Shipping and Ports in the Twenty-first Century

Globalisation, technological change and the environment

Edited by
David Pinder and Brian Slack

Ocean Management and Policy Series

10 Integrated environmental management of ports and harbours

The European experience – from policy to practice

Chris Wooldridge and Tim Stojanovic

Introduction

Environmental management of ports and port areas concerns the functional organisation of activities and operations specifically to attain high standards of environmental protection and the goal of sustainable development. Effective environmental management requires science-based evidence on which to make decisions, the identification of key performance indicators by which to demonstrate achievement, and appropriate monitoring in order to assess both the efficacy of management and the quality of the environment itself. This chapter examines how seaports within Europe have been developing towards this level of environmental practice. Two important trends in port environmental management from the past ten years are identified. The first is policy based. This involves ports collaborating on the topic of the environment as a pre-competitive issue in order to share knowledge and solutions. The second is technology based. On the one hand, this concerns the use of technology and improved information processing for the integration of port information systems; on the other, it relates to the integration of environmental performance and monitoring data within environmental management information systems (EMIS).

Each seaport may be considered unique in terms of its geographical, hydrographical and commercial profile. In addition, the diversity of form and function can be further compounded by considerations of ownership, politics, culture and legislation. This means that the environmental management and auditing tools need to be capable of being tailored to the special circumstances of each port. Without these flexible tools, ports may lack the evidence or structures to implement environmental management within the working practices of the port organisation, as envisioned in the goal of sustainable development. The fact that European ports themselves are seeking to develop collaborative, in-house solutions for environmental management, as an alternative to legislation-driven approaches, indicates the importance of the environmental issue to the port sector as a factor within business risk. Towards the end of the chapter, therefore, we move on to discuss models for the networking of environmental tools and methodologies evolved through port-inspired European research and

development projects. The scope of the findings concentrates on environmental practices in pioneer European ports, but lessons may be usefully applied to any ports operating within an institutional system of structured environmental management.

Concepts, practice and the integrated environmental management of ports

Since 1990 the experience of European seaports is that the topic of environmental management has developed from small project- or issue-based investigations to become an important consideration within the corporate business plan. However, the challenge for many seaports remains that of translating conceptual strategies into practical, applied environmental management. There is growing awareness among port managers of the significance of the environmental aspects of their ports' activities and operations, and of the liabilities and responsibilities associated with them. Progressive port authorities are playing an increasingly active role as partners in coastal zone management initiatives. However, there are some misgivings as to the most appropriate form of management option to pursue in balancing the sometimes conflicting demands of, on the one hand, port development and the commercial imperative with, on the other, the requirement for environmental protection. Pragmatic port managers have a strong preference for practical, non-bureaucratic and cost-effective environmental programmes.

Integrated environmental management has been defined as an approach to reconcile conflicting interests and concerns, and to coordinate institutional actions and fragmented efforts. It seeks to integrate with the processes of planning and decision-making those aspects of management that impact on assessment and evaluation (Born and Sonzogni, 1995). It embodies a number of concepts and guiding principles that can make possible the successful implementation of environmental management within ports. It encourages the selection of relevant approaches, comprehensive or incremental, to enable ports to focus on significant environmental aspects of their activities (International Organization for Standardization (ISO) 1996). An integrated approach offers several advantages in efficiency compared to *ad-hoc* or problem-solving approaches since monitoring, research and enforcement efforts can be harmonised (Barrow 1999). From a business perspective, an integrated approach is required to undertake a strategic assessment of environmental risks. These days, the business sector also acknowledges that there are value-added benefits for customer and public relations in taking an integrated approach (International Chamber of Commerce 1993).

Figure 10.1 depicts the environmental regime within a medium-sized commercial port, and indicates the nature of environmental challenges in the port context. Various common operational activities such as cargo handling, dredging and waterfront discharges have potential impacts on land, water, suspended sediment and air. Environmental aspects may impact on any or all media, and their effects can be trans-boundary. Furthermore, port authorities are often

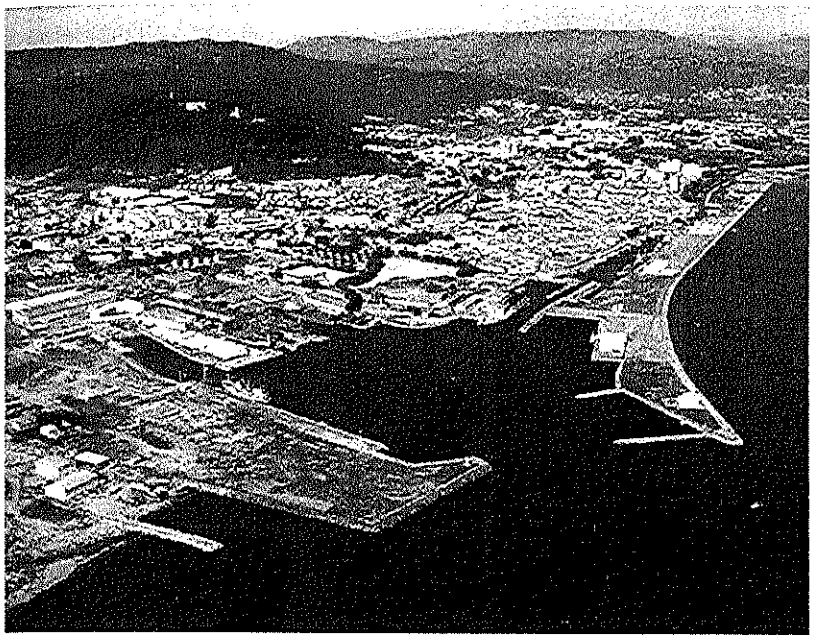

Figure 10.1 Land, sea, air, industry and environmental impacts in a port. (Courtesy of Instituto Portuario e dos transportes Maritimos-Delegação dos Portos do Norte.)

landlords to large industrial and manufacturing estates located within the port-city complex, with the attendant environmental impacts and issues typical of major industrial developments.

