and escapes from piping and superficial deposits					
Use of resources					
• Water					
• Electric energy					
• Fuel					
• Paper/ Cardboard					
• Plastics					
• Hazardous products					
Noise					

Fig. 2. Template for the inventory of aspects (ECOPORT project).
Source: Valenciaport et al., 2003.

Apart from these two methods, there are some ports that have adopted their own procedures to identify and rank environmental aspects. Examples of ports that have made public their methodology are, for example, the Port of Corunna (Autoridad Portuaria de A Coruña, 2013), Livorno (Autorità Portuale di Livorno, 2012), Valencia (Autoridad Portuaria de Valencia, 2013), Vigo (Autoridad Portuaria de Vigo, 2011), and Cartagena (Autoridad Portuaria de Cartagena, 2011).

		ACTIVITIES																			RESULTS
		Port Authority							Port Area												
									Tenants							Other Agencies					
		Port Engineering	Dredging	Marine engineering	Administrative and Planning Activities	Shipping and Navigation	Emergency Plans	.....	Cargo handling operations	Cargo storage	Port based industry	Fisheries & Aquaculture	Ship building and repair	Stakeholders activities	.....	Waste Management	Port installations maintenance	Land traffic	Recreation and tourism	Bunkering	
ASPECTS	Emissions to air					×	×											×			3
	Discharges to water	×	×	×		×	×		×			×		×					×	×	10
	Emissions to soil								×	×				×							3
	Emissions to sediments		×								×									×	3
	Noise													×				×			2
	Waste production				×				×		×	×	×				×		×	×	8
	Changes in terrestrial habitats	×		×																	2
	Changes in marine ecosystems	×	×	×		×						×	×							×	7
	Odour																				0
	Resource consumption					×				×	×		×			×		×		×	7
	Port development (land)	×		×							×							×			4
	Port development (sea)	×																	×		2
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Fig. 3. Matrix of activities and aspects (ECOPORTS method).
Source: Darbra et al., 2005.

The research demonstrated that the development of the above-mentioned procedures for the identification of aspects was positive for the sector in order to familiarize port managers with the concept of environmental aspect, to enhance environmental awareness among European ports, to review and collect relevant regulations affecting aspects, and to encourage port managers to achieve a complete Environmental Management System (EMS). However, after reviewing the literature, it may be stated that no updated methodology has been developed as a generic tool for the aspects identification in the port sector other than the two methods described above. There are some reasons that indicate that they should be currently improved and updated to the current ports requirements. Firstly, these tools considered the port environmental aspects as broad categories, such as emissions to air, or resource consumption, and they did not enter into detail of the aspects. Secondly, these tools selected the significant aspects based on the subjective assessment of the port environmental manager (or the respondent), not from a rigorous, evidence-based approach. Moreover, these methods were paper-based and, in the modern era of the Information and Communications Technology (ICT), an 'on-line' method would be more efficient.

All these reasons, plus the fact that the SEAs identification is a compulsory step in any standard to achieve an EMS, demonstrate that a new and updated methodology for identifying and assessing environmental aspects in the port sector may be of direct assistance to busy port professionals. The results obtained through the research conducted within the PERSEUS project are also in line with this need.

4. Development of the TEAP tool

In order to develop the tool, six main steps were carried out as follows:

- Task 1: Identification of port activities

Since aspects are derived from activities, the initial step was to identify the range of possible activities that are likely to be carried out in a port. Although most of the activities are obtained from the Self Diagnosis Method (SDM) (EcoPorts Foundation, 2004), other sources such as port web-sites were also considered. A total amount of 35 port activities were identified, provided in Table 1. Some of these activities are clearly developed by the port authority, such as the administrative services or maintenance of port installations; other activities may be carried out by either the authority or a specialised company, such as dredging or mooring; and finally other activities are usually carried out by terminal operators, such as the loading and unloading of products.

