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A procedure for identifying significant environmental aspects in sea ports

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Abstract

A new methodology has been designed to identify and rank the significant environmental aspects in sea ports. The main objective of the Strategic Overview of Significant Environmental Aspects (SOSEA) is to help port managers to identify significant environmental aspects and to reinforce the awareness about them in order to prioritise work in environmental management. Developed in close collaboration with port environmental managers and tested in a set of ports, it is a user-friendly tool that can be applied in approximately half a working day. It is based on ISO 14001 vocabulary and requirements and it can be considered as the base for the implementation of any Environmental Management System for port communities.

Keywords: Environmental management; Ports; Environmental aspects

1. Introduction

From the environmental point of view, sea ports can be the source of considerable impacts both on marine and land habitats. Due to their special features, sea ports are very complex systems with a wide range of environmental issues: releases to water, air and soil, waste production, noise, and dredging amongst others. Furthermore, in port areas, or in their vicinity, several activities are carried out that may cause further environmental impacts: fisheries, industrial installations, storage of hazardous materials are only some examples. Finally, the continuous movement of ships in a confined area increases the frequency of accidents and, therefore, the risk of release of hazardous materials (Trozzi and Vaccaro, 2000). The impact of both accidental and steady state pollution on the environment can therefore be significant. In some cases, the impacts may be accentuated if the port is located within or near to urban areas. Ports are increasingly under pressure to demonstrate their environmental credentials and the European Sea Ports Organisation recently published a set of recommended objectives to address the main issues (ESPO, 2003).

Frequently, some environmental issues are more important than others. A ranking of the major environmental issues in sea ports—on a statistical basis—has been established from the results obtained from the ESPO Environmental Questionnaire 1996 (ECO-information, 1999) and from the analogous ESPO Environmental Survey 2003, performed in the framework of the ECOPORTS project (Darbra et al., 2004). As a result of these two rankings, it has been possible to identify the key environmental aspects in ports that are presented below:

- Emissions to air (including gases, solid particles and energy; dust is a significant contribution).
- Discharges to water (e.g. waste waters, accidental releases during loading/unloading operations).

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- Releases to soil due essentially to industrial activities.
- Releases to marine sediments and activities affecting the seabed (such as dredging).
- Noise, with its potential impact on population and fauna.
- Waste generation and dredging disposal.
- Loss/degradation of terrestrial habitats.
- Changes in marine ecosystems.
- Odours.
- Resource consumption.
- Port development (land and sea occupation).

The relative importance of the diverse aspects depends on the characteristics of each port (its activities, size, location, type of coastline, etc.), the relevant environmental legislation affecting these aspects, and the third parties involved (e.g. neighbouring population).

An essential point of an environmental management system is the identification of the significant environmental aspects. Once they have been identified, the port can set up objectives and targets to improve its environmental performance. According to ISO 14001 and EMAS (European Eco-Management and Audit Scheme), widely accepted as the most important international environmental management standards, an environmental aspect is defined as "an element of an organization's activities, products or services that can interact with the environment" (ISO, 1996). These standards also state that the involved organisation, i.e. the port, "shall establish and maintain procedures to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impacts on the environment" (European Parliament and the Council of the European Union, 2001).

Although identifying the Significant Environmental Aspects (SEAs) may seem a straightforward operation, in practice it can be anything but simple. Experience shows that, in many cases, pre-established ideas exist and that environmental managers are often unaware of important aspects that actually affect the port. Neither ISO 14001 nor EMAS specify a method to be applied to identify SEAs and evaluate their significance. These standards only define a significant aspect as "an environmental aspect that has or can have a significant environmental impact".

This lack of orientation in the process of identifying and assessing environmental aspects was verified in several port workshops in the framework of the European project ECOPORTS (2002–2005). A pragmatic approach to identification has been adopted by ports working within the EcoPorts protocol to the extent that an aspect is recorded as being significant for the purposes of SDM (Self Diagnosis Method, Darbra et al., 2004) and the EcoPorts Foundation's Port Environmental Review System (PERS) if (i) there is a responsibility imposed on the port authority by legislation or regulation, (ii) the authority, in the case of landlord status, is deemed capable of bringing reasonable influence to bear on a tenant, and (iii) if the aspect in question is of particular national, regional or local importance. In order to fill this gap, a new methodology (Strategic Overview of Significant Environmental Aspects, SOSEA) has been developed. SOSEA has been elaborated in close collaboration with a number of European ports, where it has also been tested. It complements the suite of tools and methodologies adopted by an increasing number of European ports in order to satisfy their management aims of compliance with regulation through voluntary self regulation (Wooldridge, 2004).