To a certain extent, ports may be considered unique businesses, and the coastal zone as a location with specific issues. Ports represent a concentration of human activity as nodes in the logistic chain and points of transfer within transport networks. Furthermore, the legal basis for environmental management is complicated by the fact that the law regards the coastline as a legal boundary. This means that both maritime law and the ordinary law of the land are of relevance to ports. Responsibilities and liabilities may range from dredging to issues related to the safety of navigation and, under some types of ownership, environmental protection. Port jurisdiction can provide a further raft of environmental responsibilities requiring positive management, with the attendant demands to provide adequate resources for enforcement and reporting. Such an amalgam of intensity of use, profusion of agencies and stakeholders, multiplicity of uses, and potential conflicts for space can present complex environmental problems. An integrated approach is required to address and assess the interrelated causes, effects and management options.

The emergence of port environmental management: an overview

What progress is being made towards this integrative goal? While it is misleading to describe environmental practice as if it is common to all ports, there have been dominant trends. These have been driven by legislation, greater awareness of the impacts of port activities, and changes in business practices, all of which reflect shifting attitudes to the environment within broader society.

The overriding concern of health and safety legislation in ports during the 1970s encouraged at least some monitoring of environmental conditions that could be harmful to port employees. But ports were primarily concerned with the effects of environmental dynamics and conditions on their activities, rather than with the impact of port operations on the environment. When they looked outwards, the emphasis was on environmental factors affecting human health, such as noise and dust. Such environmental duties as were recognised tended to be carried out as adjuncts to the work of engineering or survey sections, or added to the list of activities to be carried out by the 'Harbour Master'. Environmental management, when it was practised at all, was based on technical rather than environmental standards. It was a quite different activity – spatial planning – which encouraged strategies to maintain the environment within the port and to deal with the environmental aspects of development, landscaping, excavation and landfill.

In many ports, specific environmental issues have been important drivers in the subsequent inception of an environmental programme. At the port of Dover – a UK ferry port handling 16 million passengers a year (Dover Harbour Board 2001) – dredging activity in the early 1990s produced the first initiative towards the development of environmental monitoring by the port. In other cases, a negative incident such as an oil spill, or a positive experience of cooperation with an environmental research institute (e.g. as part of an engineering contract for port development), has acted as a trigger for a port to develop and implement its environmental management activities.

More systematically, as Reynolds reviews in Chapter 12, regulation has been significant. For example, the MARPOL (73/78) convention has included provisions for adequate waste reception from ships, and this has been implemented by ports during the 1980s and 1990s through waste management plans. These have incorporated practices such as the designation of waste storage facilities for different types of material, and the establishment of contractors for recycling or disposal. Another important legislative influence in Europe has been the EU's Environmental Impact Assessment Directive (EC85/337), requiring environmental assessments for the development of ports capable of receiving vessels over 1,350 tonnes. Although these assessments are commonly prepared by consultancies, this has led to the growth of expertise on environmental mitigation in the port sector. The EU Habitats Directive (EC92/43) has further raised the requirements of port managers to understand the environmental aspects of port activities, including their impact on sensitive species or habitats in the coastal environment.

	1970s	1980s	1990s	2000s
FOCUS OF ENVIRONMENTAL APPROACHES IN PIONEERING PORTS	Health and safety (i.e. human environment) Spatial planning in the port area	Waste management Environmental impact assessment	Environmental auditing Participation in coastal zone management	Integrated port environmental management Environmental management systems
EXAMPLE UK/EU GLOBAL DOCUMENTS and INITIATIVES	Health and Safety at Work Act (UK) 1974 MARPOL International Convention 73/1978	EC 85/337 EIA Directive UNCTAD UNCTAD/SHIP/494(2) Spatial Planning in Port Area	EC 92/43 Habitats Directive ESPO (1994) Environmental Code of Practice ABP (1999) Humber Port Estuary Management	ECOPORTS (EU DG TREN) Initiative 2002-2005

Figure 10.2 Timeline of important ideas in port environmental management.

Meanwhile, the role of ports in the environmental management of the coastal zone has been enhanced by the participation of many European ports in estuary and coastal management initiatives. In response to the pressures for the use of space in coastal zones, ports are now commonly represented on committees of management or research groups as they plan the development and environmental management of coastal areas.[1] The Humber estuary (UK), the Ebbro delta (Portugal) and the Wadden Sea (Netherlands/Germany/Denmark) are three examples of locations where ports have made a significant contribution to the funding or research activities of coastal initiatives. Since ports are major stakeholders in the coastal zone, they are able to influence human activities, and this has led to the practical application of a number of techniques by ports, such as the zoning of space uses, or the regulation of activities with environmental impacts by using legal powers (ABP 1999).

Until the 1990s, much port environmental policy was the by-product of sectoral legislation, and reflected the need for ports to detail their own procedural protocols for the environmental aspects of their activities, such as the preparation of oil spill response plans. The point is that ports were essentially preparing action plans in response to individual pieces of legislation, rather than considering the environment in an integrated way as a component of their operations (Couper 1992). A classic example of the argument for a more integrated approach is the need for a port to consider anthropogenic factors beyond the

port boundaries, such as those arising further inland. In the case of a port that has a river draining into its area, an integrated approach enables the port to understand, for example, whether pollutants arise from its own activities or from those further upstream[2] (Vandermeulen 1996). Progress towards an integrated approach has been assisted in several instances by the appointment of port environmental managers or the designation of environmental responsibilities to port managers, although this is by no means universal.

Whitehead (2001: q133) describes some of the attitudinal changes to environmental issues during the 1990s. He relates the growing awareness of UK port managers in accepting the need to find out more about what is happening in the environment for which they have responsibility, together with their realisation that this entails a good level of knowledge about the environmental aspects of port activities. Furthermore, at a European policy level he notes that the environmental code of the European Sea Ports Organisation (ESPO) (1994) has influenced changes in practice, such as increased preparation of environmental plans and policies within ports.[3] Thus, many managers have come to accept the ethical, economic and profitable option[4] arguments for making investments in environmental management.