- Task 2: Identification of port environmental aspects

A review of the existing environmental aspects in ports was also conducted. The information was obtained from either port web-sites (e.g. Port of Tallinn, 2015; Freeport of Riga Authority, 2015; Port of Helsinki, 2015), port environmental or annual reports (e.g. Autoridad Portuaria de Valencia, 2011; Bremen Ports, 2011), and EMS reports (involving mostly PERS and EMAS Declarations) of port authorities (e.g. Autoridad Portuaria de A Coruña, 2013; Autorità Portuale di Livorno, 2012; Autoridad Portuaria de Vigo, 2011), marinas (e.g. Club de Mar, 2012; Club Nautico Portosín, 2012; Marina Port Vell, 2013) and terminal operators (e.g. Decal, 2012; TCB, 2012; TEPSA, 2011). Since the identification of SEA is an obligatory step in the achievement of any EMS standard, the environmental aspects identified in this process are usually published on these above-mentioned documents. Examples of environmental aspects proposed from other institutions, such as the Global Reporting Initiative (GRI, 2011), were also considered. Since a very broad research was needed, guidelines on implementing environmental law were also consulted. In particular, guidelines on the implementation of the Birds and Habitat Directives were considered, since they pay particular attention to port development and dredging activities in estuaries and coastal zones (EC, 2011).

The research contributed to gather a comprehensive set of port environmental aspects. A total amount of 55 aspects, classified under eight categories, was initially compiled. Since this number of aspects was perceived as being over-complex in terms of developing a user-friendly, practicable and pragmatic tool, it was reduced to a final list of 17 aspects, divided in seven categories (in bold in Table 2) on the basis of evaluation and feedback received from port environmental specialists from both the sector and academia. The aspects and categories selected are shown in Table 2.

- Task 3: Creation of the relationships between activities and aspects

The next step was the definition of the interactions between the port activities identified in task 1 and the port environmental aspects determined in task 2. For each activity, all the aspects that

Table 1
List of port activities identified in the research.

Administrative services	**Cargo handling and/or storage of:**
Bunkering	Containers
Dredging	Dry bulk
Disposal of dredged material	Oil, gas and petroleum products
Marine-based cargo transport (Shipping)	Hazardous cargo (non-oil)
Land-based cargo transport (train, truck, car, etc.)	Liquid bulk (non-oil)
Passengers transportation (ferry & cruise ships)	Perishable goods
Fishing & Aquaculture activities	Vehicles/Trade cars
Maintenance of port installations and infrastructure	Ro–Ro
Maintenance of port vehicle and equipment	**Port based industry:**
Ship building, repair and maintenance	Aggregate industry
Port development	Chemical & pharmaceutical plants
Pilotage	Fish market and processing
Towing	Agro food Industries
Mooring	Metal ore processing and refining
Marinas and yacht clubs	Oil refineries
Water sports	Power stations
Port Waste Management	Steel works
Ship Waste Management	

Source: Adapted from EcoPorts Foundation, 2004.

Table 2
Final list of port environmental aspects.

Emissions to air	**Resource consumption**
Emissions of combustion gases	Water consumption
Emissions of other gases	Electricity consumption
Emissions of particulate matter	Fuel consumption
Odour emissions	**Waste production**
Discharges to water/sediments	Generation of solid urban waste
Discharges of wastewaters	Generation of hazardous waste
Discharges of hydrocarbons	Generation of other wastes
Discharges of other chemicals	**Noise**
Discharges of particulate matter	Noise emissions
Emissions to soil	**Biodiversity affectation**
Emissions to soil and groundwater	Ecosystems and habitats

interact with it were determined. Table 3 shows the examples for the particular activities of bunkering and dredging. In addition, a weighting was allocated to each aspect. The possible weights were 5, 3 and 1, and they were given based on the specificity and the relevance of each aspect in relation to the associated activity. In other words, when an aspect was considered very specific and relevant for this activity, it received 5 points; when it had a medium influence, 3 points were given; and finally, when the aspect was considered more generic or with a low importance, it had 1 point. For example, in the activity of bunkering (see Table 3), the discharges of hydrocarbons and the emissions of other gases (Volatile Organic Compounds, in this case) are relevant aspects since they are highly likely to occur in performing this activity, and they are also considered specific since there are few activities that generate these aspects; for this reason, they have 5 points. On the contrary, there are other aspects derived from bunkering that, although they have to be considered because they create an interaction with the environment, the influence that they may have is low (1 point): emissions of combustion gases, fuel consumption and noise emissions.

- Task 4: Definition of the criteria

In order to assess the significance of the aspects, a set of 8 criteria was established. These criteria are provided in Table 4 along with their definition. They have been obtained from an extensive literature review (e.g. Block, 1999; EPA, 1999; Easibind, 2012), including best examples of ports that provide their criteria (e.g. Marina Port Vell, 2013; Autoridad Portuaria de A Coruña, 2013; Autorità Portuale di Livorno, 2012), and the EMS standards advice (EC, 2009; ISO, 2004), among others.

