Restructuring the maritime transportation industry : Global overview of sustainable development practices

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ÉTUDES ET RECHERCHES EN TRANSPORT

Québec

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Claude Comtois
Brian Slack

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RESTRUCTURING THE MARITIME TRANSPORTATION INDUSTRY. GLOBAL OVERVIEW OF SUSTAINABLE DEVELOPMENT PRACTICES

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Undertaken for the ministère des Transports du Québec

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Problem

Elsewhere in the world, is sustainable development fashioning maritime transport development? What are the best practices of ports and shipping lines? Should marine community of the Saint Lawrence adopt some of these practices to further develop a sustainable maritime transport? These are some of the issues from which an international portrait, a unique reference tool, was conceived.

Objectives

The aim of the study was to transmit to the marine community (ministry of Transport, industry, environmental groups and local community), an evaluation of best practices of sustainable development applied to ports and shipping.

Méthodology

From an analysis of the web sites of 800 ports and 120 shipping lines, completed with interviews in United States, Europe and Asia, the researchers Claude Comtois and Brian Slack undertook a global overview : the marine industry is being restructured; more and more adopting practices of sustainable maritime transport allows to maintain or strengthen the competitiveness of ports and shipping lines.

Résults and recommandations

In the final report, the development conditions shaping the industry are presented. The types of environmental issues confronting the industry are then identified. This is followed by a detailed examination of the development of short sea shipping around the world in terms of operating conditions, promotion policies and environmental impacts. The elements, mechanisms and constraints linked with applying sustainable development practices are explained. Finally, the competing factors of environmental performance and their implications for the Great Lakes-Saint-Lawrence system are underlined. The Ministry supports the development of a sustainable maritime transport, notably through research.

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SUMMARY

Sustainable development strategies are a reality. Sustainable development is a model for growth that secures social equity and allows economic progress while preserving resources and ecosystems. Everywhere, these strategies aim at achieving a balance between the economic, social and environmental pillars of growth processes. Henceforth, transport systems must be economically viable while taking into consideration the social and environment conditions of the host communities. In this regard maritime transport has a major role to play. It is an efficient mode, capable of handling large quantities of freight, and with the capacity to take on traffic diverted from overloaded land transport systems. Maritime transport is particularly well suited to playing a major role in the achievement of sustainable development. However, despite being perceived as a “green” mode of transport, it does generate some negative effects on the environment. This raises a series of issues at the basis of this analysis. What are the issues of port development, marine shipping and sustainable development at the international level? What are the current best practices? How can sustainable development be applied to the Great Lakes-Saint Lawrence system?

These issues are analyzed on the basis of international fieldwork supported by a review of the scientific literature, government reports and the annual reports of port authorities and shipping lines. In addition, we have undertaken a content analysis of the web sites of 800 port authorities and 120 shipping lines, and interviewed 47 people from universities, governments and industry.

The results of our study comprise seven components.

Contemporary conditions shaping the development of transport systems

Transport systems constitute a fundamental element in the formation of economic spaces. All scenarios of economic growth rest on an increase in freight, passenger and information traffic. Between 1996 and 2000, growth in world trade has exceeded that of the world maritime fleet. This reflects improved productivity in the maritime fleet through an increase in ship loading capacity . More importantly, this improvement brings to light the cumulative connections between infrastructures, industrial production and the built environment.

World regions cannot avoid intermodalism. This function rests on the most important markets, those that generate the highest revenues and offer the greatest potential for growth. In addition, the organization of transport linked to intermodal and technological progress is increasingly based on the quality of logistic services.

Intermodalism and logistics generate major economic, social and environmental upheavals. Sustainable development perspectives are increasingly defined to take into account the role and function of maritime transport.

Sustainable maritime transport

The literature review and the international data collected between April 1, 2003 and March 10, 2005, demonstrate that long-term sustainable development includes environmental, social and economic dimensions. There is widespread consensus on the importance of these three dimensions. The environmental dimension requires balancing of the interactions between human activities and the natural environment. For the social dimension, the objective is to find solutions to contemporary problems raised by technology and economic growth in order to channel changes to respect present and future societies, in the context of democratic participation and international legislation. For the economic dimension, the objective is to orientate progress in the direction of economic efficiency.

The literature review shows that environmental conditions may complicate, delay, or constrain maritime transport. The competitiveness of ports and shipping companies is partly determined by the physical geography of coastal zones and passages, which may limit port expansion and the ability to accommodate ever-larger ships. Technology has given the maritime industry the ability to modify the environment. These modifications that impact on the biophysical environment engender costs: vulnerable ecosystems may be transformed, others may be destroyed, while in some other cases artificial ecosystems may be created.

Our study has demonstrated that the paradigm of sustainable development is increasingly taking root and has become an essential factor in the functioning, organisation and performance of the maritime industry – port administrations and shipping companies.

In a very large number of countries adjustments to legislation are being undertaken to conform to the rules and regulations of the IMO. This study stresses that compliance with international conventions involves both the private sector and the signatory states who may apply the rules in many ways, notably by self-regulation of the industry, or by the controls established by the coastal state, the flag state of ships, or the state in which the port is located. It has been demonstrated that these means of control are favourable for port operations and shipping.

In addition, our study reveals that port administrations and regular shipping lines that are preoccupied by economic and market concerns must, increasingly, consider social and environmental factors in their business strategies in order to respond to the growing concerns of their customers and

the communities in which they operate. Adopting a strategy of sustainable development may give ports and shipping lines a competitive advantage and enhance efficiency and profitability.

Global overview of sustainable development practices applied to port authorities and shipping lines

With the goal of determining the sustainable development perspectives of the maritime industry, we constructed a database comprising 800 ports and 120 shipping lines. These enterprises differ greatly in terms of ownership, sources of financing, types of activities and traffic volumes.

From the evidence collected it is clear that the maritime industry faces many challenges, problems and legislative obstacles in achieving the goal of sustainable development. Nevertheless, there appears to be a consensus about the relative importance of the different challenges. Through the international survey we ranked and examined the most important challenges identified by the industry itself. Many of these challenges were shared by port authorities and the shipping companies (water quality, air quality, waste management, resource conservation, energy consumption, emergency plans, oil spills, antifouling paints, dust emissions), while others were specific to one or the other. Thus, noise, dredging, soil contamination and odours were problems identified by port authorities, while ship recycling and the transportation of hazardous materials were issues raised by shipping lines.

In addition to the question of legislation, our study demonstrates that shippers are also placing pressure on the marine industry, affecting competitiveness and the decision-making process. Port authorities or shipping lines that fail to respond to these challenges will be marginalized. This will eventually apply across all geographical regions to all port authorities and shipping companies.

The results of the international survey of sustainable development practices by ports and shipping lines reveal a wide range of strategies and practices. Several maritime industry leaders have adopted sustainable development as one of their major concerns. At the international level, the port authorities that exhibit the best examples of environmental leadership are found in Australia, Northern Europe and the West Coast of North America. The best performers among shipping lines include MOL and NYK of Japan, P&O Nedlloyd of the United Kingdom and Wallenius Lines of Sweden.

Short sea shipping

Short sea shipping appears to be the transport mode most capable of resolving many of the problems brought about by the increased use of transport in the context of sustainable development. Many countries around the world have recognized the importance of promoting short sea shipping because it possesses a number of commercial and environmental advantages. More

detailed analysis reveals, however, that this perspective has to be nuanced. Inevitably, different components of the industry give rise to a wide range of environmental benefits as well as drawbacks. Moreover, the tools available to promote the industry differ considerably. Any promotion has to recognize the strengths and weaknesses of short sea shipping, especially in terms of taxation and administrative procedures. Developing short sea shipping also requires that the links with other modes be harmonized, which in turn raises problems of investment allocation.

International portrait of the policies to promote short sea shipping

Sustainable development is at the heart of the main interventions promoting short sea shipping, but we have observed that environmental concerns remain secondary. The diffusion of knowledge concerning best practices has been a critical factor in the promotion of short sea shipping, particularly if this promotion provides evidence of integration in transport chains. Promotion requires the participation of all levels of government, and administrative as well as political action is required. The evidence points to the greatest success being achieved by a relatively small number of government agents who have experience and responsibility for short sea shipping.

Applying sustainable development strategies to the maritime industry

Relations between ports, maritime transport and sustainable development take place at many geographical scales. Our study demonstrates the particular relevance of importing knowledge, experience and practices of sustainability applied to ports and shipping. For several years the concept of sustainable development has led several port administrations and shipping lines to adopt sustainability as a fundamental principle of their business policies and to implement measures to reduce the environmental impacts of their activities.

Our study indicates that there are many ways in which to implement sustainable development that take into account social, economic and environmental factors. One of the bases of all these methods is an environmental management system, to which social and economic dimensions are added. Our detailed interviews reveal the increasing adoption of environmental management systems by port authorities and regular shipping lines in many parts of the world.

There exist many different environmental management systems. Our study suggests that the choice is particular to each enterprise, based on the risks measured or perceived by the enterprise and on the geographic milieu of the company's operations. The structure of an environmental management system for ports and shipping lines is complex. However, several basic interrelated factors need to be considered in the elaboration of a management program. The adoption of an environmental management system (EMS) requires the

conformity of marine operations with environmental legislation. The most elaborate EMSs involve international certification.

All environmental management systems are influenced by constraints of application and by management strategies. The trajectories of sustainable development depend upon the roles port authorities and shipping companies can or should play in the process. There are several measures that need to be put in place to facilitate the administration of a system in the maritime industry. These include quantifying indicators, formulating a schedule of operations, establishing environmental standards, fixing responsibilities, planning control mechanisms and selecting sustainable development measures.

Our analysis underlines the important role of governments in elaborating policies, strategies and measures to attain the social, economic and environmental goals of sustainable development. Having defined these goals, the best way to implement them is to transfer the responsibility to port authorities and shipping companies themselves. These actors can thus apply the policies in light of their particular geographical and sectoral conditions.

Our study has revealed a great interest of port authorities and shipping lines in performance indicators. These indicators should: 1) measure the human resource and financial implications of existing environmental and sustainability efforts; 2) compare this performance over time; and 3) communicate the results to shareholders, the community and the government. Applying performance indicators is a means of integrating environmental management within the traditional commercial interests of the enterprise.

Great Lakes–Saint Lawrence system

Comparing the grand axes of fluvial transport in the world reveals that the Saint Lawrence is a privileged system, but is one that is under-utilized for freight transportation.

Important progress towards sustainable development has been made by different levels of government in Canada over the past few years. In Québec, this is manifest with the publication of the Maritime and Fluvial Transport Policy. Nevertheless, important lacunae in laws and policies are evident. Certain problems that have been recognized internationally, such as soil contamination, dust emissions, odours, noise etc. have not been properly addressed by legislation in Canada.

Interviews undertaken in Québec reveal that only the port of Montréal has an environmental program. The other port administrations on the Saint Lawrence ignore the challenges of sustainable development or assume it is the responsibility of the commercial terminal operators. Moreover, no port administration or shipping line in 2005 possessed an environmental management system.

The complexity of international, federal and provincial legislation and the frequent changes constitute a brake on implementing sustainable development strategies in the port and shipping industry and in the development of short sea shipping on the Saint Lawrence River.

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1. INTRODUCTION

1.1. Changing conditions

The changes imposed by the need for sustainable development are a reality. They must answer the different demands of social development resulting from economic growth. This process must, however, be undertaken in a context where ecosystem protection has a considerable effect on the policies and practices of transport systems management. The number of environmental laws is increasing. There is already a complex system of differential charging based on congestion, pollution emissions and traffic safety, to compensate for the external costs generated by freight and passenger transport. Sustainable development has become a key feature in the processes of economic growth. The processes of sustainable development have an impact on the strategies of the transport industry and orient investment decisions. The capacity to resolve environmental problems has become a competitive factor for shippers, carriers and terminal operators (Comtois and Slack, 2003).

1.2. Mandate

We obtained a mandate from the Secrétariat au transport maritime et à la mise en valeur du Saint-Laurent, of the ministère des Transports du Québec, to undertake a research project on maritime transportation and sustainable development at the international level.

The objectives of the research blueprint are: 1) to specify the issues of port development, marine shipping and sustainable development at the international level; 2) to identify and analyze current best practices; and 3) to evaluate how sustainable development can be applied to the Great Lakes Saint Lawrence system. Generally, marine shipping includes pleasure-boating, cruises, ferries and freight transport. While all these types of navigation have an impact on the environment, the current mandate essentially focuses on commercial shipping, namely freight transportation by ship and short sea shipping.

1.3. Methodology

The methodological approach is determined by the research objectives, the conceptual framework underlining the problem and the empirical considerations of the project – port regions, public and private actors, professional practices.

Given that the literature and the information on sustainable development strategies applied to port systems and commercial shipping are fragmented, fieldwork was necessary to collect primary data. On site visits, meetings with managers and public officials, users and local agencies were the essential input for the analysis and the evaluation. We established a list of public and

private institutions that offer specialized services in terms of marine transport, port development or the environment (annex 1). A sample of agencies from the industry and governments around the world were asked series of open questions in relation to their activities and the objectives of the project. Our approach aimed at answering 11 questions:

- What environmental, port or shipping issues are identified and analyzed?
- What is the quality of the legislative framework?
- What is the quality of the referenced database?
- What are the problems treated – health and safety, dredging, waste management, energy supply, air, water, soil quality, ecosystem, etc.?
- How are these issues measured – description, frequency, recording instruments, analytical techniques, impact assessment, etc.?
- What are the performance indicators of environmental protection – government, industrial, scientific norms?
- What environmental management system is used? What factors influenced this choice?
- Is the environmental management system accredited? By whom? Organization, government, local community, etc.
- What is the usage frequency of the environmental management program – regular, occasional, case by case?
- What is the degree of integration between the environmental management program and the shipping and port operations – database, survey, report, information diffusion, personnel training, and support for the decision-making process?
- What is the impact of using an environmental management system on risk management, environmental protection and the productivity of the marine industry?

The data allows the best practices of the industry, the main issues in managing sustainable development and the challenges that shape port development and commercial shipping to be identified. In accordance with the research ethics that govern all research projects, we have treated the information obtained in the strictest confidentiality. The results of the interviews have been compiled in such a way that no individual or enterprise consulted can be identified.

The research project comprises eight methodological components, dealt with in as many chapters.

Chapter Two presents the initial research and is based on an evaluation of current conditions in the development of transport systems. This section is

presented: 1) to understand the recent evolution of transport systems; 2) to recognize economic, social and environmental changes imposed by intermodalism and logistics; 3) to evaluate the importance of marine transport in the various initiative of sustainable development; and 4) to present the issues and objectives of the research.

Chapter Three is concerned with the interpretation of these changes in light of sustainable development and provides a detailed examination of the literature addressing sustainable development. The goal of this section is: 1) to present a typology of definitions on sustainable transport; 2) to evaluate the progress of knowledge pertaining to the environment, port development and commercial shipping; and 3) to understand the problems of sustainable development applied to the marine industry in relation to environmental conditions, international legislation and competitiveness.

Chapter Four presents an international overview of the sustainable development practices of port administrations and marine carriers. The goal is: 1) to formulate a diagnosis concerning the environmental evaluation of port administrations and shipping lines; and 2) to specify the main issues, problems and international legislations that underpin the best practices of sustainable development for the whole of the marine industry.

Chapter Five presents a description of short sea shipping and elaborates an international portrait of the operating conditions of this type of marine transport. The objective of this section is: 1) to present a typology of short sea shipping; 2) to clarify the motives that preside over the diversity of definitions concerning short sea shipping; 3) to measure the importance of coastal and inland marine traffic; and 4) to evaluate the problem of short sea shipping according to legal, intermodal, physical, port and economic dimensions.

Chapter Six provides an international portrait of sustainable development practices applied to short sea shipping. The goal is: 1) to compare promotion policies of short sea shipping; 2) to evaluate the environmental impacts of short sea shipping; and 3) to present growth strategies of short sea shipping.

Chapter Seven evaluates the implementing tools of sustainable development strategies applied to port system and commercial shipping. The goal is: 1) to undertake a global overview of sustainable development practices that constitute the subject of the study; 2) to identify the main environmental management systems, their application constraints and management strategies; 3) to measure the economic impacts resulting from sustainable development practices; and 4) to propose the structure of a program of sustainable development applied to ports and shipping.

Chapter Eight presents the necessary conditions for the transfer of sustainable development strategies to the Saint Lawrence system. The goal of this section is: 1) to undertake a brief survey of the Great Lakes-Saint Lawrence; 2) to specify the actions of the ministère des Transports du Québec; 3) to present

recent decisions of Transport Canada; and 4) to acknowledge the joint initiatives between Canada and United States.

Chapter Nine presents a summary of salient facts for each of the main findings of the research and proposes a series of recommendations. This is followed by a conclusion and the bibliography. The report ends with an annex of the corresponding addresses of institutions interested in marine transport, port development and the environment.

1.4. Financial support

In order to conduct this research we received financial support mainly from the ministère des Transports du Québec. The Centre for Research on Transportation, the Department of Geography and the Centre for East Asian Studies at the Université de Montréal, as well as the Department of Geography at Concordia University, also provided support.

2. CONTEMPORARY CONDITIONS SHAPING THE DEVELOPMENT OF TRANSPORT SYSTEMS

Contemporary transport systems are undergoing a profound mutation. The policies of the World Trade Organization have led to an expansion of international trade. Besides, the introduction of market-based reforms in numerous countries has created new opportunities for transportation resulting in a globalisation in the organisation of production and considerable changes in the industrial structure of many countries. These new economic perspectives have been underpinned by an expansion of sea-land connections. This chapter aims at evaluating the contemporary conditions in the development of transport systems. The specific objectives are: 1) to understand the recent evolution of transport systems; 2) to recognize economic, social and environmental changes imposed by intermodalism and logistics; 3) to evaluate the importance of marine transport various sustainable development initiatives; and 4) to present the issues and objectives of the research.

2.1. Evolution of transport systems

Transport systems constitute a fundamental element in the formation of economic spaces. All scenarios of economic growth rest on an increase in freight, passenger and information traffic. Between 1996 and 2000, the growth in world trade has exceeded that of the world maritime fleet. This reflects improved productivity in the maritime fleet through an increase in ship loading capacity. More importantly, this improvement brings to light the cumulative connections between infrastructures, industrial production and the built environment. Economic blocs reflect a periodic superimposition of transport and communications technologies over inter-urban trading links. Consequently, the introduction of technological innovations is associated with the addition of new infrastructures leading to a refashioning of existing networks.

For the past 20 years, much restructuring has occurred within the world's economic zones. Recent advances in transport and communications such as container shipping, increasing vessel size, jumbo jets, logistics and the extensive application of information technologies to the management of traffic has created a new infrastructural arena permitting the emergence of a fresh set of economic and political activities.

The reduction in time and cost of transport inherent in these transformations has widened the markets of multinational firms and their subsidiary companies and encouraged the use of smaller production and distribution units. This process has led to the decline of traditional industrial functions, a restructuring of the labour market and the emergence of new opportunities for the development of local resources.

In this process, economic prosperity is closely associated with network hubs within development corridors where the infrastructure endowment is correlated

with high levels of accessibility – such as Montréal-Toronto; Montréal-New York; Vancouver-Seattle; Boston-Washington. Hub ports are the loading-unloading freight platforms, often containerized, welcoming large vessels of regular ocean shipping lines and smaller feeder vessels supplying them. These infrastructure requirements, demanding important investments beyond government financial capabilities, have led to an extensive process of liberalization in the organization of transport systems. The government of Canada has adopted a series of divestiture policies of its transport systems, privatizing publicly- owned transport companies and commercializing ports and airports. Many of these policies have favoured the emergence of an extremely competitive transport market, marked by a multiplication of linkages, the development of new routes, free fare structures and greater autonomy for transport firms in the organization of their operations (Dion, Slack and Comtois, 2002). New, denser infrastructures, based on multi-layered links, have intensified the network conditions or the network economy of North America.

2.2. Changes imposed by intermodalism

World regions cannot avoid intermodalism (Comtois and Rimmer, 1997). This function rests on the most important markets, those that generate the highest revenues and offer the greatest potential for growth. The concept of intermodalism has been developed to counter past preoccupations that only analyzed individual transport modes. A multimodal platform does not only include land and sea networks, but also air and telecommunications connections. Nodes produce flows of freight, passengers and information. Connections are corridors that facilitate movement of goods, people and information (figure 1).

In figure 1, we have classified terminals in terms of platforms, proto-platforms and other nodes from an analysis of statistics of sea, air and telecommunication traffic data. Platforms represent terminals with the highest rankings in terms of international traffic for all modes and telecommunications. Proto-platforms have an important international traffic in at least two modes. The other nodes are not among the most important transport terminals, but are part of existing global transport and communications networks. Applied to the Asia-Pacific region, our analysis identifies Hong Kong, Los Angeles-Long Beach, Tokyo, Singapore, Taipei-Kaohsiung, Seoul-Pusan and Bangkok as platforms. Proto-platforms include Osaka, San Francisco, Seattle-Tacoma, Manila, Nagoya, Sydney and Jakarta-Tanjung Priok. The other nodes include Beijing-Tianjin, Brisbane, Fukuoka, Dalian-Shenyang, Ho Chi Minh, Kuala Lumpur-Port Klang, Melbourne, Sapporo, Shanghai-Nanjing and Vancouver.

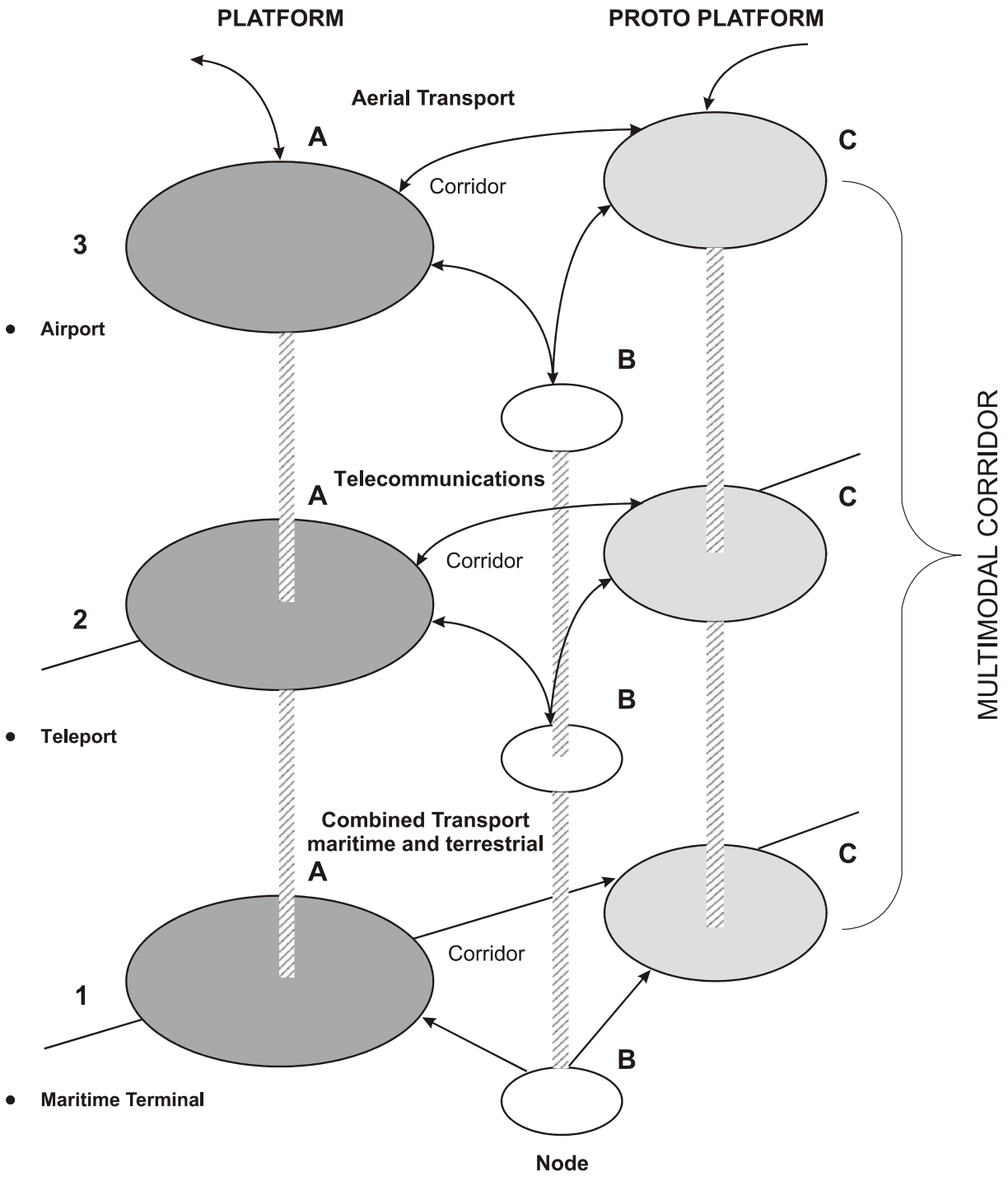


Figure 1 Diagram of multimodal platforms

Synergy is possible between these different modes. Despite intermodal competition, global processes facilitate the management of transport systems. Telecommunications have become a key feature in the functioning of logistics systems. In this context, all existing transport terminals must be integrated physically. Besides, in the perspective of a system extracting the maximum potential from existing infrastructures, it is necessary to provide greater modal choice and even to influence this choice according to economic and environmental needs. This process occurs however in a context where containerization, international shipping alliances and the emergence of global terminal operators modify considerably terminals and their supporting transport networks.

