ENVIRONMENTAL MANAGEMENT INSTRUMENTS FOR PORT AREAS

LIEN VERBEECK, LUC HENS

Human Ecology Department, Free University Brussels, Laarbeeklaan 103, 1090 Brussels, Belgium
E-mail: Lien.Verbeeck@vub.ac.be

ABSTRACT

This chapter overviews three groups of environmental management instruments: (1) preventive EM instruments such as Environmental Impact Assessment (EIA) and (2) curative EM instruments like Environmental Management Systems (EMS). For both instruments, the need to use them in ports and the procedure to implement them is discussed. Quality guidelines for EMSs are the European Eco-Management and Audit Scheme (EMAS) and the International ISO 14001 standard. A specific example of EMS for ports will be developed in a case study: the Ecoports project of the European Commission. (3) The third environmental management instrument that will be discussed in this chapter is Risk Analysis (RA). Prior to these EMS's the text reviews potential environmental impacts in ports.

Keywords: Environmental Impact Assessment, Environmental Management Systems, Risk Analysis.

1. INTRODUCTION

Modern ports face with numerous environmental problems, which need to be addressed during the port design, construction and operational phase.

Major adverse environmental impacts related to port activities are:

- Changes in the sea flow patterns, resultant costal erosion and siltation due to the construction of breakwater and other waterfront structures that obstruct normal flow.
- Disturbance to the bottom surface and benthic organisms due to dredging and dumping of dredged spoils.
- Pollution from oil spills during pipeline transfers, dismantling operations and oily waste disposal.
- Risk of oil/ hazardous cargo spills from accidents due to collisions, groundings and leakage.
- Loss of habitat such as mangroves, corals, mudflats, etc.
- Air pollution during bulk operations and leakage of gaseous cargo.
- Interference with fishing and recreation activities in nearby areas.
- Noise and vibrations during construction and operations.
- Effects on marine life due to vessel movement, anchorage and manoeuvring.
- Aesthetic interference with the natural environment.
- Disposal of wastewater.
- Increased road and rail traffic in the vicinity.

- Extensive land use.

Due to these potential impacts, environmental protection in port areas is of increasing importance. To reduce the impacts on the environment and to improve operational efficiency, initially, command and control regulations were used. A reduction in pollution was achieved through direct regulations, requiring to set environmental quality standards. More recently, these command and control regulations are completed by voluntary initiatives and innovative management. Advantages of such a new approach are a more complete coverage of the problems in port areas, more flexibility in getting to compliance with environmental regulations and laws and insurance for public credibility and reliability.

This paper describes the general use of environmental management instruments and gives more specific details on their use in ports. This knowledge can be used by Bulgarian port authorities and their stakeholders for the implementation of EMSs in their ports.

2. ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

2.1 Need for EIA

Environmental impact assessment is a procedure that ensures that environmental implications of decisions are taken into account before the decisions on port establishment or extension are made. This process involves an analysis of the likely effects on the environment, recording and evaluating these effects in a report, undertaking a public consultation, taking into account the comments and the report when making a final decision and informing the public about the decision afterwards [Petts J., 1999]. EIA contributes to legal compliance, development that is sustainable, cost savings resulting from operational and housekeeping change, "environmental friendly" technologies and improved environmental performance.

2.2 Participants in EIA

A team of professionals should conduct the EIA. This team has to consist of people with experience in:

- Environmental sciences
- Health
- Process design
- Coastal engineering
- Chemical/ mechanical engineering
- Oceanography
- Water resources
- Marine biology
- Social/ environmental/natural resource- economics
- Sociology

Next to these experts, also authorities, non-governmental organisations (NGO's) and the public are participants in EIA.

2.3 Legal framework

In European Union environmental policy, EIA is a key instrument. This policy is based on a number of Directives. The first EIA Directive was published in 1985 [Directive 85/337/EEC]. The subject of this directive was "the assessment of the effects of certain public and private projects on the environment". Since this first directive, both law and practice of EIA evolved and as a result, a second Directive was developed in 2001 [Directive 2001/42/EC]. This Directive overviews "assessment of effects of certain plans and programmes on the environment". In 2003, the Community adopted the Directive 2003/35/EC [Directive 2003/35/EC]. This Directive intends to align the provisions on public participation in accordance with the Aarhus convention on public participation in decision making and access to justice in environmental matters.

This legal framework also describes the EIA procedure.

2.4 Procedure for EIA

EIA fits in a logical framework. A general schedule of this framework is given in Figure **1**. The essential steps in this procedure are screening, scoping, public involvement, environmental impact statement, review, decision and monitoring. They are discussed in more detail in point 2.4.1 to 2.4.7.