Ports are also increasingly attending to environmental and sustainability issues as they formulate business policies and propose new developments. Global environmental issues have appeared on the agenda of port managers making proposals for developments in the 2000s. Proposals commonly consider the global evolution of transport networks, and the role of ports in environmentally friendly logistics chains. A key point here is that ports are able to support environmentally favourable forms of transport. For example, because of reduced fossil fuel consumption, ships make lower inputs to the environment than alternative modes of transport, thereby lowering emissions and reducing the contribution to global warming. Such considerations have encouraged ports to lobby for structural adjustment and investment in infrastructure to promote sea transport.

A major recent step has been to rationalise different port environmental initiatives and their common information requirements into integrated environmental management programmes (Eco-Information 1999). Tools such as audits, reports and environmental management systems (EMS) may all form elements of these programmes and have particular requirements for implementation in the port sector (Valencia Port Authority 2002). Each port faces different environmental circumstances and has a different starting point for developing environmental management, but Table 10.1 illustrates – for the Port of Dover – the post-1990 evolution of tools utilised by the Harbour Board to support environmental management activities. These tools illustrate the extent to which ports can become involved in environmental management on a procedural level. They are complemented by structural changes that have taken place in the port to appoint an environmental manager (as part of the safety and environmental management group) and designate a surveyor with specific environmental monitoring responsibilities. The list contains a number of tools

Table 10.1 Tools and information resources used by the Dover Harbour Board for environmental purposes

Output	*Date of inception*	*Environmental function*
Environmental database	1992–	Store and analyse environmental data and records
Environmental Review of the Marine Environment	1993–	Provide an initial or preliminary review of the impact of activities and operations, and establish an environmental baseline
Environmental research programme	1994–	Collaborative R&D programmes with universities and research establishments in data collection and environmental science
Environmental Database Reference Manual	1995–	Standardise monitoring and reporting and implement quality assurance for data
Surveys of water quality	1996–	Track trends in water quality and assess against guidelines/standards
Environmental policy	1997–	Influence corporate environmental practice and programmes
Waste Management Plan	1997–	Plan collection, storage and disposal of waste in an environmentally efficient manner
Environmental review	1997–	Statement of policy and environmental actions
Directory of Coastal Environmental Management	1998–	Outline other relevant initiatives and organisations, their work and contact details
Environmental Reference Manual	1998–	Detail protocols for environmental activities such as monitoring procedures
Self-Diagnosis Methodology	1998–	Review the environmental management performance using EU/Eco-information tools
Environmental Incidents Database	1999–	Record environmental incidents
Habitat Monitoring Atlas	1999–	Establish the status of flora and fauna in the port in order to identify indicator species, establish baseline, map habitats and track trends
Environmental Report	1999–	Produce a summary of environmental plans, actions and performance
Geological handbook	1999–	Build a knowledge base to complement development, operation and dredging of the port. Understand factors behind environmental quality (e.g. drainage).
Port Environmental Review System	2003–	Prepare and structure an annual environmental report, externally reviewed and certified for validity. Start of EMS.

Note
The table shows a progression of tools and reports compiled during the evolution of an environmental programme. Port environmental managers are seeking to provide a framework that integrates these individual components in order to avoid duplication and to improve access to, and interpretation of, data.

that may be common to other ports. Indeed, some are based on European port-sector standards such as the Port Environmental Review System (PERS) (Eco-Ports 2003). However, the exact design of the various components of an environmental programme or EMS will naturally vary according to the circumstances of the individual port.

Monitoring environmental performance: technologies and data collection methodologies

In the context of assessing and regulating environmental and human health impacts of anthropogenic activities, specifically the introduction of wastes, ICES (1989) defines monitoring as 'the repeated measurement of an activity or of a contaminant or of its effects, whether direct or indirect, in the environment'. Monitoring is increasingly being used as an investigative, diagnostic and environmental management tool. Indeed, it has been described as 'the sensory component of environmental management' (NRC 1990). Indicators themselves are quantified information that demonstrates environmental quality and management performance over time. The argument now pursued is that production of these performance indicators first entails collecting data on human activities, or monitoring of the environment, and the most efficient way of making these measurements is within an integrated monitoring network. The large volume of data produced will then require dedicated information management so that it can be properly collated, stored and interrogated. This can be achieved via EMIS – a toolbox of applications that are related to the functional requirements of port managers (e.g. waste management, contingency planning, spatial planning).

The European Sea Ports Organisation's environmental review (2001) recommended that ports should consider what environmental monitoring is required in order to assess their environmental progress. It also stressed the need to establish a number of relevant indicators, with targets, to measure such progress. Today, an increasing number of port authorities are including such recommendations in their environmental (and/or annual) reports and reviews. Table 10.2 lists a typical set of indicators now used by European ports.

As previously noted, port operators have in the past been more concerned with the effect of the environment on their activities than with the effects and impacts of their operations on the environment. Atmospheric, oceanographic and hydrodynamic components have traditionally been monitored for their effect on the safety of navigation, berth performance, manoeuvring and navigable depth. Today, however, an increasing number of ports are monitoring environmental quality and their own environmental performance for a variety of reasons, including a direct response to legislation and the expectations of a range of stakeholders. Monitoring in order to demonstrate compliance with legislation has been a major driver as port authorities seek ways to confirm conformity and reduce the possibility of prosecution, with all the implications that would have in terms of penalties and poor public relations. Evidence of the achievement of policy objectives can be validated only by reference to carefully

Table 10.2 Selected examples of parameters for monitoring key port issues

Issue	*Parameter*	*Technique*	*Significance*	*Rank*[a]
Health and safety	Total days per annum lost to injury or accident	Reporting form and database	Calculation of the economic costs of health and safety failures	1
Waste management	Mass of materials (kcal/kg) in waste stream	Dedicated waste reception facilities and management system	Assessment of requirements for storage and landfill	2
Dredging	Spatial tracking of vessel	Real-time monitoring of dredging activity: GPS, logger and database	Assessment of disturbance of seabed	3
Water quality	Faecal streptococci organisms/100 ml	Standard water quality analysis for bacteria	Comparison against EU Directive levels	4
Noise	Complaints about noise per 1,000 population	Structured complaints procedure and database of complaints	Assess in combination with compliance monitoring	5
Soil contamination	Heavy metals, e.g. cadmium (ppm wet weight)	Grab sampling and laboratory analysis	Trends in relative toxicity of sediments in parts of port	6
Dust	Particulates (e.g. grain dust) µg m^3	Impingers, air bubblers or gravimetric pump	Identification of potential health concerns, assessment against standards	7
Air quality	Concentration of SO_2: 98 percentile daily averages (µg/m^3)	Spectroscope or integrators	Tracking the source of air pollution and monitoring impacts of new technology	8
Habitat loss	Areal coverage of habitats (ha)	Remote sensing, trawls, traps, underwater photography, dive surveys	Assessment of changes in areal coverage of habitats	9
Energy use	Electricity consumption (kWh per degree day)	Metering and audit system	Eco-efficiency of buildings and work practices	10
Traffic volume	Emission factors for road traffic (CO_2/NO_x (g/km)	Monitoring, surveillance and recording of road movements	Health and safety implications of regularly high concentrations of emissions	11