The spatial imprint of terminals – airports, rail yards and ports – and their accessibility by railways, highways and inland waterway dredging are increasing. The areas required to operate new airports are immense. There are projects of 10,000 hectares. Activities within rail freight terminals currently in operation require configurations of more than three kilometres long. Increasing vessel size and growth in traffic have also imposed an examination of expansion and location strategies of port and marine activities.

There is very strong competition among ports to build infrastructures that will precede demand with a view to attract carriers. This includes urban region projects that permit the expansion of new industrial sectors supported by several ports – petrochemical and energy industries. Coastal areas required for new berthing space are highly coveted. Contemporary terminals must secure sites of at least 60 hectares. Port expansion strategies around the world are varied. In Hong Kong and New York, port administrations have decided to reconfigure old port sites. In Rotterdam, Antwerp, Le Havre, Singapore and Los Angeles, strategies are founded on an expansion towards contiguous areas. In Vancouver, Marseille, London and Shanghai, new spatial requirements are fulfilled through the relocation of port activities on new sites.

These strategies demonstrate that proposed new sites for unloading, handling and warehousing is a major issue for many port administrations. Often they cannot adapt existing sites to the new transport environment. Besides, port expansion through reclaimed land is often difficult because of the important negative environmental impacts involved in these proposals. Expansion on areas immediately adjacent is often impossible. Port infrastructures that were originally built on sites beyond urban fringes have rapidly been constrained by surrounding urban development. Port administrations come under enormous pressure from real estate agents seeking urban waterfronts. It is important to underline that port site property and adjacent lands are sometimes characterized by different zoning laws – municipal, provincial and federal – whose respective land use plans often come into conflict. Relocation of port activities represents a challenge; it is difficult to find adequate land areas, the costs of transferring marine activities are enormous and these sites can break up integrated transport systems while distancing the port from its traditional local markets.

2.3. Logistics and the search for sustainable development

The dynamics of transport systems underpins the transformation of economies whose growth rests increasingly on the performance of economic processes and project management – production lines, work organization and distribution systems. In this context, the organization of transport systems, linked with intermodalism and technological progresses, depend more and more on the quality of logistics services. Logistics is not a new concept. It conditions the flow of goods and information, from acquiring materials to warehousing and inventory techniques and final distribution of finished products. Contemporary economic mutations have led to a logistics revolution that henceforth requires working with customers on the processes of circulation, to detect the weakest points and the most costly activities and to conceive solutions. The objective is to synchronize production and distribution activities between firms through an intensive use of information exchange networks. But this process generates important economic, social and environmental upheavals, as specified below.

The most performing logistics systems facilitate the growth of commercial exchanges. Moreover, the new logistics modify traditional comparative advantages. The labour market can be precarious, since logistics permit a diversification of manufacturing processes and allow greater flexibility in the location of production. Logistics services are thus associated with the creation of new networks, with changes in industrial structures and with the emergence, decline or abandonment of numerous employment sectors. Henceforth, local economic growth is inscribed within global processes.

Logistics systems also target the reduction of transport and distribution costs through a disaggregation of the supply chain. The system requires the creation of vast distribution centres often located outside metropolitan areas from where large numbers of small parcels are shipped to customers. Not only do logistics services result in exceptional land take, but they also involve more ton-kilometres of freight transported. Logistics services certainly increase benefits to users, but they do not take responsibility for the social and environmental costs.

Besides, logistics systems have given rise to two economic phenomena: just-in-time and door-to-door. These management methods favour air and truck shipments, considered the most reliable, but also the most energy consuming. Rail and ships, which are the most efficient in terms of energy consumption, are perceived as the least reliable in terms of logistics (Rodrigue, Slack and Comtois, 2001).

There is a need to underline that since the mid 1980s, all these changes in logistics and transport systems have been undertaken in parallel with the search for a balance between the economic, social and environmental pillars of sustainable development, notably by the World Commission on Environment and Development (Brundtland Commission, 1987), The Earth Summit on

Environment and Development (Rio de Janeiro, 1992) and the World Summit on Sustainable Development (Johannesburg, 2002). Everywhere, there seems to be an increasing focus on collective responsibility for the practices and policies of sustainable development. It is now becoming a preoccupation of the transport industry.

2.4. Issues and objectives

To answer the objectives of sustainable development, transport systems must be profitable, compatible with the environment and favourable for the local communities. Traffic growth, dominated by road transport, the importance of airfreight in logistics services and the need for additional spaces for transport terminals, represent challenges that cannot be answered by the current status quo. In this context, maritime transport has a major role to play. It is a reliable mode of transport, capable of handling large amounts of freight, and can thus relieve congested land transportation services. Although perceived as “green”, maritime transport still has an impact on the environment.

The analysis of the best practices and best experiences currently in operation at the international scale and that should be applied to the Great Lakes-Saint Lawrence system raises a series of key issues:

- What environmental factors are affected by port development and shipping?
- What environmental policies are linked to port development and shipping?
- What sustainable development practices currently used by public and private administrations are linked to port development and shipping?
- Which factors promote complementarity or intermodal transfer from a sustainable development standpoint?
- What are the links between the practices of the marine industry on the one hand, and the policies of sustainable transport on the other hand?
- How do these programs integrate environmental aspects and operational constraints (port and shipping) in policy formulation?
- What are the impacts on ports, terminal capacity, traffic and networks, and notably on the means to manage them?
- What mechanisms exist to optimize industry practices and harmonize the relationship with the imperatives of sustainable development?
- How are these programs used and evaluated by the marine industry and by local, regional and national governments?
- What is the social impact of port development and marine shipping?

The objective is therefore to: 1) extract the variables and recurrent issues that affect sustainable development as it applies to the port system and shipping; 2) identify intervention policies for sustainable development; 3) establish linkages between policies and practices of sustainable development; and 4) evaluate the conditions for their application to the Great Lakes-Saint Lawrence system.

3. SUSTAINABLE MARITIME TRANSPORT

The interpretation of contemporary changes in transport systems from the sustainable development standpoint requires a detailed examination of the literature on sustainable transport. This section will: 1) present a typology of definitions of sustainable transport; 2) evaluate the progress of knowledge pertaining to the environment, port development and commercial shipping; and 3) examine the problems of sustainable development applied to the marine industry in relation to environmental conditions, international legislation and competitiveness.

3.1. Definitions of sustainable transport

The concept of sustainable development was popularized in 1987 with the publication of the Brundtland report, “Our common future”. According to the report, sustainable development is the ability to meet the needs of the current generation without compromising the needs of future generations. The concept sanctioned in 1992 at the Earth Summit held in Rio de Janeiro linked environmental issues with those of development. Sustainable development involves the equitable sharing of the benefits of economic progress by focusing on the conservation and preservation of natural resources, and by tackling the reciprocal influences of environmental, social and economic issues. When explained, these objectives of sustainable development seem to be shared and even demanded by most institutions and citizens.

The emergence of a consensus on the need to implement sustainable development strategies to the growth, performance and organization of transport systems has been facilitated by the dissemination of several definitions of the concept of sustainable transport.

In 1996, The Organization for Economic Cooperation and Development (OECD) designated environmentally sustainable transport as one that does not endanger public health and ecosystems and meet access needs, while using renewable resources below their rate of generation, and using non-renewable resources below the development rates of renewable substitutes (OCDE, 1996; Canada, 1997).

In 2001, at the ninth session of the Commission on Sustainable Development of the United Nations (CSDUN), the concept of sustainable development when applied to transport was defined as referring to its role in securing a balance between equity, efficiency and the capacity to answer the needs of future generations. More specifically, this implies: 1) maintaining a level of economic growth that would create the necessary wealth to achieve sustainable development; 2) environmental protection, at the local and global scale, through the reasonable use of non renewable resources and the development of new technologies; and 3) protection of individual well-being by reducing the impacts of pollution and poverty. In this context, a policy of sustainable

transport must pursue several objectives, namely: 1) securing energy supply; 2) reflecting the costs of non renewable resources in transport vehicle operations; 3) adopting production processes respective of the environment by eliminating negative externalities detrimental to future generations (Nations Unies, 2001a).

During the same year, the need to promote linkages between economic efficiency, social progress and environmental protection, applied to transport systems, was further enhanced when Sweden held the Presidency of the Council of the European Union (EU). The European Union Transport Ministers agreed on a resolution integrating environmental and sustainability issues into transport policy. More specifically, a sustainable transport system was defined as one that:

1. makes it possible to satisfy the basic needs for communication and development of individual, businesses and organizations in a safe way for the individual and ecosystems and which promotes equality within and between generations;
2. offers good value for money, functions in a fair and efficient way, makes available different types of transport opportunities, support a competitive economy and balanced regional development; and
3. restricts emissions and waste to a quantity that the earth can absorb, uses renewable assets at or under the level at which these can be renewed, and keeps the consequences of uses of land and noise to a minimum (Sweden, 2002).

Canada has been an active member of the Commission on Sustainable Development of the United Nations since its creation in 1992. In 1996, the Canadian government, with the financial support of Environment Canada and Transport Canada, created the Centre for Sustainable Transportation, a non-profit organization with a Canadian charter. In 2003, the centre presented a list of 14 performance indicators for sustainable transport (plate 1).

Plate 1 Performance indicators of sustainable transport from the Centre for sustainable transportation, 2002

Use of fossil fuel energy for all transport
Greenhouse gas emissions from all transport
Index of emissions of air pollutants from road transport
Index of road fatalities and injuries
Total motorized movement of people
Total motorized movement of freight
Share of motorized movement of people not by land-based public transport
Movement of light-duty passenger vehicles
Intensity of use of urban land
Length of paved roads
Index of relative cost of transport
Index of the affordability of urban transit fares
Index of energy intensity of cars and trucks
Index of fleet emissions intensity

Source: Centre pour un transport durable, 2002.

These indicators demonstrate the emergence of a certain consensus concerning the importance of applying principles of sustainable development to transport and production activities. There are, however, no distinctive particularities in relation to different geographical conditions. A review of the literature on sustainable transport durable is better defined under a multimodal perspective. Definitions of sustainable transport integrate economic growth, social development and environmental quality as fundamental elements in the growth of multimodal transport systems. Applied to maritime transport, the principle of sustainable development is concerned with the social, safety, economic, environmental, energy as well as continental and maritime space management issues (IMO, 2001).

3.2. Literature review on the environment, port development and shipping

3.2.1. Marine environment

International studies on the marine environment are gaining a growing pre-eminence in the scientific literature. The review of the literature attests that the articles pertaining to the marine environment seek to answer a series of issues that can be grouped under four headings:

1. How are the environment and the oceans becoming the field of new naval strategies? (Tangreti, 2002);
2. How are the management and understanding of environmental changes and impacts becoming an economic necessity? (Miossec, 1999; 2001);
3. What are the main environmental management objectives for different countries having a maritime frontage? (Marcadon, 1999; Raftopoulos, 2001); and
4. What are the possibilities for international cooperation and the blueprint linked with the adoption of international legislations? (GAO, 1999).

These issues are analyzed through the examination of climate changes and the problem raised by ocean and coastal management. These changes are interpreted by a detailed examination of environmental problems and risks of pollution. The most relevant articles are concerned with a typology of problems and environmental impacts and the difficulties raised by quantifying and estimating environmental costs.

3.2.2. Port development and the environment

Several factors have an impact on the development of port systems. The increasing size and capacity of vessels is certainly the factor with the greatest impact on maritime systems. This issue is very much present in the literature and concerns all urban centres around the world having port infrastructures. There is a need to expand existing sites, convert old sites, build new sites or hive off terminal functions between smaller sites. Two major axes can be found in the literature.

Firstly, numerous authors (Finney and Young, 1995; Huggett, 1998; Poltrack, 2000) focus on the need to establish joint management of the environment and port operations. The literature describes the importance of technological innovations, notably the development of handling equipment in response to increasing environmental legislation.

Secondly, there is an emerging literature concerned with the environmental management of new port sites (Bristow and Xiaobin 1995; Abood and Metzger, 2001; Amromin, Kovinskaya and Sofronov, 2002). These authors bring up the question of elaborating a systematic approach for port development projects, notably in the context of zoning laws.

3.2.3. Maritime transport and the environment

With regards to shipping, environmental issues are a function of increasing marine service frequencies and increasing vessel size. The growth in intermodalism underlines the comparative advantages offered by short sea

shipping, notably in the context of greater environmental protection. The literature on shipping and the environment can be grouped under three main headings.

Firstly, there is a wealth of documents describing the environmental pollution generated by ships. Their content essentially focuses on waste management resulting from shipping operations – ballast water, air pollution – or dredging – marine sediments (Bravard, Piegay, Landon and Peiry, 2000; Corbett and Fischbeck, 2000; Delouis, 2001; Corbett and Farrell, 2002).

Secondly, market globalisation and increased trade have generated growth in maritime traffic along multiple navigation routes, under varied hydrological and meteorological conditions and near densely populated coastal areas. This is reflected in the literature; several texts have been published on the regulations affecting shipping operations and the accidents linked with shipping in terms of rights, obligations and responsibilities. There is even an emerging literature, notably in Western Europe, demonstrating the importance of harmonizing national legislation and drawing up international regulations on environmental problems linked with shipping safety (Steele and Lawrence, 1994; Jenisch, 1996; Davos, 1998; Bergantino and O'Sullivan, 1999; Ringbom, 1999; SMA, 1999a; 1999b; Brusendorff and Ehlers, 2002).

Thirdly, the literature review underlines the recent contribution of research to computer models and methods concerned with the simulation, analysis and joint management of marine shipping and the protection of coastal areas (Kolb and Wacker, 1995; Kageson, 1999; EU, 2003a).

The texts specify how sustainable development is dependent on the environment, port systems and shipping, but also on their respective evolution and mutual impacts. They permit a better understanding of the role of legislation and environmental zones in infrastructure planning and the implementation of intermodalism. More importantly, this literature brings to light the impacts of port and shipping operations on the environment. The most promising research with regard to sustainable development found in the literature is clearly the research that examines the design and interpretation of complex information systems to assess environmental risks in the marine industry, and that propose forecasting models (Post and Lundin, 1996; Vandermeulen, 1996; Whitehead, 2000). This issue will be further detailed in the section on environmental management models.

The texts underline the importance of environmental realities for the marine industry. They trace a relatively comprehensive portrait of the relationship between the marine industry and the environment, and notably of the different components of the environment. Several articles published in the early 1990s describe the environmental consequences of maritime transport or of port operations, without necessarily proposing a blueprint for the implementation of sustainable development policies or practices. The evidence shows that insufficient funding for applied and fundamental research and for university

training has led to a significant gap between the scientific literature founded on critical approaches and articles that elaborate the principles and practices of sustainable development.

In this context, the most pertinent articles are those concerned with: 1) the identification and analysis of different environmental sensitivity indexes (Paipai, Fletcher, Dearnaley and Burt, 2000; Carpentier, Beltran, Hervé, Moilleron and Thévenot, 2001; Moo-Young, Ledbetter, Vanadit-Ellis, Sellasie, Myers and Tardy, 2001; Claeys, Dumon, Lanckneus and Trouw, 2001; Carballo and Naranjo, 2002; Pieters, Van Parys, Dumon and Speleers, 2002); 2) the elaboration of systematic frameworks for the environmental management of ports (Wooldridge, McMulen and Howe, 1999); and 3) the evaluation of maritime transport from a sustainable development standpoint (Giaoutzi and Nijkamp, 1993; Callaghan, 1998; Hilling, 2001; Landaburu and Canu, 2002; Saldhanha and Gray, 2002; Paixao and Marlow, 2002; Donnelly and Mazières, 2003). These approaches have permitted a better appreciation of the current position, and the necessary conditions for the implementation of appropriate legislation for sustainable transportation.

3.3. Sustainable development issues applied to the marine industry

Growth in the volume of merchandise carried by sea is one of the major phenomena of world trade, despite conjectural economic and political vicissitudes. In 2002, world seaborne trade reached 5.9 billion tons compared to 4.0 billion tons in 1990, 3.7 billion in 1980 and 2.6 billion in 1970 (CNUCED, 2003). The world's economic activities depend on maritime transport (table 1).

Despite a redirection in the flow of exchanges over the past 20 years, certain major facts remain unchanged. In 2002, crude oil and oil products account for 9,950 billion ton-miles and coal for 2,570 billion ton-miles. The movement of combustibles thus constitutes more than 50% of maritime exchanges. The major dry bulks – iron ore, grain, bauxite and rock phosphate – account for 4,291 billion ton-miles. The remaining 6,440 billion ton-miles of solid freight is mostly carried by containers on liner shipping trade routes.

Table 1 World seaborne trade, 1970-2002
(billions of ton-miles)

Year	Oil			Iron ore	Coal	Grain[a]	Five main dry bulks	Other dry cargoes	World total
	Crude	Products	Crude plus products						
1970	5 597	890	6 487	1 093	481	475	2 049	2 118	10 654
1975	8 882	845	9 727	1 471	621	734	2 826	2 810	15 363
1980	8 385	1 020	9 405	1 613	952	1 087	3 652	3 720	16 777
1985	4 007	1 150	5 157	1 675	1 479	1 004	4 480	3 428	13 065
1990	6 261	1 560	7 821	1 978	1 849	1 073	5 259	4 041	17 121
1995	7 225	1 945	9 170	2 287	2 176	1 160	5 953	5 065	20 188
1999	7 980	2 055	10 035	2 317	2 363	1 186	6 203	5 752	21 990
2000	8 180	2 085	10 265	2 545	2 509	1 244	6 638	6 113	23 016
2001	8 074	2 105	10 179	2 575	2 552	1 322	6 782	6 280	23 241
2002	7 860	2 090	9 950	2 700	2 570	1 250	6 861	6 440	23 251

[a] Wheat, maize, barley, oats, rye, sorghum, and soya beans

Note: Maritime shipping calculates distances in nautical miles and not in kilometres. The nautical mile is the distance based on the length of a minute of arc of a great circle of the earth. It corresponds to approximately 1.842 kilometres.

Source: CNUCED, 2003

Maritime transport is at the centre of economic globalisation processes and imposes a restructuring of maritime and continental spaces. The anticipated growth in world trade affects the demand for maritime transport which, in turn, has an impact on the quality of the environment. In view of this, the issue of sustainable development applied to port development and shipping must be articulated around the environmental, social and economic dimensions of sustainable development.

In the environmental dimension, the objective is to understand the reciprocal influences of the physical environment and the practices of the industry. In the social dimension, the objective is to find a solution to the contemporary problems raised by the logistics revolution and to conduct changes in the respect of current and future needs of society in the context of participating democracy. This is the function of international legislation. In the economic dimension, the objective is to orient progress towards economic efficiency.

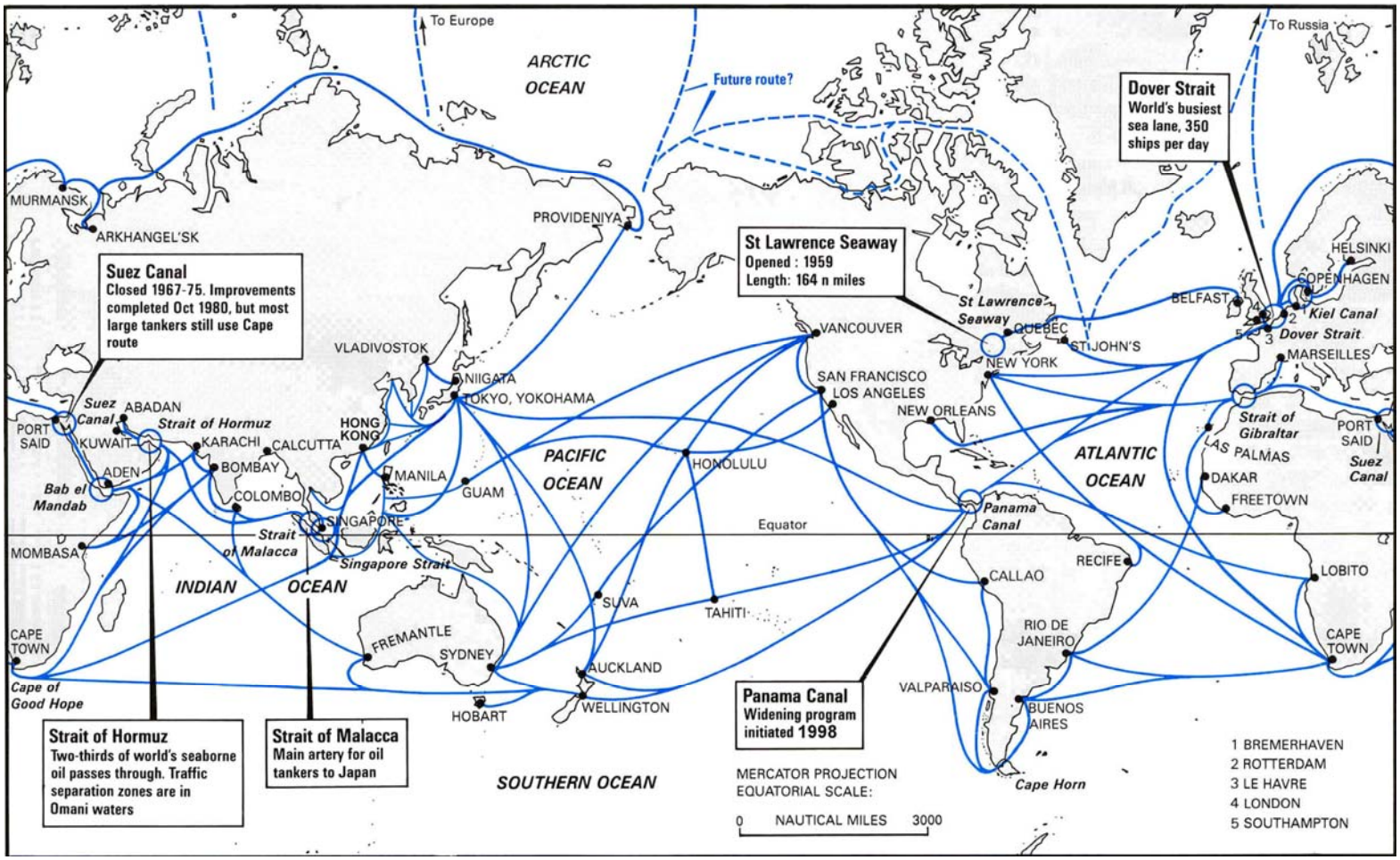
3.4. Physical environment and maritime transport

The physical environment strongly influences the activities of the marine industry. The main features of the physical environment are geographical location, topography, geological structure, climate, soil, vegetation and animal life. The location of ports and shipping itineraries are based on compulsory passages that in turn depend on winds, marine currents, depth, tides, reefs,

etc. The main ocean routes are corridors a few kilometres in width that create broad arcs on the Earth's water surface (map 1).