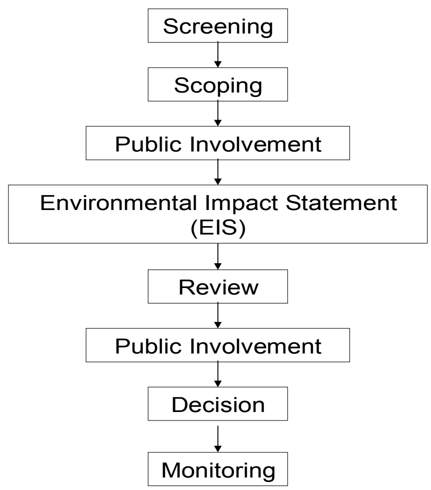

Figure 1. Procedure for EIA [EC, 2001].

2.4.1 Screening

When a project proposal is prepared, the first stage in the EIA procedure is screening. Screening involves determining whether or not an EIA is required for a project [EC, 2001].The requirements for EIA are contained in article 4 of Directive 85/337/EEC. According to this article, the first task in screening is determining whether the project is listed in either Annex I or Annex II of the Directive. If a project is not of a type listed in these annexes, EIA is not required. Projects listed in Annex I shall be made subject to an assessment, projects of the classes listed in annex II shall be made subject to an assessment where Member States consider that their characteristics so require. The second task is to determine whether there is a mandatory requirement for EIA in the Member State. If a project is on a mandatory list of the Member State, EIA is required. If no decision can be made after step 2, the third step will be to check whether or not the Member State has introduced threshold criteria below which EIA is not required. If a project is not on a mandatory or exclusion list, a screening must be made on a case-by-case basis. Therefore, criteria listed in Annex III of the Directive must be considered.

The implications of these directives for projects in ports are detailed in Box 1.

Box 1: Implication of screening in ports

According to Annex I of Directive 85/337/EEC "Trading ports and also inland waterways and ports for inland-waterway traffic which permit the passage of vessels of over 1 350 tonnes" are classified as an Annex I project. This means that these kinds of ports must be subject to EIA.

For smaller ports, Annex II has to be applied. This Annex indicates that "construction of roads, harbours and port installations, including fishing harbours (projects not included in annex I)", must be subject to EIA if this is determined either by case-by-case examination or on the basis of threshold and criteria set by the Member State. Annex III of the Directive set out selection criteria that have to be taken into account when making a case by case study or when setting thresholds and criteria. Important for ports is that Annex III mentions "coastal zones" as a criterion to be taken into account.

2.4.2 Scoping

A second step in EIA is scoping. This action is designed to ensure that the environmental studies provide all information on impacts of the project and its alternatives on the environment [EC, 2001].

Scoping starts with the description of the existing environment through a baseline study. Baseline data are the conditions on site before the project started. The impact of the project is predicted during EIA and added to the baseline levels. This combined effect is compared to the threshold levels to determine whether the project is acceptable.

Table 1 lists environmental attributes for port and harbour projects. Environmental attributes are variables that represent characteristics of the environment, where changes in these attributes indicate impacts. The basic environmental attributes are classified as air, noise, land, ecology, sediment, water and socio-economics.

During scoping, developers can ask competent authorities for advice. These competent authorities consult with other environmental authorities and the general public. The European Commission created a scoping checklist to help identifying the likely significant environmental effects of postponed projects.

2.4.3 Environmental Impact Statement (EIS)

The scoping stage leads to an environmental impact report or environmental impact statement (EIS). This report summarises all the studies carried out for the environmental impact assessment [EC, EIS review, 2001].

The first item of the EIS is a summary, which should stress major conclusions, areas of controversy and issues to be resolved. The second item of the EIS is the project description. The proposed project and its alternatives (item 3) need to be described to assess the requirement and utilisation of resources and the waste generated. Alternatives considered may concern location, project design, technology and investment alternatives. The next point in an EIS is "the aspects of the environment likely to be affected". To predict the type and magnitude of the environmental impact of a project, models can be used. For instance:

- Water quality models, which simulate dispersion of the pollutant.
- Temperature models, which define the pollution distribution in the atmosphere.

- Oil spill models, which are based on the advection-dispersion models and include processes such as volatilisation, settling of tars and wind dispersion.

Table 1. Environmental attributes for port and harbour projects [NIOT,2000].