If an aspect is not complying with the legislation, it is directly considered as significant since this will generate risks to the port. Therefore, it needs to be managed and returned to allowed levels.

Table 3
Example of interactions between port activities and environmental aspects, and the associated weights.

Activity	Aspects	Points
Bunkering	Emissions of other gases	5
	Discharges of hydrocarbons	5
	Biodiversity affectation	3
	Emissions of combustion gases	1
	Fuel consumption	1
	Noise emissions	1
Dredging	Biodiversity affectation	5
	Noise emissions	3
	Discharges of other chemicals	1
	Generation of other wastes	1
	Fuel consumption	1
	Emissions of combustion gases	1

- Task 5: Establishment of the weighting of the criteria responses

For each criterion, several possible responses were established. In addition, a weighting is assigned to each response, based on the significance of the impact generated on the environment. If the impact has a higher significance, a higher weight is assigned. Table 5 provides the examples for the criteria 'frequency' and 'duration'.

- Task 6: Creation of the connections between aspects and criteria

Since not all the criteria are applicable to all the aspects, an assessment of which criteria has influence on each aspect was carried out. As it is shown in Fig. 4, the boxes that are coloured in yellow mean that there is an interaction between them.

In order to show how the TEAP works, a case study on the application of the developed methodology is presented in section 4.

5. TEAP application

Anyone willing to use to tool has to enter to the website www.eports.cat. Initially, the respondent has to enter the name and country of the port and his or her own contact details. All this information is confidential and only the user of the tool will have access to its results. Fig. 5 shows a screenshot of the step 1: port contact details section of the tool.

Once the contact details have been introduced, the respondent has, initially, to select the activities that are carried out in the port, out of the 35 activities presented in Table 1. As mentioned before, each activity is associated with several environmental aspects, and therefore, when an activity is selected, the related environmental aspects are activated.

The tool sums the total number of points that have been activated for each aspect, derived from the activities that have been selected, and ranks them accordingly in descending order. As a result, an extensive list of the port's aspects is generated. In order to find out the list of the main environmental aspects that have the potential to be significant for the port, a threshold value has been established within this methodology: the aspects with a score equal or higher than the 50% of the maximum score are selected. This percentage is based on experts' opinions and on other methodologies identified in the literature review (e.g. Autoridad Portuaria de Valencia, 2013; Marina Port Vell, 2013). Fig. 6 shows an example of the extended list of aspects and, framed in red, there is the reduced selection that is continues through the next step. Next to each aspect, there is, in brackets, the punctuation obtained, as well as its definition (obtained by clicking the symbol of information).

One weakness of the existing methods is that they do not include criteria for the assessment of aspects, whereas this method does include this component. The port environmental aspects obtained in the previous step are reviewed and assessed against the criteria presented before. Each aspect is assessed only with the criteria that apply to it, which is based on the nature of the aspect, as detailed in Fig. 4. For instance, when assessing the aspect 'emissions of combustion gases', six criteria will be implemented. Each criterion, when applied to a specific aspect, has generally four or five possible response options, having each response a specific weighting, comprised between 0 (or 1) and 5, as shown in Fig. 7.

An average value for each aspects is achieved, based on the punctuations obtained in the criteria. This average value is calculated according to the following formula:

Table 4
Set of criteria and their definition.

Criteria	Definition
Frequency	The number of times that the port activities can generate this aspect.
Aspect duration	The length of time that the aspect lasts.
Extent of the impact	The area of influence of the impact in relation with the port surroundings.
Stakeholders' complaints	It considers the port stakeholders and local community complaints on each environmental aspect.
Legal compliance	It considers if this aspect is affected by legal requirements and if permissible levels are exceeded.
Severity of the impact	It considers the degree of impact that this aspect generates.
Quantity of waste	This criterion measures the quantity or the volume of waste that has been generated.
Consumption of resources	It is determined by comparing the consumption of the current year with the consumption of the previous years.

Table 5
Examples of criteria and their possible responses and weight.