The globalisation of markets has highlighted the importance of hub ports within global logistics networks. Trade and transport links create world markets. The drive for larger ships, illustrated by the growth in the average size of vessels servicing the world's main maritime routes, has permitted a reduction of the global costs of maritime transport through economies of scale (table 2).

MAP 1 Global shipping trunk routes



Source:: Adapted and updated from maps of *Atlas of Maritime History*, 1987; *World Atlas of the Oceans*, 2000.

Table 2 Technical features of container ships in service, 1968-2003

Year	Capacity (TEU)	Draught (in metres)	Width (in metres)	Length (in metres)
1968	500	7,9	15	160
1969	1.350	10.39	16	210
1971	1.800	10.61	30.56	243
1984	4.458	10.7	32.2	290
1992	4.340	12.5	39.4	275.1
2001	7.179	14.5	42.8	320
2003	8.063	14.5	42.8	323
1968 – 2003	+ 1.512%	+ 83%	+ 185%	+ 101%

Source: Adapted and updated from Cariou, 2000

This growth in the transport capacity of sea vessels imposes technical constraints on ports or breaches the limits imposed by inland passages such as Panama or Suez canals. The Panama Canal allows the passage of ships of 65,000 deadweight tons. The growth in size of bulk cargo ships, particularly oil tankers, in the late 1960s and early 1970s, placed the canal outside the main bulk cargo shipping lanes. The dimensions of the locks became the standard for the largest container ships of the period, the so-called Panamax class vessels that had a capacity of 4,400 TEUs with a draught of 11 metres. By the late 1980s container shipping lines began to breach this threshold, and subsequently vessels of post-panamax size have been increasing in number. A very rapid increase in ship capacity is taking place, and thus the canal is unable to handle the largest, most modern and cost efficient ships in the world's container fleet, some with capacities exceeding 8,000 TEUs. The limited number of ports capable of handling these ships constitutes the weak link of the global transport chain. The projected improvements by the government of Panama appear likely to enhance its operations. By privatizing its ports prior to the canal takeover, it has opened up its maritime terminals to investment by some of the leading port operators in the world. The objective consists in making Panama a major distribution and transport centre through the establishment of a unique port complex, with a foot in both the Caribbean Sea and the Pacific Ocean. Joined by the canal and linked by road and rail, the complex offers shippers a mix of distribution opportunities by creating a unique strategic transportation hub.

The safety of seaborne trade rests on the notion of passages as resources. Supply measured in terms of maritime straits is limited, while demand expressed in terms of number of ships using these straits increases. The physical geography of maritime routes combined with increase in the size of vessels, movement of hazardous goods and growth in traffic, increases the risks of damage to the environment. Consequently, a ship accident that closes or forbids maritime routes or passages is a form of environmental pollution that has an impact on the world economy (table 3).

Environmental conditions can complicate, postpone or prevent the activities of the maritime industry. The competitiveness of ports and marine carriers is partly determined by the physical geography of coastal areas and maritime

straits and their capacity to sustain the physical expansion of ports and the increasing size of ships. Rapid scientific and technological progress has led to a drastic modification of the physical environment. Evidence shows that the physical geography of coastal areas and several inland waterways around the world has been and continues to be transformed.

Table 3 Selected sample of marine accidents, 1986-2003

Ship name	Accident date	Ship type	Flag	Location	Pollution type
Kowloon Bridge	26 November 1986	Bulker	Hong Kong	Celtic Sea	1,200 tons of bunker fuel
Kini Kersten	1 January 1987	Container	Germany	Rozel, France	Heavy fuel
Skyron	30 May 1987	Tanker	Liberia	English Channel	Small slicks
Vitoria	23 June 1987	Tanker	Greece	La Seine, France	Kerosene, oil
Athenian Venture	April 1988	Tanker	Cyprus	Cape Race, Canada	Crude oil
Exxon Houston	2 March 1989	Tanker	United States	Hawaii, United States	117,000 gallons of oil
Phillips Oklahoma	17 September 1989	Tanker	Malta	Humber Estuary, North Sea	800 tons of crude oil
Aragon	December 1989	Tanker	Spain	Madeira Islands, Portugal	25,000 tons of Mexican crude oil
Rosebay	12 May 1990	Tanker	Liberia	English Channel	1,073 tons of crude oil
Sea Spirit	6 August 1990	Tanker	Cyprus	Gibraltar	9,600 tons of crude oil
Kimya	6 January 1991	Tanker	Malta	Irish Sea	1,500 tons of sunflower oil
Vistabella	7 March 1991	Tanker	Trinidad and Tobago	Nevis, West Indies	Heavy oil
Haven	1991	Tanker	Cyprus	Genes, Italy	144,000 tons of oil
Aegean Sea	December 1992	Oil-ore carrier	Greece	La Coruna, Spain	Light crude oil
Braer	5 January 1993	Tanker	Liberia	Shetland Islands, United Kingdom	84,500 tons of crude oil
British Trent	3 June 1993	Tanker	Bermuda	North Sea, Belgium	5,102 tons of unleaded gasoline
Borodinskoye Polye	17 November 1993	Reefer	Russia	Lerwick, United Kingdom	373 tons of fuel
Grape One	9 December 1993	Tanker	Malta	English Channel	3,000 tons of xylene
Cosmas A.	January 1994	Tanker	Malta	Hong Kong	24,085 tons of heavy oil
Pionersk	31 October 1994	Merchant ship	Russia	Shetland Islands, United Kingdom	600 tons of fuel oil and diesel
Chung Mu	9 March 1995	Chemical tanker	China	Zhanjiang harbour, China	230 tons of styrene
Fenes	25 November 1996	Bulk carrier	Panama	Détroit de Bonifacio, France	2,500 tons of wheat
Nakhodka	2 January 1997	Tanker	Russia	Honshu, Japan	6,240 tons of fuel oil
Bona Fulmar	18 January 1997	Tanker	Bahamas	English Channel	7,000 tons of gasoline
Konemu	23 January 1997			New-Caledonia	100 tons of diesel oil
Albion II	18 February 1997	Bulk carrier	Cyprus	Brest, France	Fuel and calcium
Katja	7 August 1997	Tanker	Bahamas	Port du Havre, France	187 tons of bunker fuel
Allegra	1 October 1997	Parcel tanker	Panama	English Channel	900 tons of palm nut oil
Green Lily	19 November 1997	Reefer	Bahamas	Shetland Islands, United Kingdom	340 tons of fuel and gas oil

MSC Carla	24 November 1997	Container	Panama	Azores Islands, Portugal	74 containers, 14 contained pollutants including flammable products, combustive, poisonous, corrosive and radioactive products
Rosa M (MSC Rosa M)	30 November 1997	Dry cargo	Cyprus	Baie de Seine, France	Unknown
Kairo	31 December 1997	Container	Germany	Royan, France	6,240 tons of lead tetraethyl
Bahamas	24 August 1998	Tanker	Malta and Liberia	Rio Grande, Brazil	20,000 tons of sulphuric acid
Exxon Valdez	24 March 1999	Tanker	United States	Prince William Sound, Alaska	40,000 tons of crude oil
Junior M	4 October 1999	Bulker and container	Egypt	Brest, France	700 tons of ammonium nitrate
Dolly	5 November 1999	Bitumen carrier	Dominican Republic	Martinique	Bitumen and diesel oil
Erika	12 December 1999	Tanker	Malta	Baie de Biscaye, France	30,000 tons of cargo, and 10,000 tons of heavy fuel oil
Natuna Sea	10 October 2000	Tanker	India	Batu Berhandi, Indonesia	7,000 tons of crude oil
Ievoli Sun	30 October 2000	Tanker	Italy	Îles de Batz, France	4,000 tons of styrene, 100 tons of methyl ethyl and 1,000 tons of isopropyl alcohol
Bunga Teratai Satu	2 November 2000	Container	Malaysia	Sudbury Coral Reef, Australia	Tributyltin oxide (TBT)
Coral Bunker (Crest Unity)	25 December 2000	Bulker	Hong Kong	Viana do Castelo, Portugal	100-150 tons of heavy fuel oil
Ife	January 2001	Tanker		Nigeria	11,518 tons of oil
Jessica	16 January 2001	Tanker	Ecuador	San Cristobal, Ecuador	Fuel oil
Balu	20 March 2001	Chemical carrier	Malta	Baie de Biscaye, France	8,000 tons of sulphuric acid
CMA-CGM Normandie	27 March 2001	Container	France	Strait of Malacca, Singapore	No spill
Baltic Carrier	28 March 2001	Tanker	Marshall Islands	Falster, Denmark	2,700 tons of heavy fuel oil
Averity	26 September 2001	Tanker	Britain	Manchester Canal, United Kingdom	157 tons of low sulphur diesel
Melbridge Bilbao	12 November 2001	Container	Antigua	Molène, France	Unknown
Lykes Liberator	2- February 2002	Container	United States	Île de Seine, France	60 containers, 1 containing hazardous products
Bow Eagle	26 August 2002	Chemical carrier	Norway	Île de Seine, France	200 tons of ethyl acetate
Limburg	6 October 2002	Tanker	France	Hadramawt, Yemen	Heavy Arabian fuel oil
Jambo	29 June 2003	Dry cargo	Cyprus	Ullapool, Scotland	1,000 tons of zinc sulphide
Adamandas	22 September 2003	Bulker	Cyprus	Île de la Réunion, France	Deoxidized iron ore and propulsion fuel

Source: Centre of documentation, research and experimentations on accidental water pollution (2004) "Spills: incidents alphabetical classification" http://www.lecedre.fr/index_gb.html, August 30, 2004; Lloyd's Register (2004) http://www.1rfairplay.com, August 30, 2004; Dagmar Schmidt Etkin (2004) "Analysis of US Oil Spill Trends to Develop Scenarios for Contingency Planning" http://www.environmental-research.com/publications/pdf/2003-IOSC-Risk.pdf, September 7, 2004.

For instance, in Japan, there are more than 9,000 kilometres of artificial coasts built by reclamation techniques, along the Inland Sea and in the Tokyo, Ise and Osaka Bays (Comtois and Rimmer, 1998). Growth in shipping links and cross-strait traffic impose a physical transformation of coastal areas in the Taiwan Strait (Comtois and Wang, 2003). In China, the construction of the Three Gorges Dam project in Sichuan province will flood 1,000 km^2, raise the water level on the upper Yangzi by 200 metres and create a new inland lake of 700 kilometres long near Chongqing. This will allow strings of barges totalling 10,000 deadweight tons (3 barges of 3,000 tons) to reach the port of Chongqing located 2,500 kilometres from the sea. The shipping capacity on the upper Yangzi should quintuple through a system of double-lane five-step locks, 280 metres long, 34 metres wide and 5 metres deep. In 2003, China established the National Petroleum Reserve Center. Upon its creation, the center announced that China will build four national strategic oil reserve bases. The objective consists in making oil reserve equal to 30 days of crude oil imports before the end of 2005 and to 70 days before 2010. These bases will be built at a cost of US$720 million in the harbour areas of Qingdao in Shandong province, of Zhenhai and of Hangzhou Zhejiang province and of Dayawan in Guangdong province. In 2004, Ukraine undertook the construction of a canal linking the Danube delta to the Black Sea with a view to avoid custom tariffs imposed by Romania. The canal will reduce water levels in the delta and threaten a protected area registered as a UNESCO World Heritage Site, the habitat of more than 4,000 species of plants and breeding birds.

These examples demonstrate that, in all cases, maritime transport has an impact on the environment. These impacts on the relation between living organisms and their biophysical milieu are generating costs: environments have been transformed, destroyed or even artificially created to such an extent that it is extremely difficult to identify a pristine reference.

3.5. International legislation on the activities of the marine industry

The marine industry is eminently international in terms of property, investment provisions, types of activities and volume of traffic. Marine transport implies global linkages requiring international agreements on shipping lanes and transit routes, ports of call and commercial practices. Evidence shows however that the implementation of international regulations is a long and very contentious process.

3.5.1. The International Maritime Organisation (IMO)

Shortly after the Second World War, the issue of maritime safety was addressed by the adoption of the Convention establishing the International Maritime Organisation (IMO). The International Maritime Organisation (IMO) is the main international organization responsible for providing mechanisms for inter-governmental cooperation in regulation and practices related to all technical aspects affecting international shipping, including the prevention and control of marine pollution from ships (plate 2). The definitions of marine safety and security supply have often been debated. In this report, marine safety refers to the risk factors associated with accidents, terrorist threats and

unlawful trade that could interrupt marine shipping or port operations. Marine supply covers the factors that guarantee the efficiency of the supply chain and the fulfilment of a commercial agreement.

Plate 2 Functioning of the International Maritime Organisation (IMO), 2004

Created in 1948 by the United Nations, the headquarters of the IMO are in London, United Kingdom. In 2004, the organisation had 163 Member States and two Associated States. Its governing body, the Assembly, meets once every two years. Between sessions of the Assembly, the Council, which is composed of 40 Member States elected by the Assembly, performs all the functions of the Assembly. All Member States can participate, on equal terms, in the work of all the committees of the IMO. The Secretariat of IMO consists of the Secretary-General, who is appointed by the Council subject to the approval of the Assembly. The Secretariat has a staff of almost 300.

The IMO is a technical organisation; most of its work is undertaken by a certain number of committees and sub-committees, the highest being the Maritime Safety Committee (MSC).

The Marine Environment Protection Committee (MEPC) coordinates all the activities of the Organisation in terms of the prevention and control of pollution from ships. It was created by the Assembly in November 1973. The committee is also responsible for proposing amendments to the rules, norms and procedures of the MARPOL Convention to ensure that the convention reflects current environmental concerns.

The Legal Committee was established in 1967 to deal with the legal questions which arose in the aftermath of the Torrey Canyon disaster. It became a permanent committee empowered to deal with any legal matters within the scope of the Organisation.

The Technical Cooperation Committee acts as the agency responsible for the Organisation's activities in the field of technical cooperation, notably for the benefit of developing countries.

The Facilitation Committee deals with the IMO's work to eliminate unnecessary formalities in international shipping; it is responsible for reducing red tape and simplifying documentary requirements and procedures at the port of call on the arrival and departure of ships.

It is generally these committees that are responsible for the initial work to develop conventions. The draft instrument is then submitted to a conference of all the Member States of the United Nations, including Governments that are not members of the IMO. The conference adopts a convention that is then submitted to individual governments for ratification.

A convention comes into force only when certain conditions stipulated in the convention have been met, including acceptance by a predetermined number of countries. The more complex the convention, the more stringent the conditions for its entry into force. The States which have accepted a convention take the necessary measures for its implementation. The IMO has no powers to enforce rules, codes or conventions adopted by the Assembly of the IMO, but their contents can be so important that Governments will enact them in their own national legislation.

Source: www.imo.org (September 2004)

3.5.2. The MARPOL Convention

If international cooperation in the field of shipping and maritime safety has taken place for more than 50 years, action to prevent pollution is more recent. The main reference for environmental protection resulting from world shipping operations is the International Convention for the Prevention of Pollution from Ships (MARPOL Convention). The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships.

Adopted in 1973, the Convention did not immediately come into force. The MARPOL Convention required ratification by 15 States, with a combined merchant fleet of no less than 50% of world shipping by gross tonnage. In 1978, following a series of tanker accidents during the 1960s and 1970s, the IMO held a conference leading to the adoption of new measures affecting tanker design and operation.

More importantly, the IMO modified the ratification procedures of the technical annexes of the MARPOL Convention by allowing States becoming Party to the Convention to establish a calendar between the ratification of a Convention and its entry into force. This amendment, combined with technical progress in the industry, has led to the successive adoption of various appendices. The adoption of the MARPOL Convention led to other international conventions on responsibility and compensation; they represent an important breakthrough with regards to environmental protection norms against pollution by ships from operational or accidental causes.

Since 1958, the IMO has adopted over 40 conventions and more than 800 rules, codes and recommendations concerning marine safety, marine pollution prevention and control and relevant issues (table 4).

Table 4 Entry into force of IMO conventions concerned with the environment, 1969-2004

Conventions	Entry into force	Number of contracting States in 2004	Percentage of world tonnage in 2004
MOVEMENT OF HAZARDOUS GOODS			
NUCLEAR 1971 (Movement of hazardous goods – civil liability)	15 July 1975	14	21.35
SOLAS 1974 (Emergency, movement of hazardous goods)	25 May 1980	140	98.34
MARPOL 73/78 (annexes I/II) (Oil discharge and movement of hazardous goods – noxious liquid substances)	2 October 1983	110	94.23
MARPOL 73/78 (annex III) (Movement of hazardous goods)	1 July 1992	93	79.39
HNS Convention 1996 (Movement of hazardous goods)	---	1	1.96
WATER QUALITY			
IHM: Protocol 1973 (Water quality – pollution by other substances than oil)	30 March 1983	42	43.85
MARPOL 73/78 (annex V) (Water quality – waste)	31 December 1988	96	58.98
MARPOL 73/78 (annex IV) (Water quality)	---	2	4.86
BWM Convention 2004 (Water quality – ballast water)	---	---	---
AIR QUALITY			
MARPOL: Protocol 1997 (annexe VI) (Air quality)	---	2	4.86
WASTE TREATMENT			
Amendments 1978 (Waste – incineration)	---	20	19.71
Collision prevention: Protocol 1996 (Waste)	---	9	10.34
OIL DISCHARGE			
Right to intervene in incidents on the high seas IHM 1969 (Oil discharge – international intervention	6 May 1975	74	68.25
CLC 1969 (Oil discharge – civil liability)	19 June 1975	66	36.89
FIPOL 1971 (Oil discharge – funds for cleaning)	16 October 1978	42	32.67
CLC: Protocol 1976 (Oil discharge)	8 April 1981	54	62.87
SOLAS: Protocol 1978 (Oil discharge)	1 May 1981	93	93.12
Fonds: Protocol 1976 (Oil discharge – funds for compensation)	22 November 1994	34	55.07
OPRC 1990 (Oil discharge and emergency)	13 May 1995	54	48.51
Fonds: Protocol 1992 (Oil discharge)	30 May 1996	56	83.59
CLC: Protocol 1992 (Oil discharge)	30 May 1996	60	85.79
SOLAS: Protocol 1988 (Oil discharge)	3 February 2000	40	58.82
OPRC/HNS 2000 (Oil discharge – civil liability)	---	10	15.67
Bunkers Convention 2001 (Oil discharge – civil liability)	---	5	0.45
EMERGENCY			
Preventing collisions at sea 1972 (Emergency)	30 August 1975	78	68.38
COLREG 1972 (Emergency – preventing collisions)	15 July 1977	134	96.77
STCW 1978 (Emergency – training for seafarers)	28 April 1984	133	97.92
STCW-F 1995 (Emergency – training for seafarers)	---	2	3.05
Search and rescue 1979 (Emergency – Search and rescue)	22 June 1985	65	46.82
Convention for providing assistance at sea 1989 (Emergency)	14 July 1996	32	29.21
ANTI-FOULING PAINTS			
AFS Convention 2001 (Anti-fouling paints)	---	9	9.06

Source: http://www.imo.org/Conventions/mainframe.asp?topic_id=247 (October 2004)

3.5.3. Implementation of international legislation

As an agency of the United Nations, IMO has no powers to enforce the conventions that it help creates (http://www.imo.org/home.asp). The enforcement of conventions or international treaties on the environment comes up against three difficulties.

First, national data on the results of port and shipping activities to meet international environmental obligations are often incomplete, inaccurate or doubtful. In this context, it becomes extremely difficult to evaluate the extent to which countries are meeting their international environmental obligations (General Accounting Office, 1996).

Secondly, monitoring activities seeking to evaluate the compliance of signatory countries with international environmental conventions are subject to national legal systems. Most monitoring is based on information provided by individual parties to an international agreement. States have shown to be extremely reluctant in compromising their national sovereignty by allowing environmental monitoring to be undertaken by an independent and foreign expertise (Samaan, 1993).

Thirdly, there are no centralised legislative organisations having the authority or competency to enforce international environmental agreements (General Accounting Office, 1999). International conventions on environmental protection provide few mechanisms to enforce environmental legislation. When they do possess such mechanisms, they are rarely used, or very inefficiently. Decisions by organizations responsible for international treaties on the environment must obtain the consensus of signatory countries, thus giving each member a right of veto (Ardia, 1998). Hence the Northwest Atlantic Fisheries Organisation (NAFO) and the United Nations Environment Program (UNEP) only have jurisdiction outside the 200-nautical-mile exclusive economic zone of each coastal nation. These agencies often have limited financial resources to fulfil their monitoring responsibilities and do not have enforcement authority over the navigable areas with the highest traffic density.

Consequently, the enforcement of international environmental conventions is the responsibility of private bodies or signatory countries that can fulfil their obligations through several programs including industry self regulation and controls imposed by a coastal state, by a ship's flag state or by a port state.

3.5.4. Industry self regulation

Within the shipping industry there are many bodies that help to enforce international commitments and to ensure standards in the daily operations of ports and ships. These industry regulators include the International Chamber of Shipping (ICS) (http://www.marisec.org/), the International Association of Independent Tanker Owners (INTERTANKO) (http://www.intertanko.com), the

International Tanker Owners Pollution Federation (ITOPF) (http://www.itopf.com), the International Group of Protection and Indemnity (P & I) Clubs (http://www.american-club.com), the International Association of Classification Societies (IACS) (http://www.iacs.org.uk) and the Baltic and International Maritime Council (BIMCO) (http://www.bimco.dk). There have been some successes through self-regulation, especially to meet the increasingly strict standards required by P & I Clubs and classification societies (plate 3). Most P & I Clubs are acting out of self-interest to avoid paying for accidents and spills, while classification societies are often motivated to enhance the shipping industry's image, and maintain their own company's integrity.

Plate 3 Selected private independent classification societies, 2004

Bureau Veritas is a service company specialising in QHSE management (quality, health, safety and environment) and social accountability. This company, whose head office is in Paris, has a network that covers 140 countries and includes 600 offices and laboratories. Bureau Veritas offers an extensive range of technical services and solutions in the field certification, conformity assessment, consulting and training (http://www.bureauveritas.fr).

Registro Italiano Navale, whose head office is in Genoa, Italy, is a private enterprise that provides assessment, inspection, certification and research activities in accordance with national, European and international laws, notably in the field of environment. Its services cover materials, products, projects, technologies, and installations, including the performance of work commissioned by Public Administrations (http://www.rina.it).

VShips Group, whose head office is in London, United Kingdom, is an organisation offering ship and crew management services as well as a broad range of services including consulting, financial and commercial services. Located in more than 60 cities, the group has conceived an environmental management program according to ISO 14 001 (http://www.vships.com).