<table>
<tr><td rowspan="2">Air
Meteorological parameter
Wind direction
Wind speed
Temperature gradients
Atmospheric stability
Daily rainfall
Air quality parameter
Gaseous and particulate matter
SO_2
NO_x
CO
HC
heavy metals
HC=NMVOC</td><td>Noise
Noise levels
Noise attenuating factors
Noise sensitive receptors
Wind direction</td><td>Land
Land use
Soil, slope and draining characteristics
Topography
Terrestrial ecology</td></tr>
<tr><td>Ecological parameters

Mangroves
Coral reefs
Endangered species
Fishing, breeding areas</td><td>Sediment quality parameters

Sediment transport or littoral drift
Sediment biology
Sediment toxicology</td></tr>
<tr><td colspan="3">Water
Hydrodynamics (tides, waves, currents, shoreline profile)</td></tr>
<tr><td colspan="3">Physical (pH, salinity, temperature, oil and grease, TSS[1], TDS[2], turbidity)
Chemical (DO[3], BOD[4], nutrients, heavy metals, and toxic components)
Biological (faecal coliforms, phytoplankton, zooplankton)
Water demand or consumption
Water resources</td></tr>
<tr><td colspan="3">Socio-economic parameters
Population (target receptors)
Standard of living (water supply, roads, standard of living)
Commercial valuable materials and species</td></tr>
</table>

The scenarios typically employed in predicting an impact are “most probable scenarios” and “worst-case scenarios”. The most probable scenario is characterised by the combination of discharges/emissions and hydrodynamic/atmospheric interactions that produce the frequently encountered impact. The worst-case scenario is characterised by the combination of discharges/emissions and hydrodynamic/atmospheric interactions that produce maximum adverse impacts. Examples of these scenarios are given in Box 2.

Box 2: Examples of scenarios used in predicting an impact.

Most probable scenario: Discharges, routine spillage during cargo transfer, ship/vehicular discharges, during normal climatologically conditions.

Worst-case scenario: Accidental release from tanks and pipelines at low wind speeds, diesel emissions at stable atmosphere conditions.

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[1] TSS: Total Suspended Solids
[2] TDS: Total Disolved Solids
[3] DO: Disolved Oxygen
[4] BOD: Biological Oxygen Demand

Table 2 lists examples of impact types port activities can cause.

Table 2. Examples of impact types.

Action	Type Impact
Loss of wetlands, destruction of eco-systems, coastal erosions or changes in shoreline, impact on water quality	Direct negative
Impact on marine organisms, human health problems due to water quality deterioration	Indirect negative
Impacts from various activities and subprojects can be additive	Cumulative
Impacts from various activities and subprojects can interact with other sources and create impacts larger than those originally resulting	Synergetic
Noise	Short time
Erosion	Long term
Discharge of waste water	Continuous

Likely significant effects of the project will be subject to assessment of their significance. Comparison with standards is essential but not sufficient. The impact should be specified in terms of the affected environment, population, region or public interest, duration, reversibility and possible mitigation. Based on these impacts, measures to prevent, reduce or offset adverse effects have to be included. The EIS can be dependent on the location of the port and need to take into account with the social-economic and ecological levels for decision making. Since a large audience, with varied backgrounds may read the EIA report, the results must be presented in a non-technical summary. Technical deficiencies and lack in know-how also have to be reported. Illustrations and flowcharts should help the reviewer and the public to understand the document.

2.4.4 Review

A review of the adequacy of the EIS has to be undertaken before the EIS can be used for decision making. This review may be undertaken by the competent authority or by an independent experts. Where the EIS is considered to be inadequate, the developer will be asked to provide additional information.

2.4.5 Pubic participation

As indicated in Figure 1 public involvement is required at two stages of the project. Critical environmental data may be gathered from the public based on their local experience. This is in accordance with the Aarhus convention on pubic participation in decision-making and access to justice in environmental matters.

2.4.6 Decision

The environmental information and results of consultation must be considered by the competent authorities in reaching its decisions on the application for development consent. (Article 8 of directive 85/337/EEC). When a decision has been taken, the competent authority shall inform the public about (1) the content of the decision and the conditions attached thereto and (2) the reasons and considerations on which the decision is based.

2.4.7 Monitoring

Once the project is implemented, it is indicated to monitor the effects.

2.5 *Use of EIA in ports*

The following kinds of EIA can be differentiated: rapid, comprehensive, project specific, regional, sectoral EIA and strategic EIA. These types of EIA and their use in ports are discussed in more detail.

Rapid EIA may be undertaken for projects that are likely to cause a limited number of adverse effects. This quick process involves the collection of one-season data, broad identification of impacts and prediction of impacts with simple methods. Examples of rapid EIA are given in box 3.

Comprehensive EIA may be required for projects likely to cause a range of significant adverse impacts whose extent cannot be determined without a detailed study. A comprehensive EIA is generally required when one of the following conditions exist:

- Significant seasonal changes.
- Spatial extent of the project is large.
- Project location is in the vicinity of ecological sensitive areas.

Examples of comprehensive EIA are given in box 3.

Projects that cause a limited number of adverse impacts and do not result in ancillary activities or induced developments, require project specific EIA.