Note:
a Rank refers to the priority given to the issue within the Port Self-Diagnosis Methodology (SDM) (1998). In total, 30 issues were reported.

monitored targets. The reduction of environmental risk can best be addressed by monitoring to establish patterns and trends of specific pollutant pathways, and thus early warning of significant changes or impacts. The build-up of information on specific issues derived from monitoring can be used to support decision-making processes, and repeated measurements of significant criteria can be used to construct baselines of data for comparison over time, the establishment of benchmarks, and the verification of standards.

Port authorities face a range of challenges and dilemmas in selecting effective monitoring strategies and identifying appropriate indicators. Major environmental issues may not necessarily be the direct responsibility of the authority. However, as in the case of identifying significant environmental aspects for purposes of EMS documentation under ISO 14001, many ports are taking some action to monitor on the basis that they may be considered to 'have influence' over the related activities, or that the issue itself is of pronounced local significance. Ports are increasingly accepting the notion that it is in the best interests of the sector, and the individual port itself, to monitor selected impacts of their own activities (and some of those of their clients or tenants) in order to demonstrate due diligence; avoid fines and costly clean-up or remedial operations; provide baseline, mitigating and reference data; and facilitate the implementation of environmental standards and award schemes. Legally adequate and scientifically sound criteria for use as indicators can serve the goals of environmental protection by providing not just the standards by which achievements can be tested, but also the units of assessment for comparison in the often contentious debate between conservation and profit, legislation and self-regulation, sustainability and development. However, informed decision making and appropriate management response options can be achieved only on the basis of a reasonable scientific understanding of the various interactions involved and the identification of relevant determinants by which environmental quality and performance can be assessed. The performance of carefully selected indicators derived from an appropriate monitoring programme can add objectivity to the debate on environmental quality – an area of concern often dominated by emotion, dogma and subjectivity.

With the realisation of the importance of relevance, ports are increasingly seeking a rationale to counter the 'if it moves, measure it' philosophy, a description with which some research monitoring was often branded. This is because exhaustive monitoring is unrealistic in the pragmatic and cost-conscious world of commercial ports and shipping. Also, it is unnecessary to monitor everything that may be considered to be a pollutant, let alone every parameter that may possibly affect the pollution process (McMullon 1997). Instead, systematic scoping of the monitoring criteria, methods and equipment should be carried out in order to ensure focus on the significant issues. Table 10.2 provides selected examples of parameters monitored for priority port environmental issues, and the associated monitoring techniques. Tabor (1990) points out that monitoring programmes require analytical and bioassay data that are scientifically sound in terms of accuracy and precision, and that the methodology must

be free of artefacts and interferences. The port sector can demonstrate strategies and techniques based on point source, diffuse, effect and baseline monitoring. The latter, 'the description of conditions existing at a point in time against which subsequent changes can be detected through monitoring' (Beanlands 1988), has been a particularly useful approach for ports developing the first phases of environmental management as it has assisted in determining pollutant and activity cause–effect relationships.

In terms of actually executing monitoring programmes, ports have in the past cited lack of resources and in-house expertise, as well as legal requirements, as reasons for not spending time and budget on such activities. However, several factors have encouraged ports to adopt a more proactive approach to monitoring in recent years. The development and reporting of monitoring programmes by an increasing number of port authorities have reflected the availability of a wide range of relatively user-friendly and cost-effective sensors; the real-time capability of many systems; the 'value-added' aspect in that many of the indicators and parameters measured are also useful for the management of health and safety issues (and vice versa); and the perceived value of being able to demonstrate voluntary self-regulation of environmental responsibility. Many initiatives for port environmental management acknowledge that ports require a dedicated database of information for surveillance of activities, monitoring and auditing (International Navigation Association 1999). The development of such databases has been enhanced in many cases by the recognition that not all information needs to be directly monitored by the port itself. Ports are increasingly aware of the wealth of data held by regulatory authorities and other interested parties such as NGOs and special interest groups. To gain these economies, many ports are actively forging monitoring links at local, regional, national and international levels, both within the sector and with other industries and agencies.

Monitoring tools can be most effectively organised within a well-designed monitoring network. Ports can also use data from other programmes, such as local government agencies responsible for monitoring water quality, or research programmes to model pollutant pathways. They can contribute to, and collaborate with, wider monitoring strategies for coastal zones (Tyler-Walters 1997). However, their own monitoring strategies must consider both local and regional trends in order to provide useful information. For example, water quality sampling within a port might concentrate on local suspected sources of contaminants, and areas of ecological importance; the least contaminated areas might also be chosen to provide some kind of reference value. In addition, however, regional sampling is required to assess the inputs to the marine system from upstream, the natural variability of the seas, and the extent to which impacts are cascading throughout the system. Beyond this there is the time dimension. In order to understand the significance of environmental impacts arising from port activities, monitoring and assessment of the system's long-term response – and of other factors affecting biological, physical and chemical interactions within the ecosystem – are required (Townend 2002).