Lloyd's Register of Shipping, with its head office in London, United Kingdom, is an independent private organisation offering services in risk assessment and management and assessing and classification services to improve standards of environmental safety and quality. The expertise and the activities of the company cover marine transport, rail transport, oil and gas and other industrial sectors (http://www.lr.org/).

This system of self-regulation is not without serious limitations, as ships which are denied certification by one company may obtain it through another that is not as strict in terms of quality standards. This is the case with the sinking of the *Erika* in 1999, when the classification society RINA certified the corroded ship, after it was refused by Bureau Veritas.

3.5.5. Control by coastal State

Countries with any amount of coastline are afforded rights under UNCLOS, albeit with some limitations (http://www.oceanlaw.net/texts/losc5.htm). Countries are permitted to take legal action against any ships that pollute within their territorial seas or EEZs. Prosecution can be very complex as it can involve national and international laws. While certain national laws may raise more constraints than international regulations, evidence shows that nation-States have typically to adjust discharge and concentration standards with those agreed upon internationally. These quantities may be superior to authorized national levels. Coastal states must accept and abide by standards weaker than desired if the IMO agrees to them. Prosecution of those who violate the rules may also become difficult as some pollution incidents are caused by national ships or discharges may take place in open waters where identifying the source is almost impossible except in the case of very important spills. Varied meteorological conditions prevent a complete geographical coverage. Besides, in waters characterized by high marine traffic density, remote sensing imagery or satellite photography often does not permit to identify precisely the ship at the source of the pollution.

3.5.6. Control by ship's flag State

Countries that have signed on to the IMO conventions are required to enforce the controls of the conventions on ships which bear their flag. This results in different countries enforcing requirements with varied intensity, and ultimately results in ships registering under a flag of convenience less sensitive to environmental protection, or under a country that is not a party to these conventions. As many ships can register in nearly any country, there are a high number of ships registered under these flags of convenience to avoid enforcement from their home countries. They also take advantage of foreign legislation with more lenient labour, safety and fiscal laws. The emergence of port state control is seen as one possible solution to the gaps created by weak enforcement from some flag states.

3.5.7. Control by port State

This form of control is given to port authorities within states that are signatories to the various IMO conventions. The growing use of Port State Control is a reaction by states wishing to protect their waters and ecosystems from sub-standard ships flying under flags of convenience. Each port authority has the right to inspect any ship for IMO compliance, regardless of their flag, so long as they voluntarily enter that port. While there are currently no global conventions on port state control, many regional agreements have been made to ensure port states are actually exercising their powers within this area (table 5).

Table 5 Regional port State control agreements, 2004

Memorandum	Entry into force	Contracting States
Paris	1982	20
Vina Del Mar	1992	13
Tokyo	1993	18
Caribbean	1996	20
Mediterranean	1997	10
Indian Ocean	1998	8
West and Central Africa	1999	19
Black Sea	2000	6

Source: http://www.imo.org/InfoResource/mainframe.asp?topic_id=406&doc_id=1079

The main guidelines governing Port State Control include: 1) the criteria required to participate in the process; 2) the inspection of a minimum percentage of vessels entering ports participating in these regional agreements; 3) the establishment of standards for inspection, detention, and reporting; 4) the development of a ship inspection database; 5) the standardisation of inspection procedures for inspectors; and 6) the regular publication of inspection and detention statistics in the region (http://www.tc.gc.ca/medias/documents/b02-M016.htm).

The regional approach on environmental matters has evolved to prevent the development of ports of convenience, where certain port authorities might be more indulgent towards sub-standards ships in terms of safety and anti-pollution norms established by different international maritime treaties. These international agreements and MOUs are effective in ensuring compliance in countries that are signatories to the regional efforts (Hoppe, 2000). Sub-standard ships can circulate in areas where there is a lower likelihood of inspection. These ships are increasingly being marginalized and congregate in regions located outside the main maritime trade routes, notably in developing countries.

3.6. Practices of sustainable development and competitiveness of the marine industry

Over the past decade, governments have introduced a variety of rules in different sectors that constitute steps towards attaining a sustainable environment. With regards to the marine industry, self-regulation and the control imposed by a coastal state, by a ship's flag state or by a port state are all measures testifying to efforts to enforce international environmental conventions. While these enforcement measures can be improved in terms of

legal obligations and fines, these methods still represent the most efficient international agreements in the territory of signatory countries.

Moreover, international environmental laws seem to have an influence outside national boundaries (www.pc.gov.au/ic/inquiry/15greenhouse/finalreport). The entry into force of different IMO Conventions demonstrates the emergence of a slow movement of adjusting national laws to international laws (Simmons, 1998).

The increasing amount and strength of environmental regulations at the international, national and local level is the result of three major tendencies:

1. Greater legal influence on pollution prevention processes and on the control of economic activities;
2. More intense competition between conflicting demands emanating from terminal operators, carriers and shippers; and
3. Growing concern among local communities about the activities and the development projects of the marine industry.

3.6.1. The competitive factor

International legislation suggests that the environment has become a factor of change in terms of obligations, responsibilities and competitiveness. Environmental legislation is frequently perceived as imposing a constraint on port terminal operators, carriers and shippers that limits their activities and increases the industry's costs, since it can forbid any action or decision that could impact on ecosystems. In the case of marine ecosystems, environmental legislation imposes increasing restrictions on marine activities. These restrictions can reduce the competitiveness of ports and marine carriers, forcing administrations to respond by developing environmental management systems and programs enabling them to meet regulatory requirements. Henceforth, the planning and implementation of investments in transport infrastructures around the globe increasingly include an environmental impact assessment satisfying minimum standards of analysis. All the partners of the transport industry – carriers, terminal operators, shippers, stevedores, etc. – must respond to these new regulatory requirements.

The performance achieved in sustainable development practices increasingly affects the competitiveness of the marine industry around the world. It is true that environmental management imposes restrictions that may result in more costly solutions. However, it has been demonstrated that the elaboration of a sustainable development policy framework permits industry partners to secure a commercial advantage (Comtois and Slack, 2003). The expertise acquired in environmental management has an impact on insurance premiums, the legal and compensation costs for port or shipping lines development projects, and the market capitalization of terminal operators. More importantly, port authorities or shipping companies suffering trade disadvantages as a result of

their governments' decisions to accept international environmental regulations have evaluated the possibility of taking retaliatory actions against ports and carriers of non-signatory countries in order to maintain certain equity in terms of competition, (Stopher, 2003).

There is a wide range of responses to sustainable development. The various trajectories for a sustainable environment involve three considerations:

1. Transport operations must conform to local, national or international regulations;
2. Environmental costs of transport operations must be built into the price of providing transport facilities and services; and
3. Environmental performance must be introduced into the organisation's management.

The adoption of measures of sustainable development is henceforth considered necessary by the industry in order to maintain its competitiveness both for port and shipping systems. The most dynamic enterprises can even exploit a new source of profit offered by the emissions trading systems for pollutant emission reduction control processes.

3.6.2. The profit factor

The emissions trading system is a market-based mechanism that allows the production of goods while reducing pollutant emission at the lowest cost. Introduced in the United States with the promulgation of the Clean Air Act Amendments of 1990, this system sets a limit on the total amount of pollution that can be emitted below the historic level of emissions. To achieve a reduction in emissions and ensure sustainability, a limited number of rights to emit pollution equivalent to a given amount of pollutants (i.e. CO_2, SO_2), is allocated to each polluting facility. The total number of tradable permits issued is equal to the emissions cap. This allows each company to find the most economical way to comply with emissions requirements. Under this regime, companies are able to sell extra emissions permits that they do not need to companies facing high costs for pollution control. The emissions trading system adopted in the United States has been effective in reducing pollutant emissions to a level lower than anticipated by law.

The Kyoto Protocol, adopted in 1997 and effective from February 2005, also includes an emissions trading scheme to reduce greenhouse gases and create an international regime within the framework of the United Nations Convention on Climate Change. The emissions trading scheme faced serious problems because of regulatory uncertainty, and a lack of clearly accepted definitions and standards for monitoring, verification and organized markets. It is within this context that the Chicago Climate Exchange (CCX), a greenhouse gas-

emissions trading exchange, was created in 2002 (http://www.chicagoclimateexchange.com/).

Firms with a greenhouse gas emissions allowance advance their shareholders interests by improving their companies' standing in energy consumption and reducing emissions. In 2004, the European Union released a report compiled by NERA Economic Consulting on an evaluation of market-based programs to regulate atmospheric emissions from ships (Harrison, Radov and Patchett, 2004).

3.7. Conclusion

Market-based emissions trading programs and their impact on the marine industry demonstrate that environmental issues represent a growing field of responsibility for port administrations and marine carriers, compelling them to acquire new expertise and to apply new practices. These programs are playing a central role in the establishment of sustainable development policies in coastal areas or along navigable waterways beyond the traditional jurisdiction of ports or water basins. Moreover, these programs favour the elaboration of intermodal freight transport strategies based on an increasing uses of maritime transport to achieve the objectives of sustainable development (Schroder, 1997; Schwarz, 1998; Rowlinson and Wixey, 2002; EU, 2000, 2001, 2003b, 2003c).

Reductions in greenhouse gas emissions affect freight forwarders and all transport enterprises, including marine transporters. Freight forwarders are putting increasing pressure on carriers. This favours the marine industry that can retain clients, identify new customers and increase its benefits through the implementation of sustainable development practices and the promotion of short sea shipping.

4. GLOBAL OVERVIEW OF SUSTAINABLE DEVELOPMENT PRACTICES APPLIED TO PORT AUTHORITIES AND SHIPPING LINES

The transformation of maritime and continental space continues to reflect changes in economic growth. But the literature review demonstrates that sustainable development will not be possible without major changes in port policy and planning. Occupying critical sites in coastal zones, ports are closely linked with a vast range of day-to-day transport operations. This requires the marine industry to implement elements of sustainable development in infrastructure planning and investment decisions because these elements are henceforth a factor of competitiveness. The participation of the marine industry in sustainable development strategies requires the establishment of a diagnostic concerning the environmental profile of port administrations and shipping lines. There is a need to determine the main issues, problems, and international legislations underpinning the best sustainable development practices for the marine industry.

4.1. Analytical framework

4.1.1. Methodology

In order to understand the industry's perspective of sustainable development, we built a database on the environmental awareness of port authorities and marine carriers using Microsoft Internet Explorer software (version 6.0).

The methodology involved several steps. Ports and carriers were selected using 8 directories including www.portfocus.com and http://www.hal-pc.org/~nugent/company.html. When directories did not provide internet links, the names of port and carriers were submitted to the Internet search engine Google to identify corresponding Internet addresses.

This allowed the indexing of 800 ports (map 2) and 120 regular shipping lines (map 3) for the year 2004.

All the names and Internet addresses of ports and shipping lines were integrated into a worksheet using Microsoft Excel 2000 software. We were able to create hyperlinks between a port or a shipping line and its Internet addresses. This inventory represents an Internet tool available for the ministère des Transports du Québec (www.mtq.gouv.qc.ca).

We then proceeded to examine the information pertaining to sustainable development under 17 items for each web site, including all available links from the main and secondary pages. These items covered:

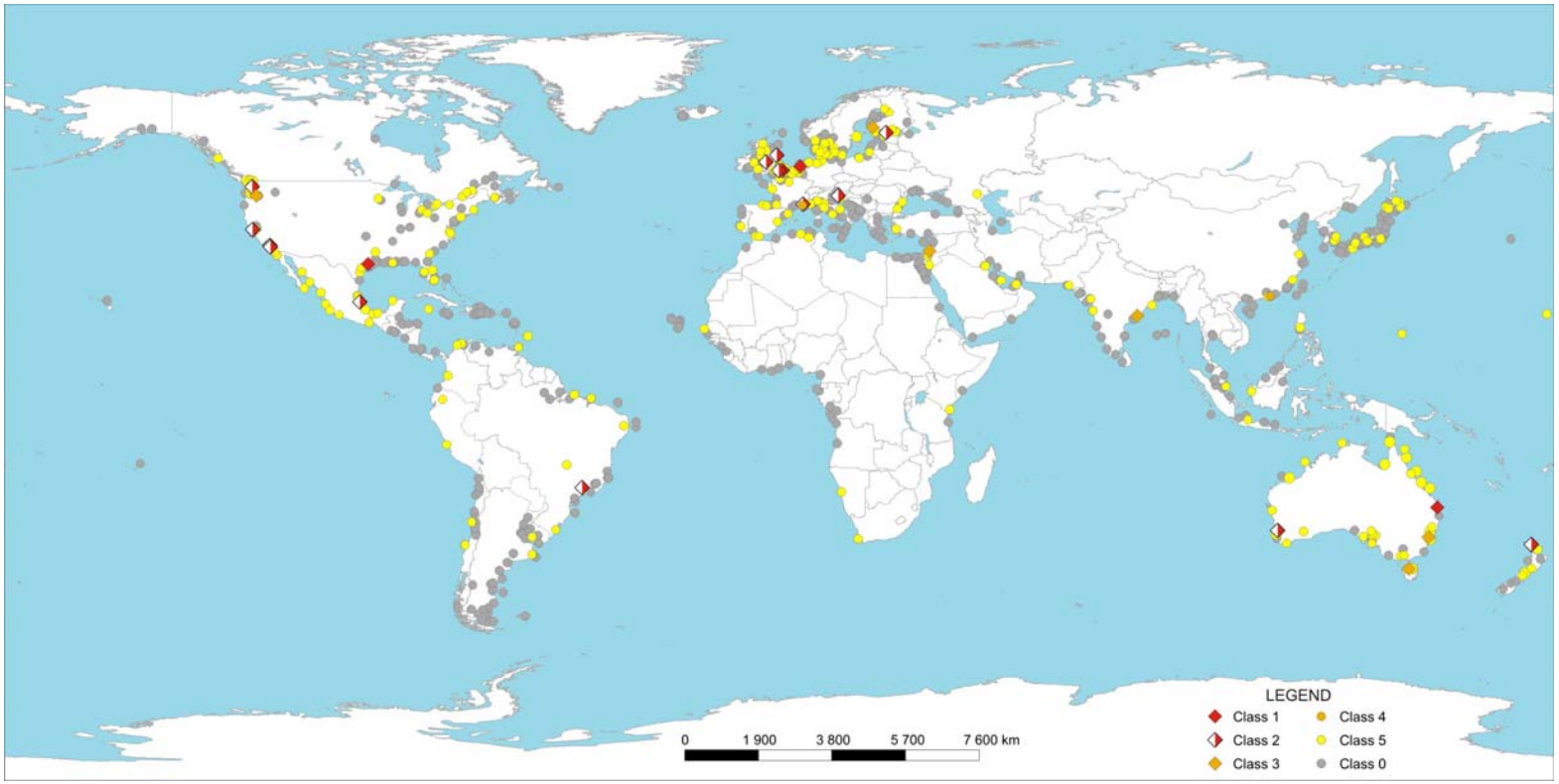
1. General overview – Port authority or shipping line mentions or demonstrates an interest for the environment in its description, notably in the sections entitled introduction, history and equipments;
2. Mission statement – Port authority or shipping line mentions environmental concerns;
3. General account – Port authority or shipping line describes its commitment in terms of sustainable development or makes reference to objectives of environmental protection;
4. Management – Port authority or shipping line uses a given program or environmental management plan having a sustainable development perspective;
5. Policy – Port authority or shipping line follows a specific policy pertaining to the environment or sustainable development emanating from the port administration, the shipping line or external authority;
6. Training – Port authority or shipping line applies a public training program with regards to environmental or sustainable development issues;
7. Programs and projects – Port authority or shipping line has elaborated programs or projects with the commitment to improve the quality of the environment;
8. Practices and procedures – Port authority or shipping line has implemented certain management techniques having a sustainable development perspective. It has also conceived plans to solve environmental problems;
9. Assessment and impact – Port authority or shipping line presents an environmental impact assessment of its operations and projects;
10. Annual report – Port authority or shipping line publishes an annual report pertaining exclusively or partially to the environment or sustainable development;
11. Development plan – Port authority or shipping line integrates the environment or sustainable development within corporate strategies;
12. Waste management – Port authority or shipping line presents a detailed and sustainable plan for waste management;
13. ISO 14 000 and EMAS – Port authority or shipping line has a certified environmental management program such as those of the International Organization for Standardization (ISO 14 000) or those of the European Union (Eco-management and audit system EMAS);

14. Legislation – Port authority or shipping line makes reference to supporting environmental legislation;
15. Resource protection and conservation – Port authority or shipping line draws attention to the need to protect, preserve or restore animal life, plant life and natural habitats;
16. Community service – The corporate structure of the port administration or shipping line includes services specifically targeted to the environment;
17. Distribution – Port authority or shipping line mentions makes reference to the environment in its distribution services, notably by integrating the concept of “green logistics”.

Besides, when the port or the shipping line Internet address had an Internet search engine, it was interrogated with key words such as “environment”, “ecology”, “EMAS” and “ISO”. This approach gave access to other links pertaining to the environment, the local community, management systems, and health and safety.

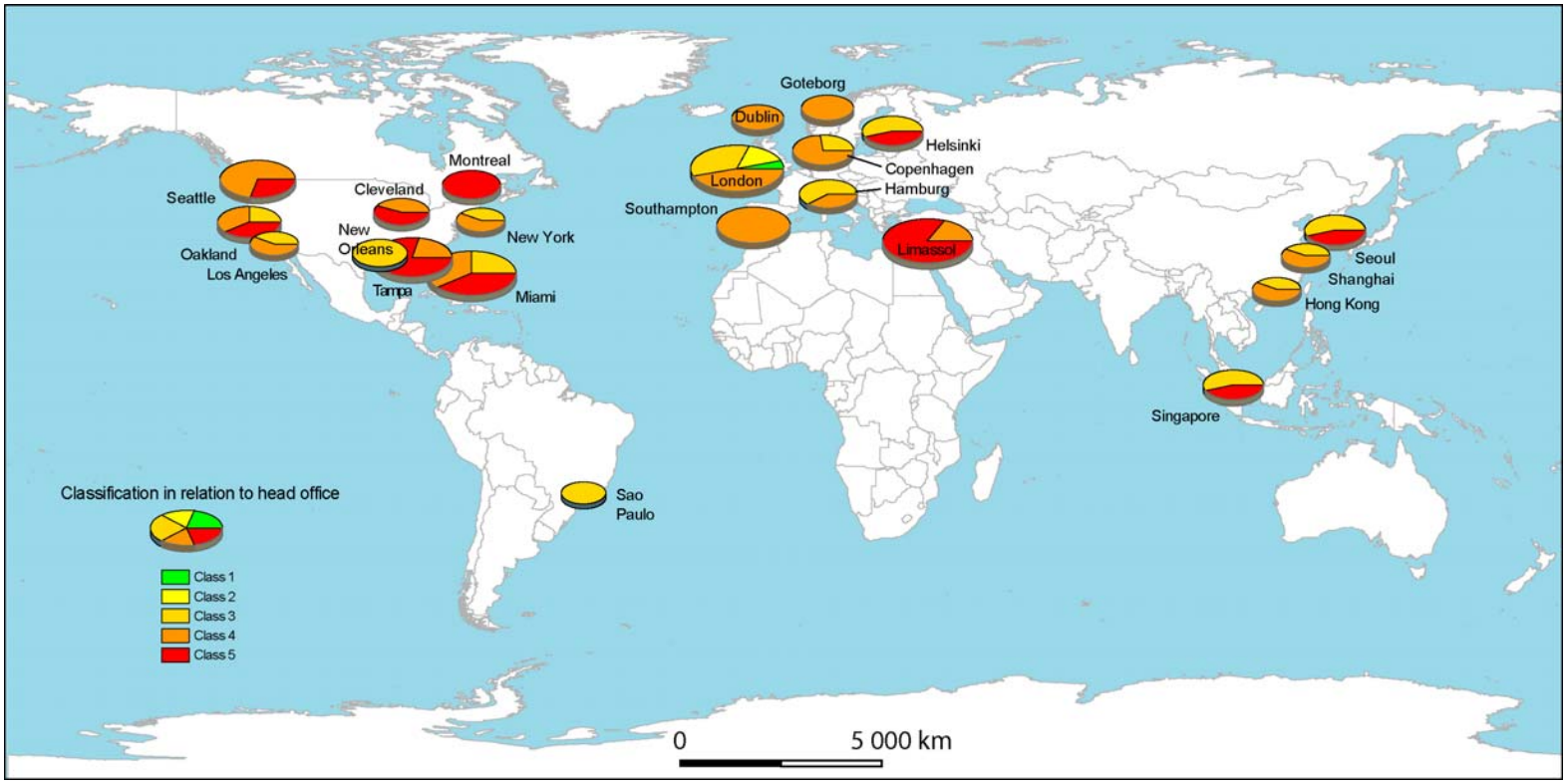
Qualitative comments summarizing sustainable development issues were then written down on the worksheet for each port and each carrier.

Map 2 Environmental profile of selected ports, 2004



Class 1:: Uses a certified environmental management system, mentions environmental impact of its activities, has an environmental policy, presents sustainable development objectives and publishes an annual report pertaining to sustainability;
Class 2:: Uses a certified environmental management system, has an environmental policy, mentions environmental impact of its activities, publishes a report;
Class 3:: Uses an non-certified environmental management system, has an environmental policy, mentions environmental impact of its activities;
Class 4: Has an environmental policy and mentions environmental impact of its activities;
Class 5: Mentions environmental impact of its activities;
Class 6: No information provided.

Map 3 Environmental profile of selected shipping lines, 2004



Class 1: Uses a certified environmental management system, mentions environmental impact of its activities, has an environmental policy, presents sustainable development objectives and publishes an annual report pertaining to sustainability;
Class 2: Uses a certified environmental management system, has an environmental policy, mentions environmental impact of its activities, publishes a report;
Class 3: Uses an non-certified environmental management system, has an environmental policy, mentions environmental impact of its activities;
Class 4: Has an environmental policy and mentions environmental impact of its activities;
Class 5: Mentions environmental impact of its activities;

4.1.2. Environmental profile of the marine industry

Data analysis allowed the ports and shipping lines to be classified in 6 categories:

1. Corporation uses a certified environmental management system, mentions environmental impact of its activities, has an environmental policy, presents sustainable development objectives and publishes an annual report pertaining to sustainability;
2. Corporation uses a certified environmental management system, mentions environmental impact of its activities, has an environmental policy and publishes an annual report pertaining to sustainability;
3. Corporation uses an in-house environmental management system, mentions environmental impact of its activities and has an environmental policy;
4. Corporation mentions environmental impact of its activities and has an environmental policy;
5. Corporation mentions environmental impact of its activities only;
6. Corporation without any sustainable development components.

4.1.3. Environmental issues of the marine industry

We pursued the evaluation of the available information by analyzing the environmental issues of port administrations and regular shipping lines.

Approximately 30% of the 800 ports (235/800) provided information on environmental awareness as part of their activities, but only 11% (85/800) had an environmental management system (EMS) in operation.

Table 6 indicates that the top 5 environmental issues identified by port authorities were: water quality (25%); waste disposal (21%); air quality (19%); habitat conservation (19%); and noise (15%).

Table 6 Environmental issues of port authorities, 2004

Issue	Frequency	Issue	Frequency	Issue	Frequency
Water quality	25%	Emergency	14%	Ballast water	9%
Waste management	21%	Dredging	14%	Dust	6%
Air quality	19%	Stormwater	13%	Contaminated soils	6%
Habitat conservation	19%	Energy consumption	11%	Odours	4%
Noise	15%	Oil spills	10%	Anti-fouling paints	3%

Approximately 34% of the 120 shipping lines (41/120) analyzed provided information on the environmental impact of their activities and had an EMS in operation either in-house or certified by EMAS or ISO 14 000.