Projects resulting in development of an entire region in terms of ancillary industries require a regional EIA. It involves evaluating the cumulative environmental impact of a project and its associated developments.

Sectoral EIA is a sector-wide environmental analysis and supports integration of environmental concerns into long term development planning. It can also be effective by incorporating regulatory mechanisms in the design. It is done when a nation or state plans to develop different projects in a particular sector.

Strategic Environmental Impact assessment (SEA) is a process for evaluating the environmental consequences of a policy, plan or programme. SEA has to address alternatives and has to predict and evaluate environmental consequences.

Box 3: Examples of the use of EIA in ports [NIOT, 2000]

Rapid EIA: Projects like captive jetties, resettlement issues, projects located in non-critical habitats.
Comprehensive EIA: Breakwater projects, projects located in critical habitats, port and harbour projects initiated for the sake of industries.

Project specific EIA: Container terminal, which handles only containers, may not have associated developments.

Regional EIA: A port and harbour project might trigger off the growth of industries and consequently rapid industrialisation and urbanisation of the region.

Sectoral EIA: When a nation plans to develop projects in the port sector. E.g. one sectoral EIA could be made when two container terminals of the same type are planned.

Strategic EIA: 5 year mobility plans, a multiple year dredging programme. A multiple year dredging programme, a 5-year mobility plan. E.g. the Flemish government decided to draw up a strategic plan and a spatial development plan for each harbour area in Flanders. This plan should be based on strategic EIA, which entails "a maximum protection of the surrounding residential areas, the maintenance and reinforcement of the ecological infrastructure within an outside of the harbour area and economical use of space, so that economic expansion of those harbours is no longer equal to interoperating more and more open space, at the expense of agriculture, nature or existing residential areas." [Thriving Canal Zone, 2001].

3. ENVIRONMENTAL MANAGEMENT SYSTEM (EMS)

3.1 Need for environmental management

A port has to comply with national coastal area policies, relevant laws and regulations governing the standard quality requirements of environmental parameters like water, fauna and flora, waste disposal, handling and storage of cargo etc. To comply with all these requirements, it is imperative for the port to address environmental issues. The most indicated instrument for this is an EMS.

3.2 Environmental management procedure

An environmental management system is a problem identification and problem-solving tool that provides organizations (ports) with a method to systematically manage their environmental activities, products and services and helps to achieve their environmental obligations and performance goals [US EPA, 2003].

Most EMSs are built on the "Plan, Do, Check, Act" cycle for continual improvement. This model of planning, implementing, reviewing and improving the process and actions that an organisation (port) undertakes, is also called "Deming circle" (Figure 2).

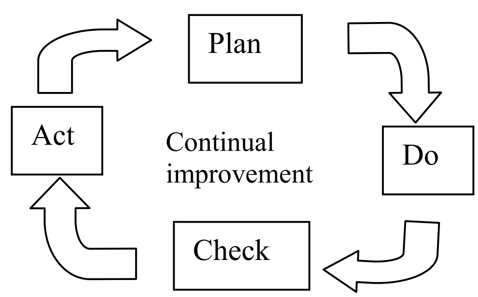

Figure 2. Deming circle, as the basic unit of an environmental management process [based on US EPA, 2003]

In an EMS standard, these steps have been expanded to eight basic steps of an EM cycle: an initial environmental audit, definition of an environmental policy, construction of an environmental programme, implementing this programme, training and communication, auditing and reviewing the EMS.

3.2.1 Initial environmental audit

Identification of environmental aspects is the first step in an EMS. Environmental aspects are any activities, products or service that can have an impact on the environment. The company must establish and maintain procedures to identify and understand all legal and other requirements related to these environmental aspects.

An initial environmental audit also contains a preliminary review of the already existing elements of an EMS and overviews its strengths and weaknesses.

3.2.2 Environmental policy

The second step in the EMS building process is the definition of an environmental policy. This is the port management's commitment to environmental improvement. The policy should serve as the foundation for the EMS and it provides a unifying version of environmental concern by the entire port organization. The policy should serve as the framework for setting environmental objectives and targets and it will be used for the planning and action. An example of a ports policy is given in box 4.

Box 4: Example of an environmental policy [NIOT, 2000]

The port commits to:

- To develop projects in a manner that provides for sustainable use of the marine ecosystem and to design all infrastructures in such a way as to minimise their environmental impacts.
- To minimise any significant adverse environmental impact through preparation and implementation of comprehensive environmental management plans.
- To develop indicators of environmental performance by the authority concerned, and includes statistics on these indicators in annual reports to government.
- To run maintenance operations in ways that enables adherence to environmental regulations, prevention of pollution, reduction of waste, recovery and recycling materials wherever possible;
- To maintain the project area in a manner that values its vegetation and its aesthetic appearance.
- To involve and communicate with community groups sharing common environmental resources
- To extent environmental education and training to all employees concerned.
- To encourage the use of environmental management procedures by contractors.