2. Existing procedures

Before the development of the new tool, a survey of the diverse methodologies for identifying environmental aspects was performed. Among them, the following can be cited as the most noteworthy:

- The ECO-information questionnaire (ECO-information, 1998). This consists of a checklist on 10 port environmental issues. A set of 18 questions are repeated for each aspect.
- The Leopold matrix (Leopold et al., 1971; Glasson et al., 1994). This matrix is considered as a very useful method for the environmental impact assessment of several civil engineering works (e.g. roads, airports, railways). Rows represent environmental issues whereas columns stand for the activities liable to cause an environmental impact. For each interaction a ranking value (magnitude/importance) is determined.
- The Environmental Technology Best Practice Programme methodology (Envirowise, 2000). This method is based on a matrix, but more objective criteria for ranking the aspects are introduced such as legislation, environmental damage, interested parties, amount of substances handled, etc.
- The ABP method (Associated British Ports, 1997). This is a method that allows identification of aspects and their ranking based on the risk that they entail and, as a consequence, of its significance. Eight steps are required to determine occurrence probability and consequence magnitude. By crossing probability and consequence levels, risk and significance are obtained.
- The Strathclyde University methodology (University of Strathclyde, 2000). This method is also matrix-based but, in this case, the aspects are present not only in the rows but also in the columns. Each aspect is compared with the others. From here a first ranking is obtained and then a quantitative analysis gives the final significant environmental aspects.

- The ECOPORT method (APV, 2001). A matrix of activities vs. aspects is the basis of this methodology. The significance is determined by cross-gauging four parameters: aspect nature, fate, environmental applicable requirements and quantity of substance.

The port authorities involved in the ECOPORTS project stated that these methodologies did not fulfil entirely such requirements as simplicity and port-specificity. They expressed the need for a simpler tool, one with a "first step" approach and requiring less time and effort for the environmental management. This is why the new methodology has been developed. Before it was considered a finish product, the method was tested in the ECOPORTS working sessions, receiving important feedback from the ports. It was then applied to a small sample of ports and, using their comments, new modifications were introduced to the tool. After this trial and evaluation process, the tool has been applied to a set of European ports.

3. The strategic overview of significant environmental aspects methodology

As a tool, SOSEA stands on its own but, at the same time, it has been designed in harmony with other tools produced within the framework of the ECOPORTS project. All of them are eventually aimed at the implementation of an environmental management system and an optional certification.

The application of SOSEA offers a set of advantages for ports:

- Identification of the significant environmental aspects.
- Enhancement of environmental awareness.
- Assessment of the environmental management concerning each significant environmental aspect.
- Identification of the reasons why a given aspect is important for the port.
- Provision of a base for the implementation of an environmental management system with potential for eventual certification (via ISO or EMAS).
- It helps the port to prioritise the actions in environmental management.
- It moves the port management to review and collect relevant regulations affecting each aspect.
- It moves the port authority towards an environmental management system and increases the awareness of the port workers in this field.

The SOSEA methodology consists of three parts, each with a different objective: (i) the "Environmental Activities and Aspects Matrix", (ii) the "Significant Environmental Aspects Questions" and the (iii) "Strategic Perspective of Environmental Aspects", which are reviewed below.

3.1. Matrix of environmental activities and aspects

The assessment of the significance of environmental aspects can be extremely subjective when a given individual performs it for a specific organisation. Therefore, an objective approach is required. A modification of the Leopold matrix has been selected (Leopold et al., 1971), which has been specially adapted to the case of sea ports.

This matrix represents all the possible interdependences between a set of defined activities and each environmental aspect. Each cell shows a given relationship: for example, dredging versus discharges to water, cargo storage versus releases to soil. In this way, each dependence or relationship must be analyzed to establish a ranking of the involved environmental aspects. Thus, a matrix (Table 1) has been designed in which the columns represent the main port activities, divided into two sections according to the responsible body or organisation (this classification is merely indicative and can be modified in each case): the example at Table 1 identifies the port authority and the operators (tenants and other agencies) located in the port area. The rows in the table represent the main environmental aspects identified through the aforementioned surveys (ESPO Environmental Questionnaire 1996 and 2003). Blanks have been included in both the rows and columns to allow the introduction of specific elements if required. In order to help those using the matrix, instructions have been provided in a document called "Guidelines for SOSEA". These include a checklist (Fig. 1) of environmental aspects and impacts, which can be very helpful as a first step before completing the matrix. In this checklist the port manager has to specify what activities are actually carried out in his/her port, ticking A (applicable) or NA (not applicable) for every activity listed. Then, according to the following criteria, the port should tick the aspects considered significant:

- Legal regulations: if there is a regulation concerning a given environmental aspect, this will always be considered significant, as non-compliance with this regulation would imply the violation of one of the fundamental principles of any environmental management system: the fulfilment of any law which can be applied to the specific organisation.
- Local scale concern: if the stakeholders, the neighbours, or any local groups have any complaints concerning an environmental aspect (for example, noise, dust, etc.), this must be taken into account and the organisation must adopt adequate measures.