Environmental management information systems in ports: rationale and experiences

Even when the focus is strictly on relevant criteria, today's advanced data collection and monitoring technologies used in response to environmental imperatives may produce an information glut. This is one major reason why IT-based EMIS are an essential tool for modern management. But there are also other drivers. Such systems do not simply cope with the scale of information available; they also allow for a consistent approach to environmental control from one port to another. Ports are keen to share technical, managerial and legal solutions to environmental problems in order to minimise duplication of effort and reduce environmental management costs. There is also a political desire – especially in Europe – for standardisation and cooperation in knowledge management between ports to reduce disparities in environmental efforts.

An EMIS has been described as 'a case-book or collection of tools organised into a system to support the administration of environmental management and planning tasks by . . . making information available to executives and the public through co-ordinating existing systems and investments by a common architecture' (Gunther 1998: 160). There is an emphasis on using information about human activity and the human interactions with the environment, and it is this that distinguishes EMIS from environmental information systems (EIS).[5] Ports already have extensive and positive experiences of managing complex information, for example in relation to vessel traffic management systems (Hanekamp 2000) as well as in the use of intelligent systems to integrate quay management, vessel loading and electronic data interchange (UNCTAD 1993). With this experience, theoretically it should be simple to link systems that manage the relevant environmental data. In practice, however, the task is extremely complex and frequently fails in large organisations[6] because of the magnitude of the challenge of linking common tools within a toolbox. Consequently, the following discussion focuses on a number of important factors relating to this task of integrating, within the port setting, major tools such as audits, reports, databases and decision support systems. Figure 10.3 presents a model for networking existing port tools, collaborative data – in this case European – and standard methods within a port EMIS.

A recent EU DG TREN research programme has focused on developing a flexible and incremental approach to EMIS on a European scale (EcoPorts 2003). A number of major findings are now emerging from this and other recent research projects designed to assess and improve the environmental performance of seaports and terminals (EcoPorts 2003). One important result is that large-scale technological solutions for port environmental information systems will become widely used only if they are flexible enough to incorporate existing tools used by ports. The previous sections have alluded to the considerable investments that many ports have already made in environmental management, and it is the capability of EMIS to act as an intelligent architecture to link these existing tools that forms the most efficient solution.

A second significant conclusion is that the development of the technical

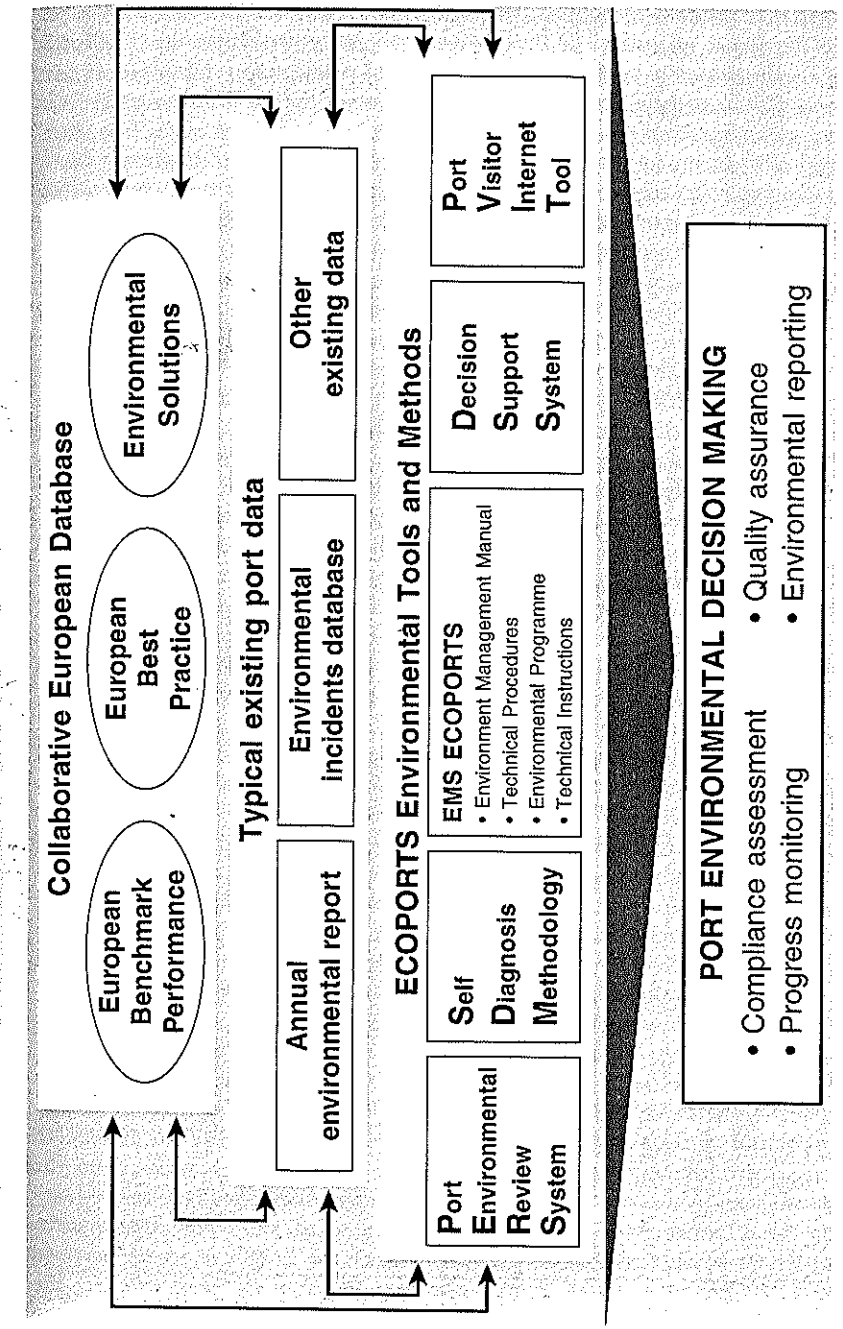

Figure 10.3 Components of an environmental management information system (EMIS) for ports.

aspects of systems, without accompanying human support elements, often leads to the failure of systems or their rejection by the port community. Since it is transportation that is the primary function of ports, many employees do not have a background in environmental management; nor do they understand the unique information processing requirements for environmental data. The provision of environmental and technical education is, therefore, an important factor in the successful implementation of EMIS. Success may also be encouraged by in-house applications that enable information systems to reflect working practices in ports more accurately.