3.2.3 Planning

During the planning phase, a plan will be formulated to put the policy in practice. The planning stage includes environmental aspects, legal and other requirements, objectives and targets and an environmental programme [Pataki and Crotty, 2002]. To ensure effectiveness, this programme designates responsibilities and defines time frames for achieving quantitative goals of environmental performance. The programme has to be revised regularly and it should be integrated with other managerial plans, strategies and budgets.

3.2.4 Implementation

The implementation phase entails allocation of functions and responsibilities. It includes that employees are motivated, trained and capable of carrying out their environmental responsibilities. Processes have to be established for internal and external communications on environmental issues and EMS documentation has to be organised in such a way that it is retraceable. Operations and activities have to be identified, planned and managed in line with the policy, objectives and targets. Potential emergencies have to be identified and procedures to prevent them and to respond when they occur have to be developed.

3.2.5 Training

Every member of the port company should know the importance of compliance with environmental policy and procedures. Significant environmental impacts related to their tasks should be clear. People should be aware of their task and responsibility within the EMS and consequences of non-compliance have to be stressed.
True training sessions, all staff members should be conscient of the extra values of the EMS. Depending upon the task of staff members, training sessions can either be managerial or technical.

3.2.6 Communication

Internal communication or communication between different functions and levels within the port is as important as external communication. The latter reflects to communications with the neighbourhood, authorities and the large public. Such communication usually is performed through yearly reports in case of informing stakeholders and through visits and open door events for informing the neighbourhood. Press by press conference briefing will inform the large public about the port's environmental performance.

3.2.7 Auditing

While the EMS is operating, performance has to be assessed. This involves monitoring operations and track environmental performance. Problems have to be identified and corrected and records of the EMS performance have to be documented and classified. The functioning of the EMS need to be periodically verified.

3.2.8 Management review

To ensure success and continuous improvement, regular reviews of the EMS are needed. During the management review, the EMS is evaluated to optimise its effectiveness. The review stage is the last phase of the management cycle. After this a new loop of continuous improvement starts.

3.3 Examples of environmental management systems

The Eco-Management and Audit Scheme (EMAS) is used in the European Union and abroad by companies, which have an important trade with EU companies. This voluntary management tool has been introduced by the European Union [Council Regulation No 1836/93]. The regulation called upon the European Commission to review the EMAS scheme no more than five years after its entry into force. In the light of the experience gained during the operation of EMAS I, the Commission proposed a new EMAS, EMAS II, which was adopted in 2001[Regulation No 761/2001]. It aims to provide recognition for those companies that have established a programme of action designed to protect the environment and to continuously improve their environmental performance [Heinelt and Smith, 2003].

In 1996, the International Standard Organisation (ISO) introduced an other system: ISO 14001. This standard has the same general objective as EMAS, namely to provide for environmental management. However it is different in a number of ways. Differences between EMAS and ISO are listed in Table 3.

Table 3. Differences between EMAS and ISO [data based on the official website of the EU].

ISO	**EMAS**
International	European Union
Since 1996	Since 1993
For the whole company or one site	Registration for each location
Initial review recommended	Initial review obliged
Only environmental policy available	Environmental statement available for the public
An audit is required, but no method is set out.	An audit methodology is set out.
	Active involvement of employees.

3.4 The use of EMS in ports

3.4.1 Introduction

In 1995, the European Sea Port Organisation (ESPO) defined the "Environmental Code of Practice" [Espo Environmental Code of Practice, 2003]. This was the starting point to formulate and implement environmental policy in ports. It was noticed that many ports had already developed concrete solutions for specific issues. However, the accessibility of this knowledge and experience was poor.

Therefore the "Eco-information project" was established. This project was executed during the period 1997-1999. Over 25 European ports participated and were supported by universities and environmental experts. The main goal of the project was to facilitate communication between port managers in different countries and to exchange practical solutions on environmental issues. The projects focussed on the development of practical tools to analyse the environmental priorities, to share experiences and to transfer best practices and to apply cost-effective solutions in local situations. Through this work, double work could be avoided and ports saved time and energy [Eco-information in European ports, 1999].

As a sequel on this project, the European Commission funded the "Ecoports Research project". This project started in 2002 and has to be completed by 2005. The project supports the port sector to further develop and implement environmental management tools and provides the European Union with data on self-regulating instruments for environmental policy. The main objective of the project is to improve the environmental performance of ports by:

- Developing an on-line environmental management and information system (EMIS).
- Implementing a unified environmental management approach through training programmes.
- Involving at least 150 European ports and terminals in a 'port & environment network'.
- Transferring know how and solutions to adequately tackle environmental issues.