Table 1
Matrix of activities and environmental aspects

		ACTIVITIES																			
		Port Authority							**Port Area**												
									Tenants							**Other Agencies**					
		Coastal Engineering	Dredging	Marine engineering	Administrative and Planning Activities	Shipping and Navigation	Emergency Situations	………	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	**Result**
ASPECTS	Emissions to air																				
	Discharges to water																				
	Emissions to soil																				
	Emissions to sediments																				
	Noise																				
	Waste production																				
	Changes in terrestrial habitats																				
	Changes in marine ecosystems																				
	Odour																				
	Resource consumption																				
	Port development (land)																				
	Port development (sea)																				

Activity 1: Bunkering	**(A ☐ / NA ☐)**
Aspects:	
Emissions to air	☐
Discharges to water	☐
Emissions to soil	☐
Emissions to sediments	☐
Waste production	☐
Resource consumption	☐
Others (specify):	

Activity 2: Dredging	**(A ☐ / NA ☐)**
Aspects:	
Discharges to water	☐
Emissions to soil	☐
Emissions to sediments	☐
Changes in marine ecosystems	☐
Resource consumption	☐
Others (specify):	

Activity 3: Marine Engineering	**(A ☐ / NA ☐)**
Aspects:	
Emissions to air	☐
Discharges to water	☐
Emissions to soil	☐
Emissions to sediments	☐
Noise	☐
Waste production	☐
Changes in marine ecosystems	☐
Changes in terrestrial habitats	☐
Resource consumption	☐
Others (specify):	

Fig. 1. Checklist of activities and environmental aspects.

- Global scale concern: any aspects that can have a negative influence at global scale (for example, destruction of the ozone layer, greenhouse effect, etc.) must be considered to be significant.
- Other: possibilities of having an influence on environmental risks e.g. economic reasons.

Once the checklist is filled-in, the port should have a complete view of all activities and the related environmental aspects. Now the matrix can be easily completed, as it has been evidenced in the application of SOSEA to diverse ports. Once it has been filled-in, the number of ticks in each row must be counted and written at its end. A threshold value must be established which will indicate whether an aspect is significant or not. In order to identify the SEAs, the following options should be considered:

(a) The aspect with the highest number of ticks is taken as a reference and a relative value is established above which an aspect will be considered to be significant; all the aspects having at least 50% the reference score will be considered significant. For example, if an aspect such as discharges to water has 10 ticks, all those having five or more will be considered significant (see Fig. 2).

(b) Any aspect where there is a breach of legislation must be considered significant?

It is important to bear in mind that the number of significant aspects it is not directly related to the environmental performance of the port. Each port will have different types and numbers of aspects. In this way, the analysis of the assessment of these aspects, carried out in the next section of SOSEA, will be specific for each port.

3.2. Questions on significant environmental aspects

This section has been developed to analyse how the management of the significant environmental aspects previously identified is being performed. To assess the management, a set of key questions are applied. The section is structured in two parts:

(a) Part A (questions A1–A8), a set of questions concerning the current situation of the management of the significant environmental aspects. The existence of relevant regulations, the body responsible for their fulfilment, the opinion of port users and stakeholders, their possible complaints, the port image, etc., are reviewed. An extract of Part A is shown in Fig. 3.
(b) Part B (questions B1–B5), on the environmental actions currently carried out by the port: monitoring of environmental aspects, procedures for port users and employees, action plans, etc. (see Fig. 4).

Answers must be filled in for each SEA. A blank space is left to add any comments. In some cases additional information is requested, as for example in questions A7 (number and type of incidents), A8 (number and type of complaints) and B1 (type of environmental indicators). Having gathered all the relevant information, the environmental manager should get a clear view of where (and for which aspects) work has to be done and resources allocated, and he/she can test whether current environmental management efforts are taking into account all the parameters recommended by the environmental standards.

3.3. Strategic aspects overview

Finally, all the information gathered is summarised in a table (the Strategic Aspects Overview, see Fig. 5) where the significant environmental aspects are located in the columns and the reasons why they are of interest for the port are located in the rows; once more, a tick will indicate when a given aspect is of interest to a port due to a given reason.