Table 7 indicates that top 5 environmental issues are: air quality (44%), anti-fouling paints (39%), waste water (22%), ballast water (20%) and energy consumption (20%).

Table 7 Environmental issues of shipping lines, 2004

Issue	Frequency	Issue	Frequency	Issue	Frequency
Air quality	44%	Waste management	15%	Ship recycling	7%
Anti-fouling paints	39%	Solid waste	15%	Oil spills	5%
Waste water	22%	Resource conservation	12%	Alternative energy	5%
Ballast water	20%	Hazardous materials	10%	Dust	2%
Energy consumption	20%	Double hull ships	7%	Emergency	2%

The policy statements of the port authorities and shipping lines draw from the general definitions of sustainable development, notably from the Brundtland commission. Industry members integrate the principles of environmental protection in their management practices, in the form of environmental policy. They adapt the principles of sustainable development – equity, long-term vision, balance – to port and shipping activities. These environmental strategies are systematically integrated in the decision making process and submitted to monitoring and control systems, to firm responsibility and personnel liability.

To allow a better interpretation of sustainable development issues in the marine industry, we integrated the data basis. First, we grouped together issues with related themes. The issue of water quality includes stormwater, ballast water and waste water. The issues of waste management and solid waste were merged. The issue of alternative energy was integrated with energy consumption. The issue of double hull ships was considered with the issue of ship recycling, since many carriers have merged these issues in the framework of the global policy of fleet renewal. These thematic consolidations led to the determination of nine environmental issues common to port authorities and shipping lines, four issues specific to ports and two specific to shipping lines (Table 8).

Table 8 Environmental issues of the marine industry, 2004

Issues common to port authorities and shipping lines	Issues specific to port authorities	Issues specific to shipping lines
Water quality	Noise	Ship recycling
Air quality	Dredging	Hazardous materials
Waste management	Contaminated soils	
Resource conservation	Odours	
Energy consumption		
Emergency		
Oil spills		
Anti-fouling paints		
Dust		

This typology of issues and their importance was confirmed during our interviews. The choice of issue, its importance and the related problems often follows the entry into force of international conventions or subjects of discussion at the agenda of the International Maritime Organization (IMO). Port authorities and shipping lines want to reduce the risk of prosecution. This list, while characterized by a strong element of universality, is nevertheless not definitive. Fieldwork has shown that there are numerous secondary issues such as bank erosion, training programs in environmental sciences and promotional campaigns for sustainable development. Evidence shows that some of these issues are often integrated within those mentioned in table 8.

4.2. Environmental issues common to port authorities and shipping lines

For each issue, we present a definition, we specify the problem and the influence of international legislation and we identify some of the best practices of sustainable development.

4.2.1. Water quality (ballast water, waste water from ships, stormwater, and snow removal)

4.2.1.1. Issue

All ships use ballast water. It is pumped onboard ships to insure stability at sea. Ballast water is required to control a ship's stability and draught and to modify its centre of gravity in relation to the cargo carried and the variance in weight distribution. Ballast water is thus necessary for crew, freight and ship safety. Port operations require the establishment of a water management system to answer the need of supplying equipment with quality water, to control floods, to stabilize coastal banks and to reduce wave oscillation with a view to facilitate the berthing of ships and to reduce the risks of coastal erosion. All these shipping and port activities operations have an impact on hydrological conditions.

4.2.1.2. Problem

A wide range of port activities can modify water quality, and there exist numerous water quality management strategies. The main problems are related to ballast water, waste water from ships, stormwater and snow removal.

Ballast water

Ballast water acquired in a region may contain invasive aquatic species that, when discharged in another auspicious region may thrive in a new marine environment and disrupt the natural marine ecosystem. They then become harmful aquatic invasive or exotic species. This is how zebra mussels (*Dreissena polymorpha*), quagga mussels (*Dreissena bugensis*), the round gobie (*Neogobius melanostomus*) and even exotic plants (purple loosestrife and the Eurasian water-milfoil) were introduced; these species have become invasive and have negatively transformed the aquatic life of many regions of the world. The rate of biological invasion is dependant on the volume of ship traffic to a region, therefore the busiest ports in the world tend to be those that are most affected with biological invaders. Map 4 shows which areas in the world have the highest likelihood of invasive species from ballast water discharge.

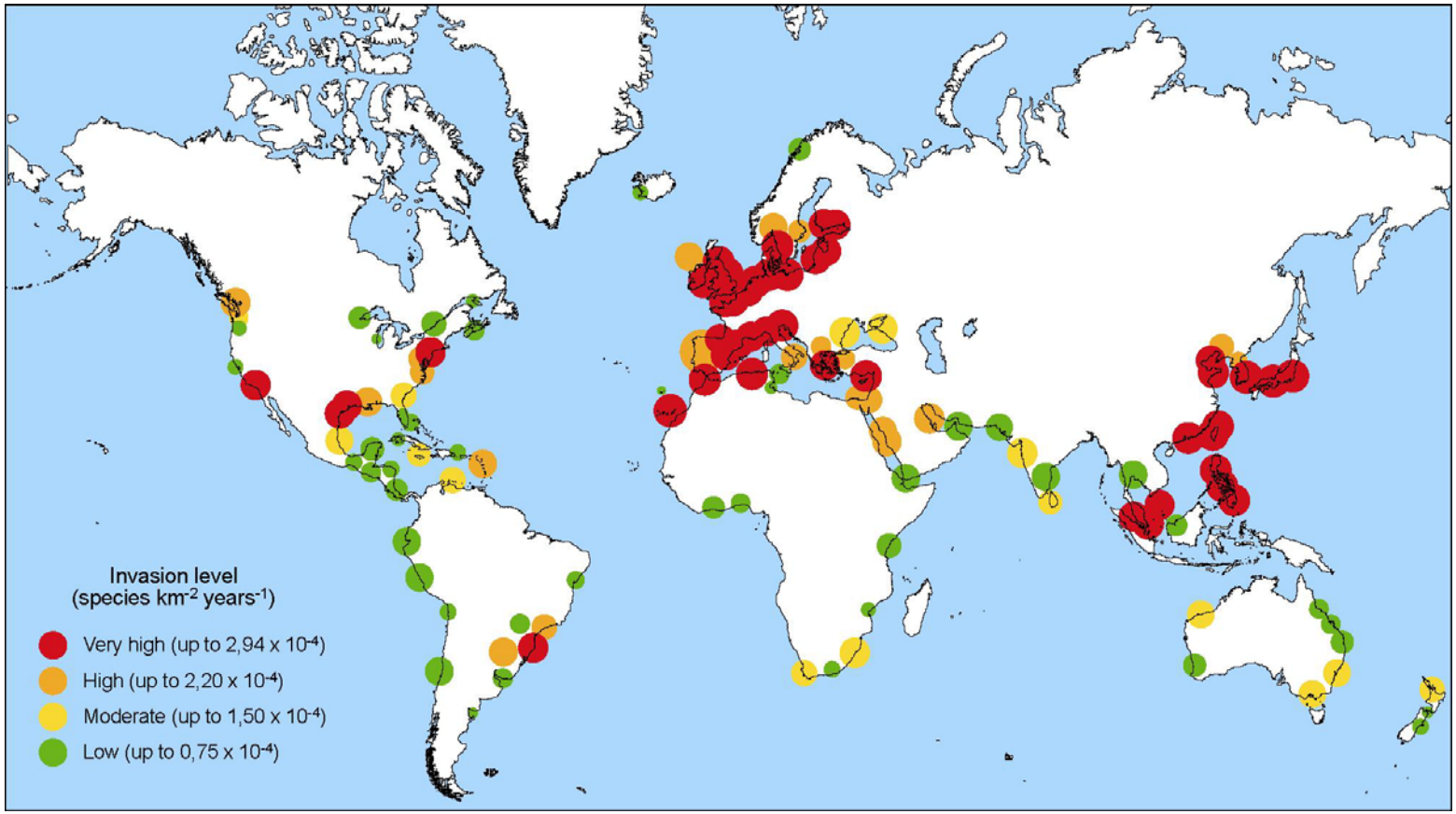
Waste water from ships

We defined waste water as water waste from galleys, showers, kitchen, waters from medical facilities, animal waste generated on board ships and bilge waters from machinery and auxiliary systems. The discharge of waste water that is biologically or chemically active can damage marine life.

Stormwater and snow removal

Daily activities of port systems produce an important volume of dust and cargo residues that are sometimes contaminated. When precipitations occur, these substances can spread in water basins through stormwater runoff and snow melt. The need to free external service areas of port infrastructures of snow and ice raises the problem of snow removal and deposit.

Map 4 Biological invasions by ballast water around the world, 2004



Source: DRAKE, J.M. & LODGE, D.M. (2004) *«Global hot spots of biological invasions: evaluating options for ballast-water management»*, Proceedings of the Royal Society of London, 271, pp. 575-580.

4.2.1.3. International legislation

Ballast water

The issue of ballast water has been the object of numerous resolutions adopted by Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO). Resolution A.868(20) on "guidelines for the control and management of ships' ballast water to minimize the transfer of harmful aquatic organisms and pathogens" was adopted by IMO in November 1997. The International Convention for the control and management of ships' ballast water and sediments was adopted by consensus at a conference at IMO in 2004 (OMI, 2004). According to this Convention, Parties undertake to adopt stringent measures to prevent, reduce or eliminate the transfer of harmful aquatic organisms and pathogens from ships' ballast water and sediments, with a view to preventing a negative impact on the environment, human health and resources. Sediments are suspended matter settled out of the ballast water within a ship.

For ports, the Convention gives information on the procedures and the reception and processing facilities that should be made available to ships with a view to reducing the introduction of harmful aquatic organisms and sediments.

For ships, the Convention offers ballast water management procedures, mentions the data monitoring procedures for ballast water exchange, indicates the necessary precautions for the empty/refill exchange of ballast water and specifies the norms that must be respected by ballast water treatment systems. These indicate the maximum microbial content of ballast water, notably infectious agents such *vibrio cholerae*, *escherichia coli* and *enterococci*.

The Convention will enter into force 12 months after ratification by 30 States representing 35% of world merchant shipping tonnage. In 2004, the Convention has not yet obtained the necessary signatures to be ratified.

Waste water from ships

According to MARPOL, waste water is defined as water from toilets, water from medical premises and water from spaces containing living animals. MARPOL does not include bilge water from machinery space. Annex 4 of the MARPOL Convention, which focuses on "guidelines for the prevention of pollution by sewage from ships", considers that on the high seas, the oceans are capable of assimilating and dealing with sewage through natural bacterial action. Annex 4 entered into force on September, 27, 2003 when it was ratified by 99 countries accounting for 54.35% of the world fleet. This Annex has been revised, before entering into force, by Resolution MEPC.88(44) of IMO. Guidelines of Annex 4 currently into force stipulate that it is prohibited to discharge sewage at sea at distance less than 3 nautical miles from the coast.

Discharge of sewage from ship at sea is authorized if carried out through a comminuting and disinfecting system approved by IMO, providing the ship is more than 3 nautical miles from the nearest land. Discharge of sewage can be carried out providing the ship is more than 12 nautical miles from the coast. Resolution MEPC.88(44) requires signatory countries of the original Annex 4 to implement the revised Annex 4 for July 2005.

Stormwater and snow removal

In 1995, the United Nations Organization (UN) adopted the Global Program of Action for the Protection of the Marine Environment from Land-Based Activities (http://www.gpa.unep.org/igr/Report-of-the-Meeting-F.htm). The program focuses on three issues: 1) municipal waste-water treatment for the prevention and reduction of marine pollution; 2) the joint management of coastal resources and river basins; and 3) the establishment of partnerships in financing and implementation of the Global Program of Action. There are currently no international regulations concerning the issue of stormwater and snow removal.

4.2.1.4. Selected sustainable development practices

Our surveys suggest that regular shipping lines are implementing different initiatives to better manage water quality.

Concerning ballast water, best practices are based: either on the application of guidelines settled by Revised Annex 4 of IMO, which implies the establishment of permanent mechanisms in ports of call; or on the development of technologies for the treatment of ballast water on board ships.

Concerning waste water from ships, the best practices are those that implement collection and treatment of toilet and kitchen waste at ports of call or on board ships.

Our surveys suggest that there are several stormwater and snow removal management methods in ports. The best systems are based on the concept of a port as a territorial enclave where stormwater and snow are collected and carried by a network of pipes to a treatment plan within the port site.

Examples

The port authorities of Los Angeles, Long Beach and Oakland, California, United States, have adopted a regulation stipulating that all ships entering the port must undertake ballast water exchange on the high sea (Urban Harbors Institute, 2000).

In 2001, the Canadian marine carrier FedNav, in partnership with engineering companies ESG International and BMT FTL, designed a ballast water

treatment system to be fitted on a bulk carrier entering the Great Lakes-Saint Lawrence. The system concept development included a combination of hydrocyclones, drum and plate filters, and ultra violet systems technology (http://www.socp.org/ballast/papers/Fednav%20Presentation%20at%20BW%20Investment%20Fair.pdf).

The port authority of Townsville, Queensland, Australia, has developed a partnership with Australian Ballast Water Treatment Consortium (ABWTC) to resolve the issue of ballast water. ABWTC has received financial support from Environment Australia's Natural Heritage Trust to design the plans of a portable plant to destroy living organisms contained in ballast water as it is loaded aboard ship. The plant must be of small size to equip a commercial vessel and be commercialized to fit any ship under construction. The plant has not yet been built, but the first test will be undertaken at the port of Townsville (http://203.52.104.70/pdf/annualreport/0203/13_Environment_72dpi.pdf).

The port authority of Stockholm, Sweden, has planned and built a waste water treatment plant at the ferry terminals. The system prevents toilet and kitchen waste water being rejected into the Baltic Sea (http://www.stockholmshamn.se/eng/thegroup/environment.html).

The port authority of Corpus Christi, Texas, United States, has developed a permanent stormwater treatment system. Up-stream, the port authority uses water-sprays at bulk loading points and covered conveyor belts. All roadways within port premises are cleaned periodically. The speed limit within the port area is fixed at 15 km/h and all trucks carrying dust-generating products are fitted with tarps and must be washed periodically. Down-stream, the stormwater pollution prevention plan includes the construction of storm ditches to contain and treat stormwater runoff. A drainage system has been installed to direct water flows to stilling basins before being released into the river or pumped into storage ponds. The filtered effluents are then used by coke and coal pad operators for air pollution dust control. Waste sediments accumulated in the basins are recycled as base material for pet-coke pads. The stormwater pollution prevention plan has been designed to exceed the minimum requirements mandated by National Pollutant Discharge Elimination System (NPDES) of the United States Environmental Protection Agency (EPA) (Urban Harbors Institute, 2000).

The port authority of Charleston, South Carolina, United States, has built under the container terminal, an underground network of pipes to collect and direct stormwater through filter cloth into a 7-hectare detention pond. Sand filters in the pond remove contaminated sediments from the water. During low tide conditions, hydraulic pressure pushes storm water through the filtration system around the perimeter of the pond, into the Wando River. A system of tide gates prevents saltwater intrusion into the pond during high tides (Urban Harbors Institute, 2000).

The port authority of Brisbane, Queensland, Australia, has built a stormwater collection system on the roof of port buildings and regularly discharges it into the toilet sewage system, thus reducing the amount of water consumption (http://www.portbris.com.au/asp/media/publications/portdev/sustainable/pbc_sustainable design_fact_sheet_the_warehouse.pdf).

4.2.2. Air quality

4.2.2.1. Issue

Activities of terminal operators and shipping lines inevitably affect the atmosphere. More importantly, evidence shows that climate change can lead to fluctuations in water levels. Besides, air quality has an impact on human health and on the quality of products handled at ports or on ships. The reduction of atmospheric pollution is thus a competitive factor that forces port authorities, terminal operators and shipping lines to promote environmental innovations.

4.2.2.2. Problem

Marine industry activities release millions of tons of pollutants into the air each year. The scientific evidence suggests that port operations and shipping activities contribute to an increase in the average temperature at the Earth's surface, while acknowledging that the share of the marine industry is less than the other modes of transport. These activities produce greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbon (HFC), perfluorocarbon (PFC) and silicon tetraflouride (SF_6). These gases prevent the wavelengths of electromagnetic radiation from leaving the Earth's surface and thus contribute to global warming.

In ports, thermal electricity stations burning coal and fuel oil and located in certain port-industrial complexes release polluting emissions of sulphur dioxide (SO_2) into the atmosphere that when mixed with cloud water creates acid rain. In addition, the combustion of fuels in vehicles used for port activities, as well as the growth of road transport for freight supply or distribution to or from ports, generates major pollution problems .

Ships pollute the atmosphere by emissions of sulphur oxide (SO_x), nitrogen oxides (NO_x), chlorofluorocarbons (CFCs) and halons – compounds in which the hydrogen atoms of hydrocarbons are replaced by bromine, and other halogens atoms, used as liquid refrigerants. On ships, CFCs are largely used for container and cargo refrigeration, as well as for insulation around pipes, air conditioning, and food compartment cooling. Halons are used in portable fire extinguishers and in fixed systems to ensure safety from fire. Ship incinerators are also a major source of toxic pollutant emissions.

4.2.2.3. International legislation

There are numerous regulations to solve the problems of atmospheric pollution. The most important international agreements affecting the practices of the marine industry are derived from the Montréal Protocol (1987), Kyoto Protocol (1997) and Annex 6 of the MARPOL Convention (1997) of the International Maritime Organization (IMO).

The Montréal Protocol stipulates that the production and consumption of compounds that deplete ozone in the stratosphere, notably chlorofluorocarbons (CFCs) and halons, are to be phased out. The Protocol was further adjusted with the London Amendment (1990), the Copenhagen Amendment (1992) and the Beijing Amendment (1999). The Montréal Protocol identifies halon as one of the sources depleting the ozone layer. In 1998, Parties to the Montréal Protocol adopted "Decision X/7" on the halon management strategy.

The Kyoto Protocol aims at reducing greenhouse gases emissions from anthropogenic sources, notably carbon dioxide emissions produced using fossil fuel. While details vary for each country in terms of objectives and commitments, the Kyoto Protocol specifies the mechanisms to achieve the objectives of emissions reduction: Article 6 concerns the joint commitment to emissions reduction, Article 12 the "clean" development mechanism, and Article 17 the guidelines for emissions trading.

On November 31, 2004, Annex 6 of the MARPOL Convention of IMO, providing "Regulations for the Prevention of Air Pollution from Ships", was ratified by 19 countries accounting for 59.9% of the world fleet. This Annex came into force on May 19, 2005. Parties have the right to impose limits on the emission of sulphur oxides (SO_x) and nitrogen oxides (NO_x) in ship exhaust gas systems, and to prohibit the emissions of ozone-depleting substances. Annex 6 also prohibits the on-board incineration of certain products such as contaminated packing materials and polychlorinated biphenyls (PCBs).

4.2.2.4. Selected sustainable development practices

Our surveys suggest that the best practices to reduce emissions of atmospheric pollutants and greenhouse gases in ports consist in facilitating the use of "clean" transportation modes, notably electric vehicles.

For regular shipping lines, the most notable improvements in air quality are undertaken in countries having established systems of differential charging along navigable corridors and in ports, in relation to polluting emissions from ships. Other measures include modifications to engine injection systems, exhaust gas recirculation systems and a reduction in vapour emissions of burned gases.

Examples

The port authority of Portland, Oregon, United States, has voluntarily reinforced its regulation on air pollution. All ship maintenance and repair activities – sand-blasting, welding, etc. – that emit particulates have been retrofitted with covers, guards and shields to prevent particulates from becoming airborne (Urban Harbors Institute, 2000).

The port authority of New York and New Jersey, United States, has replaced diesel-powered cranes with electric cranes to minimize air emissions and noise (Port Authority of New York and New Jersey, 2004).

Since 1998, Sweden has established differentiated fairway and port charges for any passenger and cargo ships calling at Swedish ports, regardless of the ships' flag State. This system was part of a tripartite agreement between the Swedish Maritime Administration, the Swedish Shipowners Association and the Swedish Ports and Stevedores Association to employ vigorous measures to decrease ship-generated air pollution. The system is based on two charging components. One portion corresponds to the gross tonnage of the ship and the other portion is based on the volume of cargo being transported by the ship. The charging levels for the gross tonnage portion are differentiated with respect to emissions of nitrogen oxides (NO_x) and sulphur oxides (SO_x) emitted by the ship. The charging scheme does not represent an increase in shipping costs, neither an increase in port incomes. Ships which have taken environmentally protective measures will be charged reduced dues, while ships with higher emissions levels will pay higher dues. The differentiated charging scheme is completed with a system of subsidies for the installation of catalytic converters. The Swedish Maritime Administration reimburses the fairway dues being paid for a five-year period to shipowners that have invested in the installation of catalytic converters. This reimbursement can be as high as 40% of the installation costs of these catalytic converters. The differentiated fairway charges scheme has permitted significant reductions in nitrogen oxides (NO_x) and sulphur oxides (SO_x) emissions by ships calling at Swedish ports. Besides, it is important to underline that the system does not lead to a reduction in overall income for the Swedish Maritime Administration (Swahn, 2002).

In Australia, the port authorities of Brisbane, Perth, Sydney, Gladstone and Port Headland use high-octane fossil fuel for their vehicles fleet. This type of fuel contains 10% of the amount of sulphur content in ordinary fuel and helps reduce greenhouse gas emissions (http://www.bp.com.au/products/fuels/bp_ecoultra/eco.asp?menuid=ee).

The port authority of Helsinki, Finland, gives a discount on harbour dues to passenger vessels using fuel containing less than 1% sulphur (http://www.hel.fi/port/english/ymparisto/HELSAT_RESUME_2003.indd.pdf).

The Japanese company Mitsubishi Heavy Industries has conceived a stratified water injection system for ship engines. The injection system makes it possible

to increase the thermal efficiency of the engines and to reduce the emissions of nitrogen oxides (NO_x). This system reduces nitrogen oxides (NO_x), with no negative impact for the engine.

4.2.3. Waste management

4.2.3.1. Issue

Growth in maritime trade generates an increasing volume of waste from vessels and the daily operations of the port terminal . The industry has to pay high waste management and disposal costs. The issue for the industry is thus to discover means to recycle waste, or to generate marine debris that are biodegradable.

4.2.3.2. Problem

Waste generated by ship operations at sea or at ports of call (organic matter, plastic materials) raises serious environmental problems, since it may contain high levels of bacteria that are harmful to human health and to marine ecosystems when discharged into water. Besides, submerged or floating plastics, metals or wood debris can hamper ship movement in inland waterways and at sea as well as in berthing operations.

4.2.3.3. International legislation

Annex 5 of the MARPOL Convention of the International Maritime Organization (IMO) providing “Regulations for the Prevention of Pollution by Garbage from Ships” came into force in 1988. The Annex totally prohibits the disposal of plastics anywhere into the sea and severely restricts the discharge of other garbage from ships into coastal waters. States that are parties to Annex 5 ensure the provision of facilities at ports and terminals for the reception of garbage. Annex 5 also requires all ships to provide a Garbage Record Book where the date, time, position of ship, description of the garbage and the estimated amount incinerated or discharged must be logged and signed. This is especially important for cruise vessels engendering a large volume of organic waste. The MARPOL Convention imposes the provision of facilities for the reception of garbage at ports. Shipping lines that have established environmental management systems are now requesting port facilities adapted to their requirements in terms of waste management. Annex 5 entered into force on December 31, 1988. To date, 119 countries accounting for 95.23% of the world fleet have ratified Annex 5.