3.4.2 Results of the Eco-information and the Ecoports project

Communication provided to be one of the essential success factors in these projects. It is shown that ports with different characteristics (size, organisation, location) can actively and voluntarily collaborate. Competition is no obstacle for this in the environmental management area. The projects' practical applicability, regarding to both environmental and cost-benefits is mirrored by the growing number of ports participating. The Eco-information project has acted as a catalyser for action amongst the participating European ports.

During the projects, the following tools were developed: a Self Diagnosis Method (SDM), a database, a methodological guide, an Environmental Management System (EMS), a Decision Support System (DSS), a Port Environmental Management Review System (PERS) and a website.

a) SDM

The Self Diagnosis Method was the first effort at European level to unify and standardise an environmental review method for industrial ports. It is a monitoring tool that consists of easy to understand questionnaires covering all fields of environmental topics that force ports and the port-city area [SDM, 2003]. The analysis at the end offers ports a clear insight into the strengths and weaknesses of its present environmental management practices and a possible scope for improvement. It has been designed to support port managers to periodically review the environmental performance of their organisation. SDM helps to apply in a non-prescriptive way the main requirements of ISO 14001 or EMAS and assist in setting-up an environmental reporting system.

During the Eco-information project, the SDM was send to over 100 ports in Europe. Over 32 ports returned the questionnaire. The questionnaire allowed establishing a list of environmental issues that were most important to ports. These are listed in Table 4. An important investigation is that dredging and disposal of dredged material is prioritising on port managers agendas. Health and safety comes on the second place.

Table 4. Top ten of the most important environmental issues in 32 European ports. 1999 [Eco-information in European ports].

1.	Dredging and disposal	6.	Dust
2.	Health and safety	7.	Noise
3.	Waste and waste management	8.	Air quality
4.	Water quality	9.	Soil contamination
5.	Port development	10.	Traffic volume

This outcome may be compared to the results of the environmental questionnaire that was conducted by ESPO in 1996, to which 281 ports in 15 countries replied. An important observation is that the management at the highest levels have been increasingly prioritising environment on their agendas. The progress in ports environmental management is given in Table 5.

Table 5. Progress in ports environmental management (1996-1999) [ESPO Environmental Committee Report, 1996 and ECO-information SDM Responses and Analysis, 1999]

Carrying out environmental monitoring	+ 13%
Having an Environmental Plan	+ 17%
Involving community and other stakeholders	+ 17%
Appointment of environmental personnel	+ 18%
Aim for environmental encouraging internal and external environmental awareness	+ 45%

The answers provided by the ports that returned the SDM show that motives why ports devote time to the environment vary. The most common reasons stated are listed in Box 5.

Box 5: motives why ports devote time to environmental management [Eco-information]

National / European legislation
Port's image / Marketing polis
Port's own environmental polis / National or local policy
Employee health & safety / Public health
Port development / Financial reasons
Complaints from local communities / Governmental organisations

Nature conservator / Protected areas

b) Database

The on-line database created during the projects contains the following topics:

- Environmental legislation.
- Links to relevant studies.
- Short descriptions of environmental solutions. Main source for these solutions are solution forms, filled in by ports themselves. These solution forms have to be filled in conform a fixed format including: the nature of a particular environmental problem, the way it was resolved, effectiveness, possible alternatives, cost/benefit and the name of the person that could be contacted for more information.
- More detailed descriptions on environmental focussed projects will be included as case studies.
- The goal of the Eco-database is to facilitate data exchange and to focus on environmental solutions instead of environmental problems.

c) Methodological Guide

The Methodological Guide supports port authorities in determining the environmental impacts of particular port activities on its surroundings. The guide is based on two in depth case studies on port-city relations in Genoa and Marseilles. In both ports, the nature, size and risk of a number of environmental issues were analysed in detail, as well as the possibilities to monitor these aspects in relation to their surroundings.

The resulting Methodological Guide has been subdivided in working sheets and information sheets. Working sheets contain practical information on a tangible subject. For instance the painting of ships or the dredging of harbour basins. Information sheets consist of general guidelines on the way a port may adjust its environmental activities toward its surroundings.

d) EMS

The Eco-port team is working on an Environmental Management and Auditing Scheme for port communities. Main focus areas of this scheme are the relationships within the port community: the port authority, the industrial facilities located within the port and the companies exploiting the port terminals. A specific training module will give background about the implementation of this scheme.
The objective is to establish common criteria for the implementation of an EMS in European port facilities.