Criteria	Possible responses	Weight
Frequency	The aspect is generated continuously	5
	The aspect is generated at least once a day	4
	The aspect is generated at least once a week	3
	The aspect is generated less than once a week	1
Duration	The aspect lasts more than 1 day	5
	The aspect lasts between 8 h and 1 day	4
	The aspect lasts between 3 and 8 h	3
	The aspect lasts between 1 and 3 h	2
	The aspect lasts less than 1 h	1

$$Average\ value\ of\ each\ aspect = \frac{\sum punctuation\ of\ each\ criterion}{number\ of\ criteria\ applied}$$

These values will be used to assess the significance of the aspect, ranking them in descending order, so that the answers located in the top positions are the ones with a higher significance. It is considered that the aspects with a punctuation of three or more are the Significant Environmental Aspects. Fig. 8 shows a screenshot of an example of the final resulting Significant Environmental Aspects. The respondent receives an email with these results as well.

As commented, the identification and assessment of the aspects should be conducted periodically (e.g. on a yearly basis) or when some changes are made in relation with the port operations in order to make sure that the significant aspects are the appropriate ones.

6. Conclusions

Ports and harbours may be located in highly valuable and vulnerable natural areas, hosting endangered habitat and species, and some of them being protected under EU/national/regional/local nature conservation legislation. For this reason, a broad mix of measures have to be applied for the effective management of potential environmental impacts which are directly linked with the Significant Environmental Aspects.

Environmental Aspects	Frequency	Aspect duration	Extent of the impact	Stakeholders' complaints	Legal compliance	Severity of impact	Quantity of waste	Consumption of resources
Normal and abnormal conditions								
Emisions to air								
Emissions of combustion gases								
Emissions of other gases								
Emissions of particulate matter								
Odour emissions								
Discharges to water								
Discharges of wastewaters								
Discharges of hydrocarbons								
Discharges of other chemicals								
Discharges of particulate matter								
Emissions to soil								
Emissions to soil and groundwater								
Resource consumption								
Water consumption								
Electricity consumption								
Fuel consumption								
Waste production								
Generation of solid urban waste								
Generation of hazardous waste								
Generation of other wastes								
Noise								
Noise emissions								
Biodiversity affectation								
Biodiversity affectation								

Fig. 4. Connections between aspects and criteria.

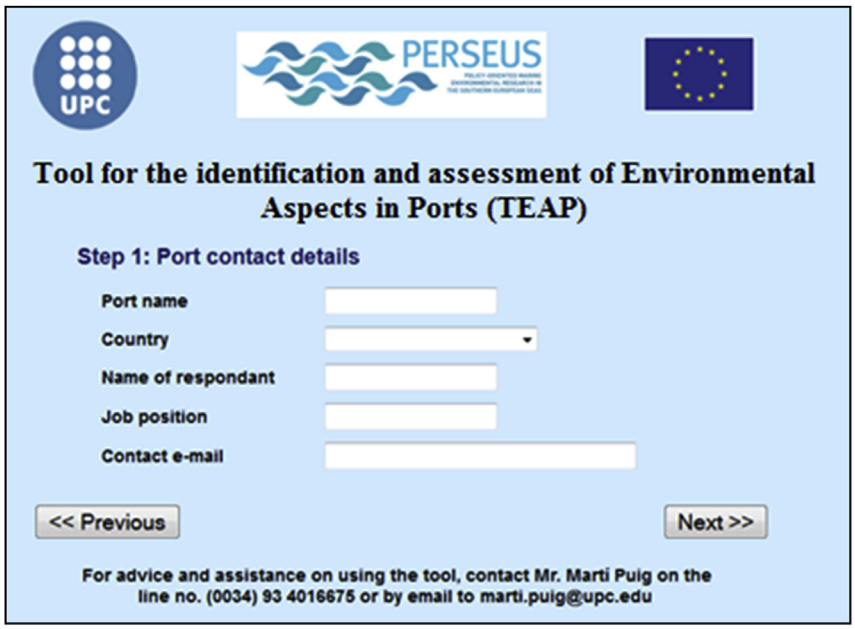

Fig. 5. Screenshot of the Step 1: Port contact details.