4.2.3.4. Selected sustainable development practices

Our surveys suggest that the best practices are based on:

1. waste reduction at source, while only using recyclable materials, waste handling and treatment technologies on board ships (compactors and comminutors);
2. control of ocean-dumped waste as regulated by existing Conventions; and
3. discharge of garbage in ports where debris is integrated within a waste recycling and management system.

Examples

The port authority of Newport, Oregon, United States, has established two convenient refuse reception facilities. On land, the port authority has constructed ten refuse facilities. Each facility has concrete pad flooring that is easily cleanable and is strategically located in an area easily accessible to the port community. Each facility includes three recycled galvanized bins, each with a capacity of one cubic meter. At sea, the port authority has put into service a modified water level barge to help fishermen off-load heavy items. This two-pronged system has been successful in collecting, recovering and recycling metal, wood, nets, paper and cardboard (Urban Harbors Institute, 2000).

The port authority of Portland, Oregon, United States, has implemented a vast program to collect and recycle 27 different materials generated by the port community. In addition, the port authority has initiated innovative projects to recover used materials for alternative uses. Wood and steel from abandoned structures, buildings and vessels are recovered, remilled and incorporated into new other port construction projects – buildings, hangars, warehouses, floating docks, ramps. This program has resulted in reducing considerably the costs of material supply for port infrastructure expansion projects (Urban Harbors Institute, 2000).

The port authorities of Los Angeles, California, and New York and New Jersey, United States, have developed a variety of waste recovery and recycling projects. The most important is the commitment to encourage the use of recycled materials (Port Authority of New York and New Jersey, 2004).

The port authority of Stockholm, Sweden, has developed a waste recovery system. The captain of each vessel wishing to dispose of hazardous waste and garbage must inform the Port traffic control centre. Waste classified, packaged and labelled is under the responsibility of the port authority before being sent to a hazardous products treatment plant in Stockholm (Port of Stockholm, 2003).

The shipping company Wallenius Lines, Sweden, has installed electric incinerators onboard all its vessels, thus reducing toxic gas air emissions (Wallenius Lines, 2000; 2001; 2002; 2003).

4.2.4. Resource conservation

4.2.4.1. Issue

Occupying critical sites in coastal zones, ports have an important impact on estuaries and marine ecosystems. Port development inevitably consumes an enormous amount of space and resources, requires periodical expansion and modifies the coastal fringe to respond to technological changes and traffic growth. Port activities require backfilling, dredging and building infrastructures on and in water. In several cases, a modification of ecosystems is considered essential to increase the competitiveness of the maritime industry. The industry recognizes, however, the importance of maintaining the hydrous regime of navigable waterways, essential for shipping activities. In the perspective of sustainable development, this recognition aims at underlining the contribution of the industry to the promotion and conservation of resources.

4.2.4.2. Problem

Day–to-day maritime transport operations founded on ship movements, maintenance activities and the construction of new infrastructures have a significant environmental impact on ecosystems. When citizens and local communities located in port areas perceive the comparative advantages that they may obtain in terms of resource conservation, they pressure port authorities to take action to prevent the destruction of ecosystems and rehabilitate areas that have been disrupted.

4.2.4.3. International legislation

There exist several international conventions concerning the conservation of nature (World Heritage Convention, 1972), biodiversity (Rio Convention, 1992), endangered species (Washington Convention, 1973), migratory species (Bonn Convention, 1979) and wetlands (Ramsar, 1971) that can influence port and shipping activities with regard to ecosystem protection. Moreover, terminal and regular shipping lines operators must comply with national legislation and sometimes with municipal regulations concerning the destruction, the conservation and the rehabilitation of natural habitats.

4.2.4.4. Selected sustainable development practices

Several port authorities have programs to monitor the biotic factors composing ecosystems, including, birds, mammal populations, marine flora and fauna, etc. In addition to monitoring programs, port authorities are involved in natural conservation and restoration activities and participate in various community

groups, committees and local projects. In terms of shipping, the most promising avenues rest on the concept of green corridors having an ecological and recreative character, in relation to the existing coastal and natural marine environment.

Examples

In the United Kingdom, Associated British Ports (ABP) lists four list four pieces of legislation that have guided the development of their biodiversity program. ABP also work in collaboration with environmental groups in the United Kingdom. The objective is to maintain the nature-conservation value of their land assets and carry out assessments of all "Sites of Significance or Special Interest (SSSIs)" having ecological potential to guide future planning. ABP is carrying out reforestation programs on several sites and is constructing bird nesting areas for endangered birds (http://environment.abports.co.uk/files/biodiversity.pdf).

The port authority of Houston, Texas, United States, has developed a partnership with Houston Lighting and Power Company to use coal combustion by-products to develop ostreiculture. Fly ash, bottom ash and boiler slag are combined with cement to form golf ball sized pellets designed to simulate suitable cultch material upon which oyster spat can settle. Pellets are then deployed in Galveston Bay to an average depth of 10 meters, on a 140 m^2 surface positioned with the long side aligned with the prevailing tide movement to form artificial oyster reefs (http://www.portofhouston.com/pdf/AR03/PHA-Environmental03.pdf).

The port authority of Auckland, New Zealand, has spent over US$ 150,000 on a program to boost snapper stocks (Lutjanidae family) in the Hauraki Gulf, and has released 90,000 of the species (http://www.poal.co.nz/newsroom/Publications/Environment%20Report.pdf).

The port authority of Le Havre, France, has invested €45.73 million for the protection of marine ecosystems. The authority has constructed an artificial island for birds, undertaken a program to rehabilitate salt marshes, and adopted a management program for protected species. The port authority also monitors halieutic resources and has established a bird observatory (http://www.havre-port.net/pahweb.html).

The port authority of Newport, United Kingdom, uses grass seeds mixed with wildflowers to make areas more attractive to neighbouring wildlife (http://environment.abports.co.uk/files/biodiversity.pdf).

The port authorities of Ipswich and Lowestoft, United Kingdom, have built bird-nesting walls and platforms to increase public and employee awareness of local bird populations (http://environment.abports.co.uk/files/biodiversity.pdf).

At the port of Seattle, Washington, United States, several wild salmon runs have been protected under the Federal Endangered Species Act. The port authority of Seattle, Washington, has replaced more than 70,000 creosote-treated wooden pilings that contaminated fish habitats with a reduced number of concrete and steel pilings, improving water quality and marine habitat (Urban Harbors Institute, 2000).

4.2.5. Energy consumption

4.2.5.1. Issue

Port operations require intensive use of energy, notably for the production of heat, electricity and lighting for buildings, freight movement on port sites and vehicle use. Besides, port authorities are often motivated to undertake energy production activities to increase their income. Ships require energy for propulsion and to pursue on-board activities while at quay. The energy issue of ports and marine carriers can be subdivided into two components: reduction in consumption and energy production.

4.2.5.2. Problem

The successive rises in oil prices have eroded the income of regular shipping lines and prevented them from benefiting from the increase in maritime traffic. In terms of operations, , the rise in the price of fuel, linked with the difficulty in increasing tariffs, have compelled marine carriers to redesign their fleet and network, leading to a decline in the occupancy coefficient of certain ports of call. This situation in turn leads to loss of productivity and flexibility. Moreover, the objective of requiring ships berthed in ports to stop their engines and use electric power from the shore raise problems of compatibility between countries and ships.

4.2.5.3. International legislation

International initiatives, such as Chapter 7 of the International Energy Program (IEP), encourage countries to consider energy conservation and the development of alternative sources of energy in order to reduce the consumption of imported oil, and exchange experiences and information on energy conservation (http://www.iea.org/Textbase/about/IEP.PDF).

In June 2004, the World Council for Renewable Energy (WCRE) gathered in Bonn to elaborate recommendations and an action plan containing 165 self-binding commitments for Governments, NGOs and companies to foster activities promoting renewable energies. It is still too soon to evaluate the impact of these commitments on port authorities, although the effects of governmental energy policies have begun to filter through to ports (http://www.world-council-for-renewable-energy.org/).

4.2.5.4. Selected sustainable development practices

Our survey suggests that several port authorities have undertaken basic studies on their energy performance to guide their planning activities, that they have fixed specific objectives concerning a reduction of their energy consumption and that they have extended their control over the whole of their transport operations, including those of regular shipping lines, road and rail carriers. Our survey also shows that approximately 80% of ports that have adopted an energy program are located in countries that are Parties to the International Energy Program (IEP). National and international initiatives in the field of energy warrant the implementation of alternative energy production programs. Several ports benefit from the size of their site and their geographical location to use alternative sources of energy (wind, solar) and increase their income.

Examples

The port authority of New York and New Jersey, United States, is conserving energy with high-lumen, low-energy lighting fixtures (Port Authority of New York and New Jersey, 2004).

The energy activities of the port of Houston, Texas, United States, have been guided by Senate Bill 5 amending the Health & Safety Code to encourage energy efficiency programs. The port favours the adoption of a better energy distribution system, the use of energy efficiency lighting control system to reduce energy consumption, and the renovation of existing port terminal buildings with new windows allowing a better use of natural skylights (http://www.portofhouston.com/pdf/AR03/PHA-Environmental03.pdf).

In Australia, the initiative of the Government with the Greenhouse Challenge has resulted in the installation of energy-saving systems at the port of Brisbane through wind and solar energy, which reduces the use of energy sources contributing to the production of greenhouse gases (http://www.portbris.com.au/asp/media/publications/annual_report/eser/pbc-eser-2001-2002.pdf).

Several ports such as Brisbane, Australia, have installed energy saving systems in their office buildings, including triphosphor bulbs, motion detectors in meeting rooms, and mandatory use of power save functions on electric office equipment (http://www.portbris.com.au/asp/media/publications/annual_report/eser/pbc-eser-2001-2002.pdf).

The port authority of Houston, Texas, United States, has undertaken building renovations, and replaced cool-roofing systems which reduce the amount of energy needed to cool buildings in summer (http://www.portofhouston.com/pdf/AR03/PHA-Environmental03.pdf).

Several port authorities in the United Kingdom and the Netherlands are changing electric and gas burning navigation buoys to solar power (http://www.merseydocks.co.uk/new/downloads/environment2004.pdf).

Wind energy is also very popular in ports and several turbines have been installed – or planned – in the ports of Liverpool, United Kingdom (6), Fremantle, Australia (proposed), Marseille, France (6, but expected to increase to 35), and Amsterdam, the Netherlands, (20, but expected to increase to 40 in 2005) (http://www.freport.wa.gov.au/About/environ/index.aspx?section=4#sustainable_energy).

Several alternative sources of energy are also used at the port of Liverpool, United Kingdom, where the port authority has completed the construction of a combined heat and power generating plant, which conserves energy by using fuel for two processes at once (http://www.merseydocks.co.uk/new/downloads/environment2004.pdf).

The port authority of Kembla, Australia, has built a demonstration wave-energy plant, which is expected to generate enough electricity to power 500 houses (http://www.kemblaport.com.au/Environment.htm).

The port authority of Los Angeles, California, United States, has developed a pilot program by retrofitting the engines of two tug-boats. Modifications to the engines included changing the injection timing sequence and the cooling system so as to enable injection of diesel fuel at lower peak combustion temperatures and supplying the lowest temperature water. Each engine was further equipped with an electronically controlled system to verify engine conditions. This experience has optimized engine efficiency and performance, and reduced maintenance costs and mechanical wear as well as fuel consumption and polluting emissions. The port authority has converted part of its port vehicle fleet to electric or alternative fuels (Urban Harbors Institute, 2000).

At the port of Göteborg, Sweden, electricity from the ro/ro terminal generator is produce by wind power, hence minimizing environmental impacts. The port authority of Göteborg has also decided to invest in gas-driven vehicles to reduce emissions and in the long term to change over to renewable energy and to increase by 50% the use of railways for goods transported to and from the port (Port de Göteborg, 2004).

The port authority of Zeebrugge, Belgium, plays an important role in the production of clean energy. The port authority has concluded an agreement with the Interelectra company to operate a wind turbine park with 23 wind turbines with a total annual production of 17 500 MWh (http://www.portofzeebrugge.be/content.asp?p=171).

Energy conservation policy can be linked with that of air pollution emissions reduction. The port authority of Los Angeles, California, United States, has adopted a policy limiting ship speed to 12 knots within a radius of 40 kilometres from the port (Los Angeles). The port authority has also imposed a requirement for all ships berthing at the port to turn off their engine and use shoreside power in the context of "green bunkering, cold ironing" (Urban Harbors Institute, 2000).

4.2.6. Emergency plans

4.2.6.1. Issue

According to the International Ship and Port Facility Safety Code (ISPS Code), a shipowner must appoint a Company Safety Officer and a Ship Safety Officer. Port authorities must also appoint a Port Facility Safety Officer. Details of the procedures and security measures the port facility and the ship should apply in case of emergency must be elaborated and submitted for approval by an independent classification society.

Ports and ships must be able to react rapidly to any emergency situation resulting from their activities or operations. The capacity of port authorities and regular shipping lines to reduce risks and quickly undertake actions in response to emergency situations also represents an economic incentive. Freight forwarders wish to be associated with ports and shipping lines able to manage crisis situations.

4.2.6.2. Problem

Activities of port terminal operators and marine carriers can be hampered by natural disasters (earthquakes, hurricanes, landslides), traffic disruption (collisions at sea, rail or road transport accidents, icebergs), terrorist attacks and civil disorders that may generate a variety of accidents (toxic spills, fires, explosions) and require the protection or evacuation of people, the protection of products and equipments and the securing of the perimeter. A survey conducted by IMO in 2004 by 39 governments representing 83.6% of world merchant shipping reveals that only 28.7% of ships and 10.8% of ports had submitted a security plan in compliance with the ISPS Code.

4.2.6.3. International legislation

Essential security measures emanate from the MARPOL Convention and International Ship and Port Facility Safety Code (ISPS Code), as well as from the International Convention for the Safety of Life at Sea (SOLAS) of the International Maritime Organization (IMO).

Annex 1 of the MARPOL Convention focuses on "guidelines for the prevention of pollution by oil"; the Annex was ratified in 1983.

Annex 2 of the MARPOL Convention focuses on “guidelines for the control of pollution by noxious liquid substances”; the Annex was ratified in 1983.

Annex 3 of the MARPOL Convention focuses on “guidelines for the prevention of pollution by harmful substances in packaged form”; the Annex was ratified in 1992.

Annex 5 of the MARPOL Convention MARPOL focuses on “guidelines for the prevention of pollution by garbage from ships”; the Annex entered into force in 1988.

4.2.6.4. Selected sustainable development practices

Our surveys suggest that the best practices rest on continuing education for ship crewmembers and port staff, based on regular simulation exercises to evaluate and increase the capacity of personnel to manage emergency situations.

Examples

The port authority of Headland, Australia, in partnership with port tenants, has drawn up an emergency plan based on an inventory of types of vessels, the nature of incidents, possible consequences and the scope of the actions required (http://www.phpa.wa.gov.au/). The plan clearly details procedures and the responsibilities of port personnel.

The port authority of Auckland, New Zealand, employs an emergency management program specifically targeting environmental problems. Components of the program focus on fire fighting exercises, spill response procedures, notably for oil spills, regular response training for port personnel, in partnership with civilian authorities and regular shipping lines, and emergency manuals updating (http://www.poal.co.nz/newsroom/Publications/Environment%20Report.pdf).

The shipping line P & O Nedlloyd has drawn up a training program for ship crewmembers that is more stringent than the emergency plan requirements of STCW-F 1995 established by IMO. The principle implies an evaluation of the training of each officer in order to determine differences between acquired competencies and those needed to exceed IMO requirements and the elaboration of additional training program. Each year, the company allocates US$ 2.2 million to personnel training.

The shipping company Evergreen, Taiwan, has established a crew-training centre at Nankan. The centre is equipped with a replica of an engine room and a ship’s bridge with a 360º screen projector.

4.2.7. Oil spills

4.2.7.1. Issue

The nature and pace of economic growth are closely linked with the control and the use of energy. This relationship has however a geographical dimension. The difference in the location of oil producers (Caribbean, North Africa, Caspian Sea, Persian Gulf, and Southeast Asia) and oil consumers (North America, Western Europe and East Asia) implies the transfer of fossil fuels. The transport of petroleum remains the main activity of the marine industry. Industrial growth, notably in East Asia, has created a steady surge in demand for the maritime transport of crude oil. This is demonstrated by the increase in the size and the number of tankers in operation. In March 2005, the four main Chinese shipping companies launched a joint plan for the development of an oil tanker fleet of 18 vessels each with a capacity of 2 million barrels by 2008 to ensure the security of China's oil supplies.

4.2.7.2. Problem

Pollution by crude oil is one of the most serious environmental problems of maritime transport activities. The main sources of oil spills are related to the activities of loading and unloading petroleum to and from vessel tank and from the operational activities of the ship's engine room. Discharged products contain polycyclic aromatic hydrocarbons (PAH), BTX (benzene, toluene and xylene) and heavy metals (zinc, chromium, copper and cadmium) recognized for their toxic effects and that can be harmful for human health and the environment.

4.2.7.3. International legislation

Annex 1 of the MARPOL Convention MARPOL of the International Maritime Organization (IMO) providing "guidelines on the prevention of pollution by oil" was ratified in 1983.

The Annex requires the establishment of appropriate technologies for retaining oily wastes on board ships and includes the requirements for governments to provide shore reception and treatment facilities at national oil terminals and ports.

The Annex also specifies requirements to segregate ballast tanks on tankers to ensure that ballast water is never to be contaminated by oil carried as cargo or fuel.

Annex 1 also includes other measures concerning regulations on the construction and equipment provisions of oil tankers.

Since its ratification, several amendments have been included in Annex 1 to reinforce and improve existing requirements, notably that all tankers have double hulls or an alternative design having similar properties.

Moreover, the Marine Environment Protection Committee (MEPC) of IMO amended the MARPOL Convention to reduce the amount of oil discharged into the sea from ship operations. Operational oil discharge from tankers is allowed outside special geographical areas, at more than 50 nautical miles from the nearest land. The rate at which oil may be discharged must not exceed 30 litres per mile travelled by the ship. Ships are prohibited from discharging oily waste from machinery space containing more than 15 parts of oil per million.

4.2.7.4. Selected sustainable development practices

Our survey suggests that the best sustainable development practices applied to the control of oil spills are based on port reception and treatment facilities.

Examples

The port authority of Cordova, Alaska, United States, recovers used oil from harbour users and members of the community in dockside oil disposal tanks. A bilge water vacuum pump is available for boat users who want to empty and clean their bilge of oily water. This oily water is pumped into a holding tank of 3 000 litres where the water and oil are separated. All the oil collected is then transferred to an industrial boiler as fuel. The costs are essentially recovered in moorage fees (Urban Harbors Institute, 2000).

The port authority of Newport, Oregon, United States, has designed a motor oil and oil filter recycling program. Oil filters are recovered and then placed under an industrial oil filter press, which crushes the filters and squeezes out the excess oil. Both the oil recovered from the filters and the filters themselves are recycled by the port. The cost of providing this service is factored into established port user fees (Urban Harbors Institute, 2000).

The port authority of Los Angeles, California, United States, has undertaken a pilot project by retrofitting a tugboat with the installation of a holding tank to collect engine waste oils (Urban Harbors Institute, 2000).

The port authority of Göteborg, Sweden, has invested more than US$ 10 million in a vapour recovery system when loading petroleum products into vessels. The recovery system has three installations with a respective capacity of 1,500, 2,000 and 2,400 m^3/hour. The plants have an adsorption capacity of 95%, reducing the emissions of volatile organic compounds from ship loading from approximately 450 to 25 tonnes a year (Port of Göteborg, 2004).

The shipping company Wallenius Lines, Sweden, has equipped all its ships with a high capacity tank to collect oily wastes to be treated for recycling in Sweden (Wallenius Lines, 2000; 2001; 2002; 2003).

The terminal operator Hutchison Port Holdings, Hong Kong, China, has equipped its port terminals with an oily waste recovery system. Terminals are provided with an oily water separator that enables the oil content of waste water to be separated and recycled.

The Japanese enterprise Ishikawajima-Harima Heavy Industries (IHI) has designed a new technology for the construction of liquefied natural gas (LNG) carriers. The design is a stand-alone storage system in contrast to the membrane types, which rely on the ship's structural strength. The system ensures a secondary layer that prevents a leakage of cargo in the event of a slight collision.

The Hong Kong Salvage and Towage Company, China, has pioneered its own design of vessels for the collection of floating oil. The efficiency of the vessel's oil recovery unit gives a 92% recovery rate.

4.2.8. Anti-fouling paints

4.2.8.1. Issue

An adequate coating choice and application on a new vessel ensures optimum protection, while improving ship efficiency and reducing maintenance costs. The choice of coating is becoming more and more important in the context of a reduction in ship crew sizes and a subsequent reduction in onboard maintenance crews. The capital value of a vessel declines with time, in the course of use. The marine environment, in which ships operate, is responsible for corrosion above and below the waterline. Coating should prevent metal rusting and tolerate deterioration by use and exposure to the sun, sea, rain and ice. Several coatings are designed to counter the wear and tear resulting from shipping operations, such as impact and abrasion resistance for bridges, cargo holds and the engine room, as well as anti-fouling paints to prevent parasites from attaching to the hull under water. This allows the ship to move more rapidly and contributes to a reduction in the consumption of fuel oil. A well-maintained ship is also usually easier to place on the charter market and is often requested for the movement of high value goods; the ship can generate higher income and maintain a higher value on the second-hand market.

4.2.8.2. Problem

Anti-fouling chemical products, notably the organotin tributylin (TBT) contained in the coating applied to vessels, leaches in salty sea water and can destroy sealife including algae, molluscs (mutations in oysters, sex changes in whelks),

shell-fishes, sea mammals (poisoning of dolphins, sea-otters and whales), fishes and invertebrates (infections).

4.2.8.3. International legislation

The Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO) has been concerned with anti-fouling paints since 1988. In 1990, the MEPC adopted Resolution 46(30) addressing "measures to control potential adverse impacts associates with use of TBT in anti-fouling paints", which was followed in 1999 by the adoption of Resolution A.895(21) addressing "anti-fouling systems used on ships".

In 2001, IMO adopted an international convention addressing "the control of anti-fouling systems used on ships". The Parties were required to ban the use of TBT in anti-fouling paints before 2003; the Parties have to remove or to seal all TBT paints on their vessels by 2008. The Convention makes recommendations concerning ship inspection. Vessels more than 24 meters in length or above 400 in gross tonnages must be certified. Classification societies issue certificates to ships conforming to the clauses of the Convention. The Convention will enter into force 12 months after 25 States representing 25% of the world's merchant shipping tonnage have ratified it. Several countries have already completely prohibited the use of anti-fouling paints containing TBT on ships flying their flag.

4.2.8.4. Selected sustainable development practices

Our survey suggests that major research is now under way to develop toxic-free anti-fouling paints. The best practices are based on the use of natural biological compounds or silicone products.

Examples

The port authority of Los Angeles, California, United States, has undertaken a pilot-project to reduce the need to paint vessels by coating ship hull with a Teflon-based material (polytetrafluoroethylen) containing no toxic chemicals. Besides, the deckhouse was constructed of aluminium, which eliminates the need for paint. This experience facilitates ship maintenance and eliminates periodic repainting (Urban Harbors Institute, 2000).

The port authority of Portland, Oregon, United States, has established a protocol that prohibits vessels, notably cruise ships, from calling at the port if the hull is covered with anti-fouling paints containing heavy metals (Urban Harbors Institute, 2000).