The information science literature also attests to the fact that many IT projects take a technocentric approach to developing information systems, and neglect the informal, human elements (Mayda 1997). There is a need for research that assesses not only the capability of IT tools, but also their ability to aid broader 'human' information systems. The technical specifications for integrated environmental management systems, although necessarily specialised for the port and marine environment, are within modern technological capabilities. However, the organisational changes required to enable staff to implement port environmental management are a more comprehensive undertaking.

In sum, information systems have the potential to provide an economically efficient and effective toolbox for ports undertaking environmental management. Specific technical solutions are required to network environmental tools, and these can work if they allow ports to incorporate the output of existing environmental management programmes. Optimisation, however, requires a focus on the human element, providing adequate training support, and modelled accurately on port working practices.

What has not yet been considered, but must not be overlooked, is that information systems also have a role to play in the final phase of the information cycle: dissemination. Ports are under growing pressure to demonstrate their environmental credentials through transparency of action and the publication of environmental strategies and performance data. Increasingly, environmental legislation encourages ports to organise their environmental information in a form that is relevant to shareholders, regulators, clients, insurers and the public. Evidence of ports' environmental achievements (or otherwise) needs to be provided through the promulgation of appropriate performance indicators.

Traditionally, of course, this has been achieved via printed documents. Best practice in this regard is perhaps provided by the Scandinavian countries, which have imposed some of the most exacting reporting standards. In Sweden, for example, the Environmental Code (chapter 9, §6, section 1) requires all harbours and docks accessible to ships of more than 1,350 GRT to provide an annual environmental report. These reports are guided by advice from the Swedish Environment Protection Agency (General Advice 96: 1). Typically they provide a formal review of licences and permits issued, and report data on emissions and waste. Crucially, they aim to balance the danger of reader overload with the provision of sufficient information to allow the port to verify the report's claims and demonstrate precautionary measures taken (Fortes and

Akerfeldt 1999; Port of Göteborg 2002). Inevitably, however, even best-practice hard-copy reports tend to have a restricted circulation, which increasingly means that transparency and accountability tend to fall further behind the rising expectations set by current societies. Against this background it is appropriate to return to the theme of IT applications pursued earlier in this chapter. One particularly effective way of communicating environmental commitment and achievement to stakeholders, regulators and the public should be the Internet. What evidence is there that this potential is being exploited?

Table 10.3 lists the results of an online global survey of a random sample of

Table 10.3 Environmental reporting on port Web sites, 2003

A	*Do ports provide evidence of environmental management or planning online?*			
	Americas	*Europe*	*Oceania*	*Total*
Positive result:	15/22 68%	14/19 74%	9/9 100%	38/50 76%
B	*Do ports publish an environmental policy online?*			
	Americas	*Europe*	*Oceania*	*Total*
Positive result:	11/22 50%	7/19 37%	7/9 78%	25/50 50%
C	*Do ports publish an environmental report online?*			
	Americas	*Europe*	*Oceania*	*Total*
Positive result:	2/22 9%	3/19 16%	3/9 33%	8/50 18%
D	*Do ports put environmental monitoring data online?*			
	Americas	*Europe*	*Oceania*	*Total*
Positive result:	4/22 18%	5/19 26%	7/9 78%	16/50 32%
E	*Do ports advertise achievement of ISO/EMAS/other certification of environmental management system?*			
	Americas	*Europe*	*Oceania*	*Total*
Positive result:	0/22 0%	2/19 11%	5/9 56%	7/50 14%

Note
Figures indicate the number of affirmative statements from the total number of Web sites analysed.

50 port Web sites. In some respects the data are encouraging. A large majority of the ports sampled provided information relating to environmental management and planning, while half set out their environmental policies. However, only a third put environmental monitoring data online, and less than a fifth gave access to a complete environmental report or publicised an environmental management system certified by ISO, the Eco-Management and Audit Scheme (EMAS) or any similar agency.[7] Overall, the high proportion providing at least some environmental information indicates that more ports are reporting publicly in a very accessible manner, as recommended by various codes of practice such as EMAS. The credibility of these reports depends on the quality of the environmental performance data and the inclusion of science-based evidence from environmental monitoring. It is evident that in these respects there is still much that remains to be done. In this sense, major shortfalls remain with respect to ports' environmental accountability to the public.

The fact that much remains to be done should not be taken to indicate that the process ports use to address environmental demands has stalled. Progress continues to be made with new technology-based management tools, and reporting is on an upward curve. Moreover, in Europe at least, considerable momentum has been developed in recent years as ports have collaborated on a broad front to implement a plan of action. The vehicle for this collaboration has been the ESPO, formed in 1993 as the EU member states' independent port sector representative organisation. Funded and run by its roughly 700 members, ESPO can be considered a role model for collaboration.

ESPO collaboration and improved environmental management

One of ESPO's first activities was to produce an environmental code of practice (ESPO 1994) that combined recommendations on a management approach with objectives and targets for priority issues such as dredging, port planning and development, and emergency response plans. The code attempted to take into account the remarkable diversity of the sector as expressed in terms of the location, size, type, ownership, and local and national policies of its membership of around 700 ports. Benchmark environmental initiatives driven by ESPO include the setting up of Environmental Challenges for European Port Authorities (ECEPA) (de Bruijn 1998), to provide a vehicle for initiating joint environmental research projects between ports from different member states. Another contributory activity has been the commissioning of ESPO's Environmental Survey in 1996, aimed, first, at assessing the sector's response to major environmental management issues and, second, at establishing benchmark performance for future monitoring of progress. There has also been active participation in the EU Eco-Information project (1996–9) which was co-funded by several major European port authorities. This research and development initiative established a network of cooperation on environmental issues between port partners and resulted in

practical tools for reviewing environmental management performance such as the 'Self-Diagnosis Methodology' (SDM'98).