In this paper, the importance of identifying SEAs as an integrated action of the environmental management of a port has been demonstrated. The existing methods for the identification and assessment of aspects have been presented in this paper, including the common methodologies at EU level (ECOPORT and SOSEA), as well as the individual port methods. Nevertheless, it has been demonstrated through the PERSEUS research that the ports that use either one of the established methodologies or its own method

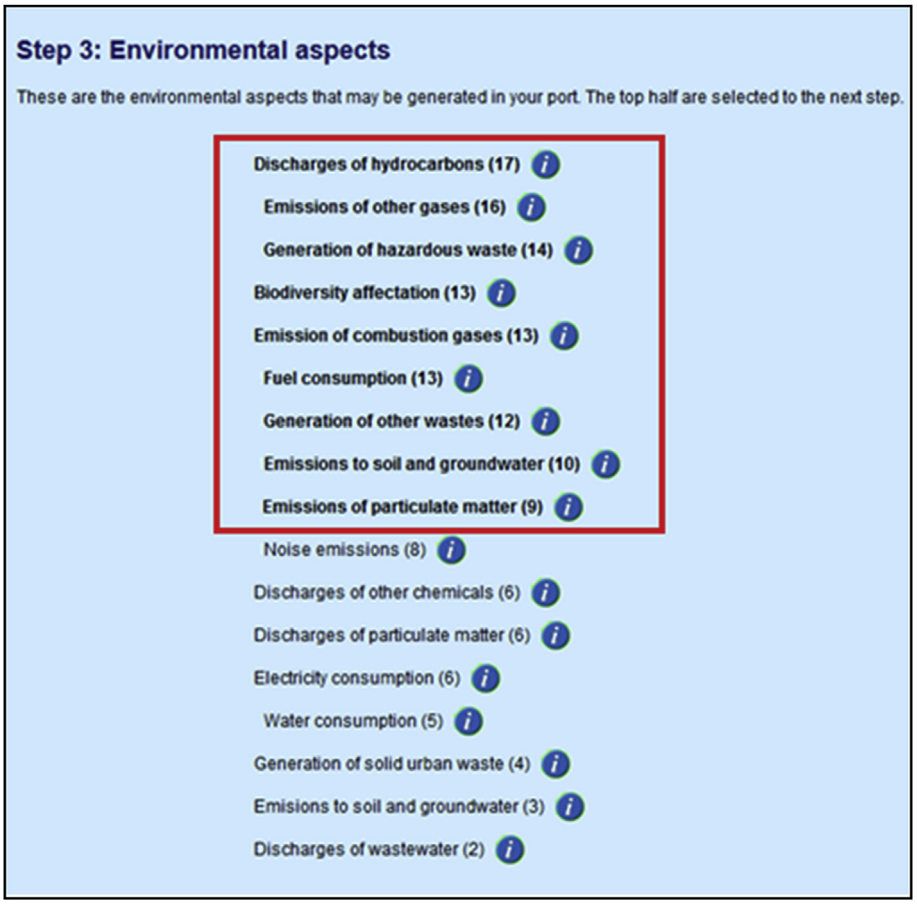

Fig. 6. Example of an extended list of environmental aspects with their occurrence.