The National Institute for Coastal and Marine Management (NICM), The Hague, Netherlands, has undertaken a vast study of alternative anti-fouling systems. The products and methods evaluated include copper-based anti-

fouling paints, tin-free or pesticide-free anti-fouling paints, natural biocide paints, prickly coatings, hull cleaning methods and the use of electric charges at different sections of the hull. Each of these products or methods comprises advantages and drawbacks in terms of costs, environmental impacts and frequency of use (NICM, 1997).

The shipping company Leif Höegh, of Norway, and Wallenius Lines, of Sweden, use silicone based paints. These coatings are more expensive than other types of anti-fouling paints, but they keep the hull free from organisms and enable the carriers to reduce the consumption of fuel oil, and consequently reduce the amount of air pollutant emissions (Leif Höegh & Co, 2002; Wallenius Lines, 2000; 2001; 2002; 2003).

The shipping company Nippon Paint Marine Coatings has developed a new TBT-free anti-fouling paint technology with its Ecoloflex SPC product. This anti-fouling paint works by the leaching of the biocide in conjunction with hydrolysis and the physical motion of the seawater. This motion reduces the hull's surface roughness as well as resistance between the ship's hull and the water surface, hence improving fuel economy.

4.2.9. Dust emission

4.2.9.1. Issue

Ports are important sources of earnings for regional economies. They can attract various manufacturing enterprises, distribution activities linked with truck, train or barge transport as well as complementary industrial services (warehousing, customs, logistics, etc.). All these sectors and the inherent transport activities of port operations generate dust emissions.

4.2.9.2. Problem

Dust emissions have an impact on the quality of the port environment through the release of harmful unhealthy visual, physical, chemical substances that may affect the productivity of employees and disturb port activities. Dust can be released from open sky, soil or aggregate deposits, construction activities, the transport of materials, or the handling and discharge of bulk cargo. The smallest particulates do not require much wind to create dust-drift. Besides, industrial activities in ports, through their manufacturing processes and polluting emissions, can have profound negative effects on neighbouring residential areas. Adverse health effects include skin irritations, inhalation of toxic products or allergies (i.e. soya). In addition, cereal handling, mostly storage in compact and insulated grain elevators, creates a risk of spontaneous combustion or fire.

4.2.9.3. International legislation

The International Maritime Organization (IMO) has elaborated guidelines and practices for the transport of hazardous goods containing provisions that may concern the adverse effects of dust emissions. Dust emissions control measures on port sites are generally within the jurisdiction of regulations addressing air quality or local regulations on air pollution. Firms that are the source of dust emissions may be required to establish, at their own expense, appropriate mitigating measures that respect the environmental standards of existing local regulations.

4.2.9.4. Selected sustainable development practices

Our survey suggests that the best dust management practices include a reduction of the source of emissions from cargo and port infrastructures by carrying out transfer activities in enclosed systems, by managing storage activities and by regular maintenance of roads and vehicles. Other measures aimed at protecting human health and the natural environment from air particulates include the construction of a green belt.

Examples

The port authority of Göteborg, Sweden, has undertaken work to expand the Skandia Harbour terminal by constructing a 600 metre- long tunnel between the building site and the port gate, in order to separate and control pollutant emissions from construction vehicles and port operations (Port de Göteborg, 2003).

The port authority of Queensland, Australia, Queensland receives complaints concerning dust from their coal terminals. The complaints occur mostly in the summer, during drier conditions and unfavourable wind direction. The port authority invested AU$ 66,000 in 2002-2003 to implement a noise and dust-monitoring plan. The program involves reducing stockpile heights to lessen the potential for wind impact and dust lift-off from stockpiles and using water sprays to dampen stockpiles areas (http://www.pcq.com.au/2004/downloads/2003pcq_sustainability.pdf).

The air quality program of the port of Nelson, New Zealand, contains guidelines to reduce the adverse effects of odours and dust (http://www.portnelson.co.nz/files/environmental_full.pdf).

The plan includes general shrub buffers planted along the main road arteries surrounding the port and solid fence erected to reduce dust movement. In addition, industries at the port whose activities concern forest products, fertilisers and chemical products must adopt a Code of practice for minimising dust emissions from their operations. This policy was drawn up following the adoption of new environmental standards on air quality by the city of Nelson in

2003. The air quality plan indicates that activities should not give rise to unreasonable adverse effects which compromise the amenity of adjacent activities and the surrounding environment, such as undue levels of noise, dust or other discharges to air (www.ncc.govt.nz/environment/SOE/SOE_01/SOE_01.pdf).

The port authorities of Gladstone and Newcastle, New South Wales, Australia, water bulk stockpiles with automatic sprinklers to reduce dust emissions in the ports. Besides, these ports have planted green borders between bulk cargo terminals and neighbouring areas in order to control the impact of wind and to avoid dust emissions around quarries (http://www.pcq.com.au/2004/downloads/2003pcq_sustainability.pdf).

4.3. Environmental issues specific to port authorities

4.3.1. Noise

4.3.1.1. Issue

Ports must have access to road and rail networks. Traffic growth, a generator of local employment, also creates different noise levels. There is a need to underline that some of these noises have for objective to insure personnel safety in port operations in line with the movement of vehicles and ship loading and unloading operations.

4.3.1.2. Problem

Areas in close proximity to port sectors are exposed to high noise levels. Noise represents irregular and chaotic sounds, traumatising to the hearing organ and that may affect the quality of life by their unpleasant and disturbing character. Noise may lead to damage to human health, notably psychic disorders and sleeping problems.

4.3.1.3. International legislation

There are no international laws or conferences relating to noise nuisances. Concern in this area is growing however, especially in areas where residential developments are built close to ports, pushing port authorities to adopt noise management measures in order to maintain strong local community relations. Several of these measures have been drawn up in response to municipal regulations limiting noise levels in general.

4.3.1.4. Selected sustainable development practices

Our survey suggests that the best practices are based on the use of alternative sources of energy, speed limits in port districts and the construction of noise

barriers using coniferous trees or noise walls in port adjacent areas or along road and rail corridors.

Examples

The port authority of Göteborg, Sweden, has equipped some of its quays with electricity generators and high voltage cables to supply vessels with electricity from the shore. This system has reduced the noise generated by the vessels' own auxiliary engines and prevented 80 tonnes of nitrogen oxide (N_2O), 60 tonnes of sulphur oxide (SO_x) and 2 tonnes of solid matter being emitted into the air each year (Port of Göteborg, 2004).

At the port of Amsterdam, Netherlands, the government has introduced the concept of a "noise zone", where noise standards apply, and this is located a sufficient distance from sensitive receivers, such as homes which are prohibited in the area.

The port authority of Auckland, New Zealand, has instituted noise control initiatives, including the creation of a "Noise liaison group" established with local residents, set up a 24-hour noise control hotline for neighbours to call, eliminated warning sirens from heavy machinery (except where safety is concerned), fitted equipment with soundproofing and noise reduction features, ceased the use of ships' horns to signal departure, eliminated rail crossing alarms, and directed night truck traffic through gates furthest from residential areas, and is also working with shipping lines to reduce noise from ship generators which is their most common source of complaints (http://www.poal.co.nz/environment/noise.htm).

The port authority of Hay Point, Australia, monitors noise levels during 3 periods each day and develops monthly statistics of noise events and complaints, so that they may identify exactly what the complaint relates to, and attempt to prevent future occurrences (http://www.pcq.com.au/2004/downloads/Q44_JulFinalRPT_13Aug04.pdf).

The port authority of Fremantle, Australia, has undertaken an industrial buffer study; this study will incorporate noise, odour, dust and light pollution remediation measures (http://www.pcq.com.au/2004/downloads/Q44_JulFinalRPT_13Aug04.pdf).

4.3.2. Dredging

4.3.2.1. Issue

Each year, hundred million cubic meters of marine sediments are dredged around the world to maintain or improve navigable waterway systems, to ensure shipping safety, and to answer the growing need to reclaim land for urban, industrial or transport activities and construct marine infrastructures and

coastal bank protection. Dredging is essential to create and maintain sufficient water depth for shipping operations and port accessibility, since in certain areas, it is not possible to build new navigable waterways. Besides, cable networks, pipelines and other infrastructures on the seabed prohibit any new dredging activities near land. It follows that the search for sand and quality minerals to development new areas is carried out far from the shore, thus increasing the cost per dredged unit.

4.3.2.2. Problem

Water and marine sediments are often contaminated by numerous products that settle onto the underwater floor, notably heavy metals (lead, zinc, mercury, copper, cadmium), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons, dioxins, pesticides (dichlorodiphenyltrichloroethane or DDT) as well as oil and greases from ships. But soils can also be contaminated by activities that are not imputable to shipping. Dredging activities have a negative impact on the marine environment. On the one hand, they modify the hydrology by creating turbidity that can affect the marine biological diversity. It is important to maintain the water column, since it regulates marine and plant life. On the other hand, the contaminated sediments and water raised by dredging require spoil disposal sites and decontamination techniques.

4.3.2.3. International legislation

Dredging is regulated by Convention 1972 on “guidelines for the prevention of marine pollution by dumping of wastes” (London Convention 1972), adopted at the Intergovernmental Conference on the Convention on the dumping of wastes at sea. The London Convention 1972 entered into force on August 30, 1975.

In 1996, the International Maritime Organization (IMO) added a Protocol to Convention 1972; the Protocol also considered guidelines for the prevention of marine pollution by the dumping of wastes. The objectives are to protect and preserve the marine environment from all pollution sources and to take appropriate measures, according to available economic, technical and financial capacities, to prevent, reduce or eliminate pollution caused by dumping of wastes or other materials or incineration at sea. Parties to the Convention agree to enforce the Convention within their jurisdiction. In coastal and internal waters, national legislation often has priority.

4.3.2.4. Selected sustainable development practices

Our survey suggests that are four methods for the disposal of dredged materials:

1. Sediment disposal in running or open water;
2. Sediment disposal in land dump or sea bed disposal sites approved by public authorities;
3. Sediment valorisation through the productive use of materials for habitat restoration, beach silting, shore stabilization, park development, residential, industrial and infrastructure constructions, filling old mines or for agricultural, horticultural or forestry purposes; and
4. Using ecological dredging methods.

Examples

The port authority of Canaveral, Florida, United States, uses a clamshell dredge that allows segregation of uncontaminated sands from silt and clay; the sandy material is placed in a berm configuration to enhance the nesting habitat of marine life and provide natural storm protection (Urban Harbors Institute, 2000).

The port authority of Boston, Massachusetts, United States, has excavated nine underwater cells at a depth of 20 meters in areas not accessible to commercial shipping. Uncontaminated sediments extracted from these cells are disposed of in the Massachusetts Bay, located at 40 kilometres from the coast. The dredged contaminated sediments are placed in the cells and capped with a one-metre layer of clean sandy material. This approach controls the environmental impacts of dredging activities and provides better substrate conditions for benthic community development (Urban Harbors Institute, 2000).

The port authority of New York and New Jersey, United States, forwards all sediments resulting from dredging activities to a disposal site located on a platform off-shore where dredged material is screened to separate debris from sediments. Uncontaminated sediments are pumped to an on-shore site where they are mixed with cement kiln dust to enhance their compressive strength. This sediment mixture is then used for the construction of a parking lot of 24 hectares at the Jersey Gardens mall in Elizabeth, New Jersey. Debris is buried in approved land disposal sites (Port Authority of New York and New Jersey, 2004).

The port authority of San Diego, California, United States, built a small scale processing plant to process highly contaminated copper sediments. The port authority adapted the copper extraction system used at the mines to perform remediation of the dredged sediment issue. Sediments underwent a two-stage

process: sediments were physically separated into different size fractions and in a second stage of remediation the sediments were treated chemically and the copper was recycled. The port authority then reused the onsite uncontaminated sediments onsite as fill (Urban Harbors Institute, 2000).

The port authority of Brisbane, Australia, uses a two kilometres long pipeline to transport dredged materials to the airport to meet terminal expansion needs. Sediments are deposited in a drying basin, where their level of contamination is evaluated, before being used as construction material (http://www.portbris.com.au/asp/media/publications/annual_report/ar/pbc-ar2002-2003.pdf).

The port authority of Geraldton, Australia, uses dredged materials essentially composed of limestone to build off-shore artificial reefs, in partnership with the local lobster fishing industry (URS AUSTRALIA PTY LTD, 2002).

The company Folsom Marine Service Corp at the port of Plymouth, United Kingdom, uses a "Mud Cat" machine to remove sediment from the underwater floor without stirring up the water and destroying plant life. The machine works with a spiral auger which scrapes the bottom and sucks in sediment without first putting it in suspension in the water (http://www.mudcat.com/flyash/public-service-7.html)

4.3.3 Contaminated soil

4.3.3.1. Issue

Land management is a major concern for port authorities. Technological progress and changes in the type of freight handled have rendered many sites obsolete. For the past three decades, port sites, often located at the heart of cities, are coveted for urban development. More importantly, land requirements are prompting port authorities to seek greenfield sites often located beyond urban fringe, far from the existing port facilities. Soil contamination represents a major economic and financial issue for the marine industry.

4.3.3.2. Problem

The development of abandoned or under-used sites requires careful evaluation in relation to the perceived or real contamination level by toxic substances. The contamination level increases the costs and problems of redevelopment.

4.3.3.3. International legislation

There is a strong movement to integrate sol quality in global sustainable development strategies. In 1982, the United Nations Environment Program (UNEP) prepared and adopted a world soils policy to complement the action plan to combat desertification processes. The plan received was supported by

the Creation of the World Soil Charter by the Food and Agriculture Organization of the United Nations (FAO) that aims at strengthening international cooperation for the rational use of world's soil resources.

In 1992, the Rio treaty makes reference to the multiple soil functions and its role in greenhouse gases exchanges via the atmosphere.

In 1999, the importance of soil in any sustainable development strategy became a subject of European concern with the Bonn Memorandum on soil protection policies within the European Union and the creation in 2000 of the European Soil Forum (ESF) whose role is to link policy makers with soil scientists to improve soil protection.

While there is no international legislation on soil protection, evidence shows that the problem of contaminated soils has given rise to several international groups. CLARINET (Contaminated Land Rehabilitation Network for Environmental Technologies) is a concerted action within the environment and climate program of the European Commission, and is coordinated by the Austrian Environment Agency. CLARINET brings together the combined knowledge of academics, government experts, consultants, industrial land owners and technology developers. CLARINET provides a thematic network on interdisciplinary research through the integration of technological, social and economic dimensions for contaminated soil management. The funding for the research activities comes from the participating countries' environmental agency budget (http://www.clarinet.at/). NICOLE (Network for Industrial Contaminated Land in Europe) is a group of enterprises and university institutions formulating technical recommendations for site remediation (www.nicole.org). NICOLE is funded by membership.

4.3.3.4. Selected sustainable development practices

Our survey suggests that the best practices are based on remediation of sites where contaminated soils are biologically and chemically treated before being recycled as construction materials or used on site as fill.

Examples

The port authority of Chicago, Illinois, United States, converted a landfill into a 185 hectares golf course along Lake Calumet. The land owned by the port authority was used for over 20 years by the municipality as a solid waste landfill to dispose of incinerator ash and waste water sludge. When the contract expired, the port authority was responsible for capping and securing the landfill as directed by the Illinois Environmental Protection Agency. The project involved: 1) blending waste water biosolids with treated sludge; 2) modifying the soil chemistry through a mixture of different types of soil; 3) capping 85 hectares of landfill with 60 centimetres of clay to minimize the risk of contamination; 4) designing a landscape environment avoiding damage to

the underlying clay cap; 5) creating drainage and irrigation systems to prevent infestation of harmful aquatic organisms and pathogens that could contaminate local plant and animal life biodiversity (Urban Harbors Institute, 2000).

The port authority of Long Beach, California, United States, covered the costs of an ambitious remediation program for a 12-hectare site contaminated by oil and gas. The operation involved: 1) excavating contaminated soil from the waste disposal sump to depths below the groundwater table; 2) filling the excavated sump with clean soil; 3) stabilizing the chemical elements of the contaminated soil removed by drying and mixing with cement and other construction materials; and 4) placing the decontaminated soil in a layer above the clean fill (Urban Harbors Institute, 2000).

The port authority of Seattle, Washington, United States, converted 73 hectares of contaminated landfill into a container shipping terminal and intermodal rail yard. The project involved rehabilitating five contaminated sites by cleanup and redevelopment. Contaminated sediments were removed and forwarded to a submerged site, on the coastal fringe. The site was then filled with clean sediments. This has provided 8 hectares of new marine habitat (Urban Harbors Institute, 2000).

The port authority of Vancouver, Washington, United States, used formerly contaminated soil as embankment fill in the port's main entrance. Part of the port area was contaminated with trichloroethylene, a toxic chemical used as an industrial solvent. The soil was treated and cleaned with soil vapour extraction technology (Urban Harbors Institute, 2000).

The port authority of Sydney, Australia, recycled all waste materials from the demolition of a disused railway embankment for former wheat silos, including 34 000 tonnes of sandstone material, to answer the need for construction materials for port expansion projects (http://www.sydneyports.com.au/Mediaroom/pdf/Environreport.pdf).

The port authority of Houston, Texas, United States, recycled wood palettes and used them to build fences and office furniture and as construction materials for prisons (Urban Harbors Institute, 2000).

The construction company Gammon from Hong Kong, China, has undertaken the site remediation of a former shipyard on Northern Tsing Yi Island in Hong Kong. The project has allowed the extraction of heavy metals and a reduction in the amount of money spent on cement of 30%.

4.3.4. Odours

4.3.4.1. Issue

Ports are important areas for the location of industrial manufacturing activities, which are important generators of employment. They are also an essential link in the transport chain, since they are the source of important land traffic movements. On account of their high level of accessibility, port industrial areas are increasingly considered as suitable sites for the establishment of waste management plants. Besides, port expansion needs are often fulfilled by the creation of a dump for discarded materials close to port infrastructures.

4.3.4.2. Problem

Sectors located close to ports can be disturbed by the negative effects of odours emanating from products handled in the ports or smoke emissions from different port activities, exposing the population to harmful gases.

4.3.4.3. International legislation

There are no international agreements or laws concerning negative externalities in terms of odours. Remediation measures of negative externalities from odours on port sites generally depend on air quality control programs or local regulations on air pollution.

4.3.4.4. Selected sustainable development practices

Our survey suggests that the best practices in this field are linked with joint measures for enhancing air quality and reducing harmful effects of dust and noise.

Examples

In Australia, regulations governing port environmental impact studies require the integration of the harmful effects of odours in environmental impacts (http://www.freport.wa.gov.au/About/environ/index.aspx?section=4).

The port authority of Bunbury, Australia, lists odours under its air quality strategy. Management prescriptions are similar to the dust management strategies. Strategies aim at minimizing the impact of harmful odours by cleaning berths and where appropriate, roadways of product as soon as possible after product handling is completed (http://www.byport.com.au/docs/environmental.pdf).

The air quality plan of the port of Nelson, New Zealand, addresses odours by suggesting that port activities should not give rise to unreasonable adverse effects which compromise the amenity of adjacent properties, services and

zones, such as undue levels of noise, smell, traffic or dust. Complaints about odour comprise about 30% of all complaints received by the port (www.ncc.govt.nz/environment/SOE/SOE_01/SOE_01.pdf).

The Hanjin and California United terminals at the port of Long Beach, California, United States, have installed diesel oxidation catalysts which reduce odour, noise, carbon monoxide, hydrocarbons and particulates in exhaust (http://www.polb.com/html/4_environment/airquality/AltFuels.html).

The presence of noxious odours at the port of Fremantle, Australia, has led the port authority to start a process to identify a buffer zone in order to reduce deleterious impacts on the surrounding population (http://www.freport.wa.gov.au/About/environ/index.aspx?section=4#buffer_study).

4.4. Environmental issues specific to shipping lines

4.4.1. Ship recycling

4.4.1.1. Issue

There are numerous advantages inciting ship-owners to prolong the life cycle of ships which no longer correspond to existing standards. These ships allow carriers to forward goods at cheaper costs. In sharp contrast, any movement to remove these vessels from shipping services leads to an unavoidable increase in freight transport tariffs.

4.4.1.2. Problem

There are numerous ways in which ships interact with the environment. Several ship-owners are irrespective of international regulations and forward dry bulk and petroleum on substandard ships. In the context of environmental protection and safety, the quality of the ships in operation tends however to become an important competitive factor on global markets. The aging of the world fleet thus raises the issue of ship recycling. Ship hulls may contain hazardous substances such as asbestos, heavy metals, hydrocarbon and products depleting the ozone layer. In addition, the disposal of hazardous materials during ship recycling can contaminate the soil. Given the strictness of environmental regulations and labour safety laws in industrialized countries, the dismantling of ships is often undertaken in countries where legislation is less restrictive in these matters such as China, India, Bangladesh and Pakistan.

4.4.1.3. International legislation

The Basel Convention on the “control of transboundary movements of hazardous wastes and their disposal” entered into force in 1992. Its main

objectives are to: 1) ensure that the generation of hazardous waste is reduced to a minimum; 2) dispose of hazardous waste within the country of their generation; 3) establish enhanced controls on imports and exports of hazardous waste; 4) prohibit shipments of hazardous wastes to countries lacking the legal, administrative and technical capacity to manage and dispose of them in an environmentally sound manner; and 5) cooperate on the exchange of information, technology transfer and the harmonization of standards, codes and guidelines. The Convention establishes a list of the categories of wastes to be controlled and mentions procedures for their transboundary movements. The Basel Convention has also adopted guidelines on the environmentally sound management of ship recycling. It is important to underline that these guidelines match the requirements adopted by the International Labor Organization (ILO) on safety and health in shipbreaking.

In 2003, the International Maritime Organization (IMO) adopted Resolution A.962(23) concerning “IMO guidelines on ship recycling”. The main objectives of these guidelines are to: 1) encourage recycling as the best means to dispose of ships at the end of their operating lives; and 2) provide guidance in respect of the construction of ships that facilitate recycling and minimize the use of hazardous materials and waste generation during a ship’s operating life. In addition, the Resolution formulates the concept a “green passport” for ships. This document provides information with regards to materials utilized in the construction of the ship that are known to be potentially hazardous for human health and the environment. The document would accompany the ship throughout its operating life. Successive owners of the ship should maintain the accuracy of the information contained in the “green passport”, and incorporate into it all equipment changes, with the final owner delivering the document, with the ship, to the recycling facility. In March 2004, IMO mandated the Marine Environment Protection Committee (MEPC) to determine appropriate measures for the entry into force of these guidelines.

4.4.1.4. Selected sustainable development practices

Our survey suggests strong concern within the shipping industry for ship recycling. The best practices are based on an assessment of the risks presented by substandard ships and the legal responsibilities of ship-owners. The best practices focus on establishing a ship quality index, increasing the number of ship inspections in ports of call and building ships in a way that facilitates safe and environmentally sound recycling.

Examples

The European Commission has established a black list of 66 ships under 13 shipping registries considered as being inadequate because they do not respect existing international maritime standards and legislation. The Commission wishes to convince shipping lines to avoid chartering these

vessels (Commission européenne, 2002). The list is available on the Internet at the following address: http://www.shipgaz.com/english/facts_statistics/2003/030207_banned_ships_eu.pdf.

The shipping company Wallenius Lines, Sweden, has elaborated a two-prong inventory system. First, the environmental impact is measured at the ship's design stage when the carrier adopted a material choice policy that considers the life cycle of all materials used and their environmental impact. Second, there is a need to measure the environmental impact in terms of fleet operation; each vessel must provide information related to engine functions – fuel consumption and air pollutant emissions –, maintenance services – waste production, bilge water disposal, use of chemical products – shipping operations – use of antifouling paints, release of ballast water – fire protection and air-conditioning systems – greenhouse gas emissions (Wallenius Lines, 2003).