At the bottom of the table, the port manager is invited to rank the SEAs, assigning them a score between

		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					x	x											x			3
	Discharges to water	x	x	x		x	x		x			x		x					x	x	10
	Emissions to soil								x	x				x							3
	Emissions to sediments		x								x									x	3
	Noise													x				x			2
	Waste production				x				x		x	x	x				x		x	x	8
	Changes in terrestrial habitats	x		x																	2
	Changes in marine ecosystems	x	x	x		x						x	x							x	7
	Odour																				0
	Resource consumption					x				x	x		x			x		x		x	7
	Port development (land)	x		x							x							x			4
	Port development (sea)	x																	x		2
	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Fig. 2. How to rank significance. In this example, the highest score for an aspect (releases to water) is 10; three more aspects (waste production, changes in marine ecosystems, resource consumption) score $\geqslant 5$, and are to be deemed significant as well.

A2 Which organisation(s) is/are legally responsible for enforcement of the regulations of this aspect?

Options: **A.** Port authority
B. Others
C. None
D. Don't know

Aspect	Answer	Specify/further detail (compulsory if Answer = B)
Discharges to water	A	It exists a European directive which regulates the discharges of ballast water
Waste production	B	The City Council is responsible for these subjects
Resource consumption	D	I don't know who is the responsible for this aspect
Changes in marine ecosystems	C	Nobody is responsible for this aspect

Fig. 3. Example of a question of section A.

B1 Are the Port's SEAs regularly monitored?

Options : **A)** Yes
B) Partial
C) No
D) Don't know

Significant Environmental Aspect	Answer	Environmental Performance indicators used	Specify / further detail
Discharges to water	A	Oil in water	Oil and metals are monitored regularly. Effects on disposed dredged material monitored
Waste production	B	Number of containers and frequency of collection	This aspect it is not very well monitored. We need to work more on this subject.
Resource consumption	A	Consumption of water, electrical energy, fuel, etc.	
Changes in marine ecosystems	C		

Fig. 4. Example of a question of section B.

1 and 10. This ranking is complementary to the one obtained through the matrix (tick count), and it should be compared with that.

4. Discussion

The information obtained by the application of the SOSEA methodology can be useful for the port management in different ways. First of all, it gives evidence of the significant environmental aspects related to port activities. The *identification* step is therefore important, even if the *significance* has not yet been established. This is another relevant feature of the methodology. Afterwards, the significance of the diverse aspects can be determined by applying the criteria contained in the "Guidelines", and will be clearly represented on the matrix. The knowledge and awareness attainable by going through SOSEA is essential for the future implementation of a certifiable environmental management system (ISO 14001 or EMAS). Furthermore, through a set of key questions, SOSEA helps to assess the specific management status of each SEA, making clear whether and where there is room for improvements and stronger efforts. Finally, the yearly application of SOSEA can give a snapshot of how significant environmental

	Discharges to water	Waste production	Resource consumption	Changes in marine ecosystems					
Legislation and Regulations									
• International conventions / legislation	✓								
• European legislation	✓	✓							
• National legislation	✓	✓							
Policy									
• Own port environmental policy	✓	✓	✓	✓					
• European / international policy	✓	✓	✓						
• National / local policy	✓	✓							
Public and Employee Health									
• Public health	✓	✓							
• Employee health & safety	✓	✓							
Port Image and Public Relations									
• Port image (general)	✓	✓	✓	✓					
• Marketing of the port	✓	✓		✓					
Complaints from External Parties	✓	✓		✓					
Financial costs			✓						
Port Development									
• Current actions		✓							
• Short term (1-2 years)									
• Long term (3-10 years)			✓						
Natural Environment									
• Terrestrial habitats		✓							
• Marine ecosystems		✓		✓					
• Global concern	✓	✓	✓	✓					
Others (please specify:)									
Importance of Aspect on a scale of 1 to 10*	9	8	4	4					

Fig. 5. Example of the strategic aspects overview. In this example, the aspects in the columns include only those previously selected as significant through the matrix.

aspects, and the way they are addressed in practice, evolve (Darbra, 2005).

Once the SOSEA procedure was considered complete and ready for evaluation, it was applied to several European ports, each with its own peculiar characteristics. On average, the time required to go through the tool was half a working day, although it varied according to considerations such as port size, experience of port managers, and availability of information. As for the difficulty, SOSEA was found to be easily applicable, although questions of interpretation were raised when filling in the matrix. The approach was rated useful and of direct interest by all the participant ports. The ports considered SOSEA to be a practical and useful tool that can assist port managers in obtaining relevant information for a particularly important part of any environmental management system—the identification of significant environmental aspects in support of the implementation of EMS or formal certification of existing systems.

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