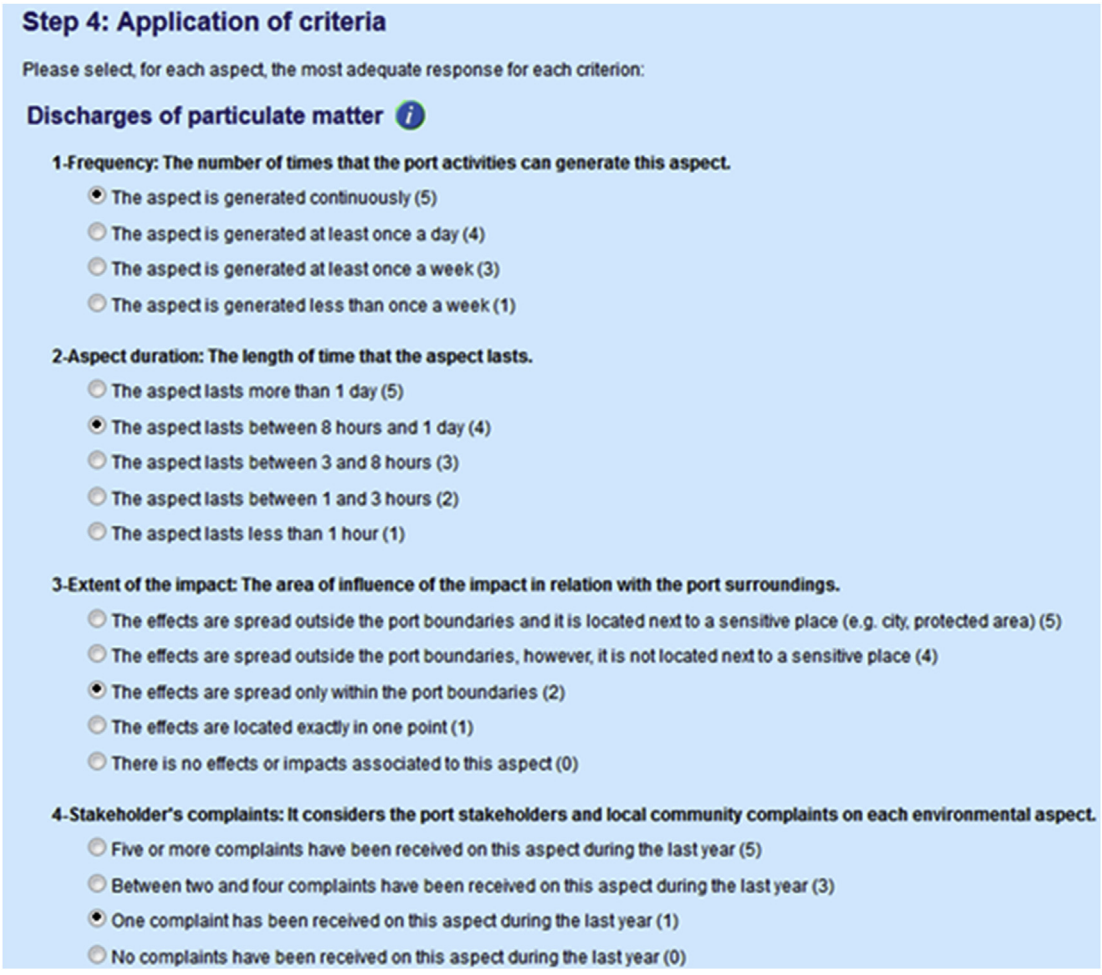

Fig. 7. Screenshot of Step 4: Application of criteria.

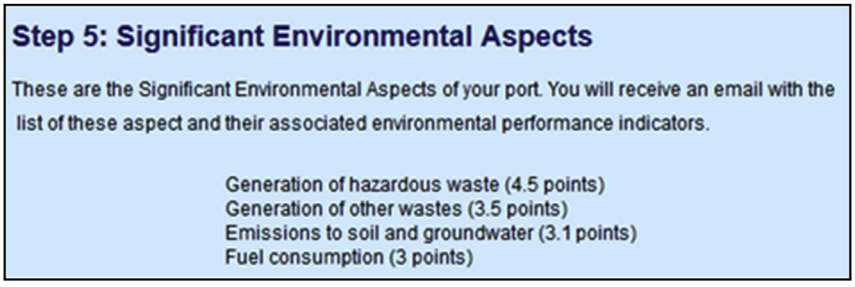

Fig. 8. Example of the final list of SEAs with their average final score.

and make it publicly available are still a minority. For this reason, a new methodology has been developed, available to all European ports. It does not matter the size or the commercial profile of the port, since it is applicable to all types of them providing specific results for each one.

To develop the methodology, the wide range of environmental activities and aspects existing in ports has been identified through an extensive research and review. Since the impacts generated on the environment are largely determined by the activities that are carried out in a port, the interactions between them have been identified. From the user selection of port activities, the aspects that may impact on the environment are compiled using TEAP. Through the definition of criteria and the provision of weighting to the possible responses, the final list of Significant Environmental Aspects is generated. This tool has been tested with the results obtained from the pilot ports' questionnaires.

It is suggested that the tool could assist port managers in identifying the SEAs of their own port area in a user-friendly, practicable and time-effective manner. As already mentioned in this paper, this step alone is a substantive component of any credible EMS (e.g. Lundberg et al., 2007; Zobel and Burman, 2004). In addition, the use of this methodology could be beneficial not only for individual port authorities but also for the whole port sector. As the individual ports are engaged in the objective of continual improvement of their environmental performance, the sector as a whole will be able to demonstrate evidence of progress in its

environmental performance. The adoption and application of TEAP, along with publicly available environmental reports based on the port's management of its SEAs has the potential to enhance further the exchange of knowledge and experience throughout the sector and with its wide range of stakeholders.

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