ESPO published an environmental review in 2001 as a follow-up to its original code. Today the collaborative momentum is being maintained by the involvement of ESPO ports in the co-funded EU EcoPorts Project (2002–5), the main goals being to harmonise the approach of port administrations in Europe to environmental management and to exchange best practices in respect of port-related environmental issues. The significance of these initiatives is that they have produced tangible tools and methodologies to assist implementation of publicly declared sector policies. They include a database of practical solutions, a new (2003) SDM for reviewing environmental management performance, and a PERS designed to assist development of an EMS.[8] A methodological guide to practical solutions applied to the port-city area, a forum for the exchange of experience, and a Web site[9] for networked access to news, developments and results are also available to participating partners. In the near future, EMIS and training support are envisaged products of the continuing project.

ESPO's overall declared policy towards environmental management is to encourage compliance with legislation and the attainment of high standards through voluntary schemes of self-regulation. Ports in the organisation wish to create a 'level playing field' by limiting consideration of the environment as a competitive factor. The strategy for implementation is based on 'ports helping ports' through networked exchange of shared experience, together with the provision of tools and methodologies to assist with putting in place the recommendations of the ESPO code. One way to judge the extent to which these port-inspired initiatives have been successful is to evaluate, through independent analysis, port managers' perceptions of progress in environmental management (Wooldridge 2000). Port authorities are now commenting favourably on the benefits of implementing a positive environmental programme. They include in these benefits cost savings; reduced environmental impact; improved public image and fewer complaints; an enhanced safety regime; wider port development opportunities; improved stakeholder relationships; and better

Table 10.4 Progress in port environmental management, 1996-2003

Management Component	*1996 (%)*	*2003 (%)*	*Increase (%)*
Does the port authority have an environmental plan?	45	62	+17
Does the plan aim for 'compliance-plus'?	32	45	+13
Does the plan aim to raise environmental awareness?	44	56	+12
Is environmental monitoring carried out in the port?	53	69	+16
Does the plan involve community and stakeholders?	53	56	+3

Source: Derived from surveys in 1996 and 2003 by the European Sea Ports Organisation. Results for 2003 are as yet interim. As the numbers and identity of respondent ports are not the same in the two surveys, the trends of progress are more significant than the percentage values imply.

compliance with legislation. Moreover, as Table 10.4 demonstrates, the period since ESPO's formation has been marked by increasingly positive attitudes to the environment among port operators, attitudes that have led to a clear improvement in standards. By 2003, around two-thirds of respondents reported that their ports engaged in environmental management and had an environmental plan. A majority indicated that their plans were intended to improve environmental awareness and involve the community and other stakeholders. And almost half were aiming for 'compliance plus'.

Conclusion

Progress in European port environmental management has been driven by increasing legislation and regulation, and through recognition of the common challenges posed by environmental issues. Additional drivers have been the impact of societal expectations and, most recently, the emergence of the deliberate policy that the environment should be a pre-competitive factor among European ports. While port sector activity in this field initially produced a wide range of responses, mostly issue led, an impressive recent trend has been a shift towards mutual assistance through collaboration. The fruits of this – which are admittedly still developing – have been structures and methodologies with the potential to standardise approaches to environmental management and remove the environment as a competitive factor.

An upturn in levels of environmental reporting arguably demonstrates another positive change in attitude towards environmental management by port professionals. Progress towards an integrated approach, with all its attendant benefits, is being made through a series of iterative steps. This reflects the diversity of approach, resources, awareness and attitudes within the port sector. Policy at a European level is well established and widely accepted. However, the major gap between policy objective and environmental quality is the critical phase of implementation at the local level. It is at this local level that technical developments will play an important role. Tools and methodologies derived from collaborative research and development (such as environmental management systems, decision support systems, Self-Diagnosis Methodology, the Port Environmental Review System and databases, auditing and performance analyses) increasingly provide the mechanism for implementation. Particularly significant is the fact that these developments frequently place environmental issues in the business plan itself and, in the process, acknowledge the benefits of an integrated approach to information management – benefits that can accrue to both the individual port and the sector.

Yet despite this progress, for commercial port managers and designated environmental managers the challenges remain substantial and varied – depending, of course, on the existing approaches in each port. The establishment of environmental performance and monitoring programmes, and key indicators, is crucial to producing the evidence and understanding that will support practical environmental management. There is increasing pressure from regulators and

the local community for port authorities to demonstrate unambiguous evidence of their claims regarding sustainable development and compliance with legislation. The result is that the sector has begun to identify port-specific performance indicators of both environmental quality and environmental management activity. Various physical, chemical, biological and managerial indicators are emerging and are being applied over a growing number of port areas. These in turn require the development of environmental management information systems in order to structure information into a retrievable format and maximise the components that allow an integrated response.

EMIS can be developed in a number of ways, but experience suggests that a networked and incremental approach will allow maximum flexibility to accommodate the existing individual tools that ports have developed. Experience in developing and validating an EMIS approach also demonstrates the importance of taking into consideration the human dimension. In themselves, technological 'solutions' are not sufficient. Continued progress to ensure the user-friendliness of EMIS is a key goal if these tools are to be accepted and used by the port community. Also key in the human context is capacity building among European port professionals. Despite the advances of recent years, there are still opportunities among port staff for increased understanding of environmental solutions and environmentally friendly practices. As ports seek to make progress on these fronts, it may well be that useful lessons – positive or negative – can be learned from elsewhere in the world. What is certainly evident is that, while the European experience has great relevance for port management in other continents, there is still considerable scope to refine the quality of the knowledge we are currently able to export.

Notes

1 Some European ports have even gone as far as to engage in conservation in order to enhance the working environment for their employees or gain positive public relations. The port of Bristol, for example, includes wildlife corridors within the port area, as well as an owl conservation initiative.
2 This kind of environmental information has the potential to become more easily available to ports as environmental agencies take an increasingly networked approach to managing their own data.
3 The Eco-Information (1999) survey estimates that the number of European ports having an environmental plan increased by 17 per cent (from a baseline of 44 per cent) between 1996 and 1999.
4 Profitable options refer to the capital benefits of a healthy environment, which can be degraded. For example, the possibility of using the port area for recreational purposes is lost if there is a severe reduction of water quality.
5 Environmental information systems are likely to contain more extensive pure science information, such as that needed to resolve questions of environmental impact, than is the case with EMIS.
6 A failure rate of 60 per cent has been quoted by Coopers and Lybrand (1996) in a recent international study of organisational systems development.
7 When the data are broken down by broad global region, they suggest that Oceania tends to lead the Americas and Europe. With only nine ports sampled in Oceania, however, this difference could be more apparent than real.