To develop the scheme, the following tasks have to be carried out:

- State-of-the-art review of environmental management practices in port communities in Europe.
- Search for a general applicable scheme.
- Testing and validation of the adapted EMS.
- System review and preparation of a summary report

e) DSS

Ecoports is working on a Decision Support System (DSS), which aims at supporting managers to take decisions on environmental problems. The basis is an investigation of the environmental problems that may arise from port activities. Potential solutions to these problems are described. Starting from a port operation, an infrastructure plan or a current environmental problem, the system offers a review of potential effects and solutions.

The DSS also uses risk analysis-based technologies to assess possible environmental impacts of port operations. See also section 4.

f) PERS

The Port Environmental Review System (PERS) is primarily designed to assist ports to implement recommendations of the ESPO Environmental Review [ESPO Environmental Review, 2001]. These include that ports should:

- Prepare a publicly available environmental policy, setting out their strategies and methods of achieving these strategies.
- Regularly review their plans to take account of legislative and other changes.
- Produce an annual Environmental Review that is accessible for the public.
- Consider the environmental monitoring required assessing their environmental progress.
- Establish a number of relevant environmental indicators with target to measure progress.
- Consult adequately within the local community on their environmental programme.

The System defines a standard for good practice to review and report significant aspects of port environmental management. It may be considered as a first step in a phased programme to implement an Environmental Management System (EMS). Ports wishing to progress to systems such as ISO 14001 and EMAS can do so by building on the PERS experience.

PERS includes the option for a certificate or verification by an independent auditor [PERS, 2002a].

A PERS book has been created by the Ecoports Foundation. The book consists of 7 sections. Each section has the following components: (1) an introduction describing the purpose of the specific section, (2) specifications on how to complete the specific section, (3) accompanying guidelines, (4) and example and /or format to facilitate completion of the specific section.

The title of the sections and the short description are given in Table 6.

g) The Eco-website

The Eco-website (www.ecoports.be) offers the opportunity for the ports to search information, to exchange information and to liaise with experts in the participating ports. The website contains contact information on participating ports, the latest news regarding the Eco-network, information on environmental issues and developments in the field of port environmental management.

Table 6. Content of the PERS book [PERS, 2002b] .

Section	Title	Content
1.	Port Profile	General information on legal status, geographical characteristics and commercial activities
2.	Environmental policy statement	Port's intentions with regard to environmental performance and its framework for action
3.	Register of environmental aspects and legal requirements and Performance indicators	Documented evidence of environmental aspects, impacts and relevant legislation
4.	Documented responsibilities and resources related to environmental aspects	Identification of key personnel and structure of organization
5.	Conformity review on legal requirements and policy	Review of legislative compliance and formulation of action plans
6.	Environmental report	Requirements of preparation of annual reports
7.	Selected examples of best practice	Successful management options or solutions to environmental challenges

4. RISK ANALYSIS (RA)

4.1 Needs of risk analysis

The density of traffic, the nature of cargo handled, the composition of the channel beds, etc influence environmental risks in a port and harbour facility. The risk of grounding increases as ships approach relatively shallow waters and restricted channels of port areas.

Environmental risk analysis provides a framework giving information needed to make management decisions. RA helps to identify existing problems, anticipate the risks and planned actions, establishes research priorities and provides a scientific basis for regulatory actions [Nath et al., 1998]. In this way, RA helps to ensure safety of a port.

While qualitative risk analysis is essential for any port and harbour, quantitative analysis is imperative when hazardous substances are handled. It is mainly undertaken to enable port authorities to determine the action that is needed to improve the safety of navigation and to deal with the foreseeable effects of an incident in the area.

4.2 Procedure

The components of a framework for Risk Analyses are illustrated in Figure 3.

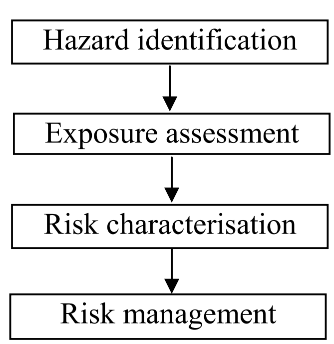

Figure 3. RA framework [Nath et al.(chapter 8), 1998].

The hazard identification phase determines whether a particular danger exists, if the effects associated with the hazard are significant to warrant further study or immediate management action, and the kinds of data required to determine the level of risk.

During the exposure assessment, the exposure to the hazardous agent in question is determined. The process includes the measurement or prediction of movement, fate and partitioning of chemicals in the environment.

The risk characterisation phase involves describing the nature and magnitude of risks, including the inherent uncertainties. Risk can be defined as a product of the probability of occurrence of a hazardous event and the magnitude resulting harmful consequences [Nicholson et al., 2003]. Information from previous phases is integrated and communicated with decision makers.