8 PERS has the option of applying voluntarily for a Certificate of Validation based on independent review and attainment of the specified standard of management.
9 www.ecoports.com.

References

Associated British Ports (ABP) (1999) *Humber Ports and Estuary Strategy*, Southampton: ABP.

Barrow, C.J. (1999) *Environmental Management: Principles and Practice*, London: Routledge.

Beanlands, G. (1988) *Scoping Methods and Baseline Studies in EIA*, in P. Warthern (ed.) *Environmental Impact Assessment: Theory and Practice*, London: Unwin Hyman, pp. 33–46.

Born, S.M. and Sonzogni, W.C. (1995) 'Integrated environmental management: strengthening the conceptualisation', *Environmental Management*, 19: 161–181.

Coopers and Lybrand (1996) *Managing Information Systems and Systems Risk: Results of an International Survey of Large Organisations*, London: Coopers and Lybrand.

Couper, A.D. (1992) 'Environmental port management', *Maritime Policy and Management*, 19: 165–170.

de Bruijn, H. *Forward Programme for Environmental Research*, Proceedings of ESPO Environmental Conference, Lisbon, 29 May 1998, Gare Maritima de Alcantara: European Sea Ports Organisation.

Dover Harbour Board (2001) *Annual Report and Accounts*, Dover: DHB.

Eco-Information (1999) *Eco-Information in European Ports: Sharing Knowledge Towards Environmental Regulation in the Port-City Area. Final Report*, EC Transport RTD Programme, The Hague: Eco-Information Secretariat.

EcoPorts (2003) 'Environmental management information system', available at http://www.ecoports.com/ports/tools/index.asp (accessed 1 May 2003).

European Sea Ports Organisation (ESPO) (1994) *Environmental Code of Practice*, Brussels: ESPO.

—— (2001) *Environmental Review*, Brussels: ESPO.

Fortes, H.J. and Akerfeldt, K. (1999) *Environmental Reporting in Sweden*, London: Middlesex University Business School.

Gunther, O. (1998) *Environmental Information Systems*, Berlin: Springer-Verlag.

Hanekamp, H.B. (2000) 'The port of Rotterdam: how ECDIS, GIS, EPFS and AIS technologies can help in developing a vessel traffic management and information service', *Port Technology International*, 9: 17–22.

International Chamber of Commerce (ICC) (1993) 'Business Charter for Sustainable Development: principles for environmental management', *Environmental Conservation*, 20: 82–83.

International Council for the Exploration of the Seas (ICES) (1989) *Report of the ICES Advisory Committee on Marine Pollution, 1988*, Co-operative Research Report no. 160, Copenhagen: ICES.

International Navigation Association (PIANC) (1999) *Environmental Management Framework for Ports and Related Industries*, Report of PIANC PEC Working Group 4, Brussels: International Navigation Association.

International Organization for Standardization (ISO) (1996) *ISO 14001. Environmental Management Systems: Specification with Guidance for Use*, Brussels: European Committee for Standardization (CEN).

McMullon, C. (1997) 'The Validity of Scientific Criteria for the Environmental Auditing of Port and Harbour Operations', unpublished PhD thesis, University of Wales, Cardiff.

Mayda, J. (1997) 'Policy and decision-making as a focus for integrated data management', in N.B. Harmancioglu and M.N. Alpaslan (eds) *Integrated Approach to Environmental Data Management Systems*, Dordrecht, the Netherlands: Kluwer Academic, pp. 67–78.

National Research Council (NRC) (1990) *Managing Troubled Waters: The Role of Marine Environmental Monitoring*, Marine Board, NRC, Washington, DC: National Academy Press.

Port of Göteborg (2002) *Environmental Report, 2002*, Göteborg: Port of Göteborg.

Tabor, M.W. (1990) 'Chemical analysis for assessment and evaluation of environmental pollutants: fact or artifact?', in S.S. Sandhu, W.R. Lower, F.J. De Seres, W.A. Suk and R.R. Tice (eds) *In situ Evaluations of Biological Hazards of Environmental Pollutants*, Environmental Scientific Research vol. 38, New York: Plenum Press.

Townend, I. (2002) 'Marine science for strategic planning and management: the requirement for estuaries', *Marine Policy*, 26: 209–219.

Tyler-Walters, H. (1997) 'Monitoring programme design and implementation in coastal management initiatives in England and Wales', unpublished MSc dissertation, University College of Wales, Aberystwyth.

United Nations Conference on Trade and Development (UNCTAD) (1983) *Planning Land Use in Port Areas: Getting the Most Out of Port Infrastructure*, UNCTAD Monographs on Port Management, UNCTAD/SHIP/494(2), Geneva: UNCTAD.

—— (1993) *Computerized Container Terminal Management*, UNCTAD Monographs on Port Management, UNCTAD/SHIP/494(10), Geneva: UNCTAD.

Valencia Port Authority (2002) *Guide for the Implementation of Environmental Management Systems in Port Facilities*, Valencia: Port Institute for Studies and Cooperation (IPEC).

Vandermeulen, J. H. (1996) 'Environmental trends of ports and harbours: implications for planning and management', *Maritime Policy and Management*, 23: 55–66.

Whitehead (2001) quoted in *Select Committee on Environment, Transport and Regional Affairs, Minutes of Evidence. Evidence given on Wednesday 14 February 2001*, London: The Stationary Office.

Wooldridge, C.F. (2000) 'Quality assurance in European port operations', *BIMCO Bulletin*, Baltic and International Maritime Council, 95(1) (February): 55–58.

First published 2004
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

Simultaneously published in the USA and Canada
by Routledge
270 Madison Ave, New York NY 10016

Routledge is an imprint of the Taylor & Francis Group

Transferred to Digital Printing 2007

Typeset in Galliard by Wearset Ltd, Boldon, Tyne and Wear

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging in Publication Data
A catalog record for this book has been requested

ISBN 0-415-28344-2