In a final stage of the procedure, decisions are made about whether an assessed risk needs to be managed and the means for accomplishing it.

4.3 RA in ports

The first important factor that has to be estimated for risk analysis of ports is the vessel traffic intensity. Determination of this factor entails an estimation of the number of ships visiting the port. Also the vessel type, design and construction are important factors [Nicholson et al., 2003].

The second step is the study of characteristics of hazardous substances handled by the port. A hazardous substance is a material, which under certain conditions, can lead to fire, explosions or corrosion. It can be toxic, reactive or radioactive.

Despite acceptance of excellent codes of practice for design and operation of plants and storage, there have been accidents or incidents with varying degrees of severity. Therefore, the facilities of a port should be examined thoroughly and the various failure scenarios have to be identified. The worst-case scenario involves the release of a maximum amount of material under worst weather conditions. The worst-case scenario may be catastrophic failure of barge tank, due to collision, grounding or any such failure that involves the release of the entire quantity. The most credible loss scenario (MCLS) is the most likely scenario, which is perceived based on engineering judgement. This establishes events that could occur taking into account the design, operation and maintenance failures. Examples of MCLS in a port are pipeline leakage, unloading arm failure, tank rupture, safety valve failure and tank overflow. Box 6 gives an example of risks related to loading and unloading of cargo.

Box 6: Risks related to loading and unloading of cargo

During loading and unloading of cargo, there is a dynamic interaction between cargo, personnel and equipment that induce potentially dangerous situations that may cause accidents. Thus main factors that influence failures in this case are: type of cargo, human failure, instrumentation, response time and safety systems. The identified scenarios should be analysed under all weather conditions.

Another aspect of RA in ports is frequency and probability analysis. To determine accident probability, average statistics concerning the number of collisions, groundings, pipeline failures, etc. are used. This allows estimating how often the incident has occurred in the past. These historical data should be interpreted with care, because design or measurement criteria may be changed.

The most critical step in risk analysis is the estimation of the consequences of an incident. A relative easy approach is to start from postulating the worst possible release, like assuming the total failure of the storage vessel and its immediate discharge into the surrounding atmosphere. More realistic estimations of the volume of release can only be made using mathematical models and engineering judgement.

The following variables can be considered for analysis:

- Quality, magnitude and duration of release.
- Dispersion parameters such as wind speed, wind direction and weather stability.
- Ignition parameters, such as ignition source, location and strength.
- Energy level contribution to explosive effects.
- Impact of release on people, property, or environment.

Box 7 gives an example of risk management in case of release of hazardous substances.

Box 7: Example of risk management in case of release of hazardous substances [NIOT, 2000].

When a spill occurs, identification of the hazardous substance and determination of the proper response procedure are required.
Information required for identification of the substance:

- Name and CAS number (chemical information) of substances released or markings on tank, car, truck or vessel.
- Physical state of released substance (solid, liquid, gas, vapours present)
- Source of release (tank, truck, barge, stationary installations)
- Approximate volume of release and/or total volume of source
- Media into which release has occurred and anticipated movement of spill
- Local terrain/ accessibility (topography, porosity of ground surface
- Distance to drinking water supplies
- Distance to population centres and public areas such as schools, churches, public buildings, busy intersections, shopping centres, recreational facilities
- Distance to sewers
- Distance from other hazardous substances
- Distance to food and feed facilities
- Whether conditions currently at site or forecast over next 24 hours (wind speed and direction, air/ ground/ water temperature, precipitation
- Injured people
- Threat of fire

In case of a spill, the response procedure can either be a mechanical, physical or chemical treatment.
Mechanical techniques are used to stop a release, immobilise or hinder the spread of a release or collect the hazardous substance or the contaminated soil, sediment or water. Examples of these techniques are dredging, skimming and pumping. To hinder the spread of a release, dykes and barriers can be used.

Physical treatment processes allow separation of the hazardous substance and the contaminated medium, without adding chemical reagents. Therefore, natural adsorbents as activated carbon or molecular zeolites can be used.

In a chemical treatment, the hazardous substance is chemically transformed through addition of reactive chemical. However, this operation has to be carried out very carefully because the chemical reactant can be an even bigger hazard to the environment.

5. CONCLUSION

There is a growing requirement placed upon industry and service companies to demonstrate environmental responsibility to customers, legislators, employees, shareholders, investors and environmental groups. Environmental management instruments can help ports to manage environmental performance. Next to the general applied environmental management instruments EIA, EMS and RA, new instruments are under their way. Among them, networking between port authorities on environmental management is important. In the EU preliminary collaboration in this area has been initiated. So far, this resulted in an 'Ecoports network'. Bulgarian port authorities are invited to join this network that provides a platform for exchange of knowledge.

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