The company Wallem Ship Management (WSM), of Hong Kong, manages more than 20 vessels for the Japanese shipping line Nippon Yusen Kaisha (NYK). The company has elaborated a unique system of ship management. The system uses an Internet tool establishing a joint assessment for each ship under Liberian International Ship & Corporate Registry (LISCR), Lloyd's Register (LR) and Wallem Ship Management (WSM). The management system consolidates each vessel's operational conditions within a single report covering the ship's operating life.

4.4.2. Hazardous materials

4.4.2.1. Issue

One of the most important maritime trade activities concerns the movement of heavy chemical products, including sulphuric acid, phosphoric acid, nitric acid, caustic soda, hydrochloric acid, ammonia, alcohol, animal and vegetable oils and fats, petrochemical products and coal-tar products. The main issue is for shippers to avoid accidents and to answer the quality standards fixed by the International Maritime Organization (IMO).

4.4.2.2. Problem

Amendment 2 of Annex 2 of the MARPOL Convention refers to the International code for the construction and equipment of ships carrying dangerous chemicals in bulk (IBC Code), which identifies more than 250 noxious liquid substances having an impact on marine resources, public health and port site attractiveness. As a result, there are numerous elements to consider or guidance documents to complete.

4.4.2.3. International legislation

Annex 2 of the MARPOL Convention of the International Maritime Organization (IMO) on the "regulations for the control of pollution by noxious liquid substances in bulk" was ratified in 1983. Annex 2 provides guidelines for the design, construction and operational requirements of chemical tankers as well as the discharge conditions for noxious liquid substances as a result of shipping activities, tank cleaning or deballasting operations and procedures for the prevention of accidental discharge at sea. In addition, Annex 2 details the measures for the control, treatment and disposal of wastes from chemical tankers at a discharge port. Several amendments have been incorporated into Annex 2 to reflect technological evolution and knowledge improvement concerning the impact of chemical products on the marine environment.

Annex 3 of the MARPOL Convention of the International Maritime Organization (IMO), relating to "regulations for the prevention of pollution by harmful substances carried by sea in package forms", was ratified in 1992. The objective of the Annex is to identify these substances based on their physical, chemical and biological properties. The International Maritime Dangerous Goods (IMDG) Code adopted by IMO lists hundreds of specific dangerous goods, many of which are identified as marine pollutants. The regulations contained in the Annex state the detailed standards on packaging, marking, labelling, documentation, stowage and the quantity limitations on board ships for preventing or minimizing accidental pollution by harmful substances and facilitating recovery by using clear and specific marks to distinguish them from other cargoes.

4.4.2.4. Selected sustainable development practices

Our survey reveals that the best practices are all integrated within the framework of the International Maritime Dangerous Goods (IMDG) Code adopted by IMO. Some of these practices integrate the IMDG Code through advanced training of crew aboard ships, while others respect the Code through best practices targeted at improving the quality of ships in operation.

Examples

The shipping company OOCL, Hong Kong, China, has an environmental goal to handle hazardous cargo to avoid any leakage of materials. It has strict guidelines and procedures for handling hazardous cargoes, enforced by senior managers, who are assigned the role of safety officers. Procedures are also in place to control acceptance of Dangerous Goods, which must comply with all international, national regulatory requirements. Besides, OOCL has developed an in-house web-based training website called "DGSmart", to ensure that all required staff are familiar with the International Maritime Dangerous Goods (IMDG) Code
(http://www.oocl.com/company_profile/environmental.htm).

V.Ships use of the UN HAZMAT policy (IMDG) is required, and ensures compliance with state and international regulations (http://www.vships.com/img/pdfs/Environmental%20Report.pdf).

The company also has a specific objective to complete MARISEC Annex 2 Inventories of hazardous materials for their managed vessels that are over 15 years old (http://www.marisec.org/resources/shiprecylcing-inv-hazardous.pdf).

In 2004, the port authority of Manila, Philippines inaugurated a control area to ensure the safe handling of dangerous goods. The terminal operating system is conceived to shorten delays and prevent unnecessary movement of hazardous materials in the port area. The yard also contains a U-ditch where chemical spillage can be properly washed and recouped in a chemical holding tank. It also features a buffer area 45 meters away from the sea to prevent sea water from contaminating containers during storms or the rainy season.

4.5. Conclusion

The information provided by web sites confirms the idea that the environment represents a growing concern for port authorities and shipping lines.

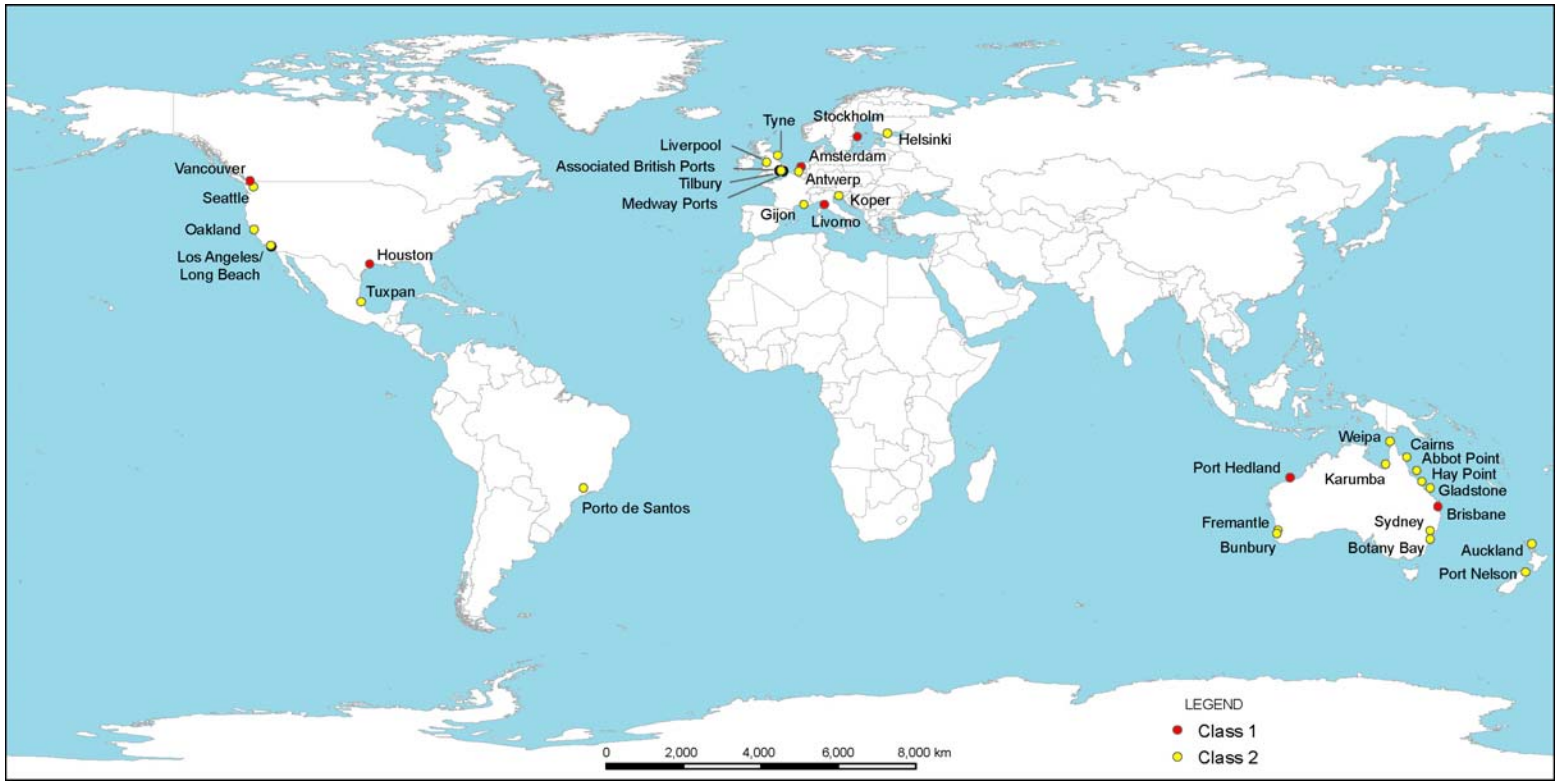
The global overview of sustainable development strategies for port authorities and shipping lines suggests numerous practices of sustainable development. The best practices appear to be found in the world's busiest ports either in developed or emerging economies.

There are some champions within the maritime industry whose practices are clearly at the forefront of contemporary concerns of sustainable development. At the international level, the port authorities that demonstrate the best quality of environmental leadership are in Australia and Northern Europe and on the West Coast of North America (Table 9) (Map 5).

Table 9 Port authorities with the best environmental performance, 2004

Class	Port	Internet address
1	Amsterdam	http://www.portofamsterdam.com/smartsite.dws?id=4
1	Brisbane	http://www.portbris.com.au/
1	Houston	http://www.portofhouston.com/
1	Livorno	http://www.portauthority.livorno.it
1	Port Hedland	http://www.phpa.wa.gov.au/
1	Stockholm	http://www.portofstockholm.com/
1	Vancouver	http://www.portvancouver.com/
2	Abbot Point	http://www.pcq.com.au/2004/ports_abbotpoint.cfm
2	Antwerp	http://portofantwerp.be/
2	Associated British Ports	http://abports.co.uk/
2	Auckland	http://www.poal.co.nz/
2	Botany Bay	http://www.sydneyports.com.au/portfacilities/main.asp?pageid=157
2	Bunbury	http://www.byport.com.au/
2	Cairns	http://www.cairnsport.com.au/
2	Fremantle	http://www.fremantleports.com.au/
2	Gijon	http://www.puertogijon.es/
2	Gladstone	http://www.gpa.org.au/
2	Hay Point	http://www.pcq.com.au/2004/ports_haypoint.cfm
2	Helsinki	http://www.hel.fi/port/english/
2	Karumba	http://www.pcq.com.au/2004/ports_karumba.cfm
2	Koper	http://www.luka-kp.si/
2	Liverpool	http://www.portofliverpool.co.uk/
2	Los Angeles	http://portoflosangeles.org/
2	Medway ports	http://www.medwayports.com/
2	Oakland	http://www.portofoakland.com/
2	Port Nelson	http://www.portnelson.co.nz/
2	Porto de Santos	http://www.portodesantos.com/index_i.html
2	Seattle	http://www.portseattle.org/
2	Sydney	http://www.sydneyports.com.au/home.asp
2	Tilbury	http://www.forthports.co.uk/ports/tilbury/
2	Tuxpan	http://tuxpanport.com.mx/
2	Tyne	http://www.portoftyne.co.uk/
2	Weipa	http://www.pcq.com.au/2004/ports_weipa.cfm

Map 5 Port authorities with the best environmental performance, 2004



Class 1: Uses a certified environmental management system, mentions environmental impact of its activities, has an environmental policy, presents sustainable development objectives and publishes an annual report pertaining to sustainability;
Class 2: Uses a certified environmental management system, has an environmental policy, mentions environmental impact of its activities, publishes a report.

Among the shipping lines with the best practices are MOL and NYK in Japan, P & O Nedlloyd in the United Kingdom and Wallenius Lines in Sweden (table 10) (map 6).

Table 10 Shipping lines with the best environmental performance, 2004

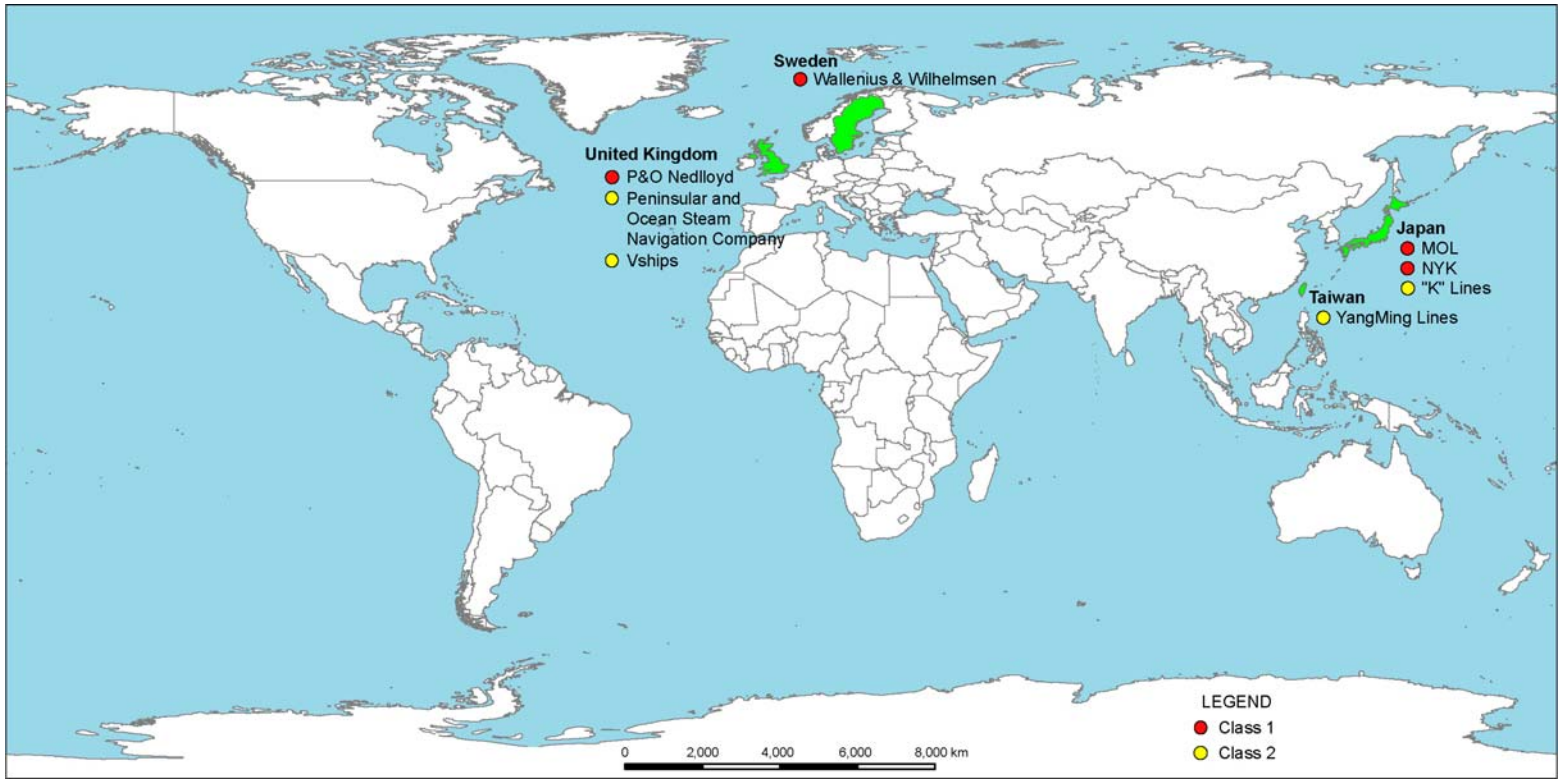
Class	Marine carrier	Internet address
1	Mitsui OSK Line	http://www.mol.co.jp/research_e.shtml
1	Nippon Yusen Kaisa	http://www2.nykline.com/home/index.html
1	Peninsular & Oriental Nedlloyd	http://www.ponl.com/
1	Wallenius & Wilhelmsen	http://www.2wglobal.com/www/WEP/index.jsp
2	K Line	http://www.kline.co.jp/index_e.html
2	Peninsular and Ocean Steam	http://www.portal.pohub.com
2	V.Ships	http://www.vships.com/
2	Yang Ming Line	http://www.yml.com.tw/index.asp

Obviously, port authorities and shipping lines recognize that they have a role to play in sustainable development strategies.

The marine industry is aware of the comparative advantage of navigable waterways in a context where maritime transportation is perceived as a solution to the environmental problems engendered by land transportation.

This situation underlines the interest of examining sustainable development policies favouring a greater usage of short sea shipping.

Map 6 Shipping lines with the best environmental performance, 2004



Class 1: Uses a certified environmental management system, mentions environmental impact of its activities, has an environmental policy, presents sustainable development objectives and publishes an annual report pertaining to sustainability;
Class 2: Uses a certified environmental management system, has an environmental policy, mentions environmental impact of its activities, publishes a report.

5. SHORT SEA SHIPPING

Despite the important environmental consequences associated with water transport, its environmental impacts are lower when compared to other transport modes.

Water transport is seen as a mode that can provide more environmentally sustainable solutions to many of the problems brought about by the growth of transport use by society. Upon more detailed examination, however, such a view requires elaboration. Shipping is a complex industry, and inevitably in such a complex structure significant differences produce a widely different set of environmental challenges and opportunities. At the same time, the opportunities and means to promote greater use of water transport differ considerably. Before exploring the issues specifically related to inland and coastal shipping it is necessary to define the terms. We will then assess the importance of coastal and inland shipping. This overview is followed by an examination of the legal, technological and economic challenges confronting short sea shipping.

5.1. Typology of shipping

Water transport is the most important mode of transport globally, transporting more cargo across the world than any other mode. The industry is not homogeneous, however. It is generally divided into several largely separate sectors:

1. Deep-sea international shipping – transport of cargo mainly between trading blocs, and usually involves trans-oceanic movements.
2. Coastal shipping – transport of cargo in enclosed seas and along coasts, frequently within the confines of one country.
3. Inland shipping – transport of cargo along rivers and lakes.
4. Cruise shipping – transport of vacation passengers for set periods of time that may involve several ports of call.
5. Ferries – transport of freight and passengers between two points
6. Recreation boating – use of pleasure craft for recreation purposes.

Cruise shipping can involve deep-sea, coastal and inland dimensions, and ferries can be seen to be part of coastal shipping. Here we focus on coastal shipping and inland navigation for both freight and passengers. They compete for traffic with land transport modes and are usually under more regulatory control by national and regional political agencies than deep-sea shipping.

5.2. Short sea shipping: some definitional issues

As with many other parts of the shipping industry, coastal and inland navigation is poorly defined and subject to many problems of data specification and jurisdictional responsibility (Musso and Marchese, 2002).

5.2.1. Scale and geographic scope

It is frequently assumed that the network structure of these sectors is more restrained than deep-sea shipping, and that average line-haul is much shorter. The typical Great Lakes-Saint Lawrence River shipping routes belies this assumption, a trip from the Lakehead, Ontario to Sept-Iles, Québec is longer than many deep-sea routes. For example from Sept Iles, Québec to Duluth, Minnesota involves 1,585 nautical miles, while an intercontinental voyage from Miami to Panama is 1,200 nautical miles.

5.2.2. Size and type of vessels

It is frequently assumed that coastal and interior shipping deploy smaller vessels than their deep-sea counterpart. Again this may be true to some degree, but there is no precise distinction, and inland vessels may be many times larger than deep-sea ships. At the same time the types of coastal ships vary enormously from self-propelled to gearless, and from freighters to bulk carriers to RoRo ships. Lake vessels deployed on the St Lawrence Seaway have capacities of up to 26,000 net registered tons, while many deep-sea general cargo ships have capacities of less than 5,000 tons.

5.2.3. Functions

Just as deep-sea services are made up of many types of function, so coastal and inland shipping comprises many different activities. These range from feeder services, liner services, tramp, and vessels under private charter, and may include cargo types of enormous diversity. Ferry ships involve a wide range of size, speed, and type. These three distinctions indicate that there is no unique type of inland and coastal shipping activity, that the differences are blurred between them and other sectors of the shipping industry.

5.2.4. Scope

The term “cabotage” is sometimes applied to short sea shipping, but it has very specific regulatory implications, implying a trade that is restricted to national

carriers. It is normally typified by the exclusion of foreign vessels from engaging in traffic between two domestic ports. This has its equivalent in the airline industry where cabotage refers to the Eighth Freedom established under the Chicago Convention of 1946.

In Europe there are ambiguities between the terms “coastal” and “short-sea” shipping. A report by the European Conference of Ministers of Transport referred to coastal shipping as involving movements between ports in adjacent countries, while in the United Kingdom the term coastal is applied to movements exclusively within the British Isles. Even with reference to short sea shipping there are ambiguities.

The European Commission defines short sea as the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe (Commission européenne, 1999). On the other hand the European Short Sea Network defines short sea shipping as the waterborne transport of cargo and passengers by sea or inland waterways as part of the logistic transport chain in Europe and the regions connected to Europe. This includes waterborne transport in geographical Europe, either intra-EU and or transport between EU and third countries, for example on the Mediterranean or on the Black Sea (www.shortsea.info/).

In the United States, MARAD does not define short-sea shipping, although in a recent publication it identifies short-sea shipping as a policy objective in trying to reduce road congestion and alleviating air pollution (www.marad.dot.gov/Programs/shortseashipping.html).

The United States also reveals some of the ambiguities, where services between mainland United States and Hawaii and Puerto Rico are considered as domestic, while a much shorter service across Lake Ontario between the United States and Canada is regarded as international.

5.3. Inland and coastal traffic

There are significant disparities between different regions and the success of coastal and inland traffic. Europe appears to be a success story. According to a recent European Union report, 68% of all sea-borne goods handled in the European Union in 2000 were handled by short-sea shipping. There was a widespread distribution throughout the Community, with one third of the total carried in the Mediterranean and a similar proportion in the North Sea, the remainder in the Atlantic, and the Baltic and Black Seas (Xenellis, 2003). Short sea shipping was the only sector in Europe during the decade of the 1990s to keep pace with the growth of road transport growing by 38% compared with 40% for road transport. In terms of tonne-kilometres short sea shipping and road transport have a virtually equal market share, 41% versus 43% respectively. Inland water transport in the European Union currently

accounts for 7% of the total market, and has remained stable over the last decade.

In the United States water transportation is highly significant, although its market share and actual volumes have declined recently. Truck transport has been the big gainer (table 11).

Table 11 Freight traffic in the United States by mode, 1965-2000 (ton-miles)

	1965	1975	1985	1995	2000
TOTAL (ton-miles of freight)	1,854,034	2,284,706	2,949,410	3,648,036	3,778,042
Domestic air carrier	1,353	3,470	5,156	12,520	14,983
Intercity truck	359,000	454,000	610,000	921,000	1,074,000
Class 1 rail	697,878	754,252	876,984	1,305,688	1,465,960
Domestic water transport	489,803	565,984	892,970	807,728	645,799
Coastwise	302,546	315,846	610,977	440,345	283,872
Lakewise	75,918	68,517	48,184	59,704	57,879
Internal	109,701	180,399	232,708	306,329	302,558
Intraport	1,638	1,222	1,102	1,350	1,490
Oil pipeline	306,000	507,000	564,300	601,100	577,300

Source: http://www.bts.gov/publications/national_transportation_statistics/2003/index.html

Trucking is dominant for higher value goods. Water transport is the mode that is oriented towards low value bulk commodities (table 12).

Table 12 Freight transport activities by mode, value and volume in the United States, 1993-2002

	2002 (US$ billion)	Percent change (1993-2002)	2002 (millions tons)	Percent change (1993-2002)	2002 (billion ton -miles)	Percent change (1993-2002)
TOTAL all modes	8,483.10	45.1	11,572.80	19.4	3,204.40	32.4
Total single mode	7,052.90	42.7	10,878.10	21.9	2,913.00	36.3
Truck	6,200.50	40.8	7,622.30	19.4	1,311.10	50.8
For-hire	3,838.50	46.2	3,666.00	30.5	1,001.50	59.2
Private	2,340.30	33.3	3,920.50	10.6	302	28
Rail	320.5	29.5	1,816.50	17.6	1,199.40	27.2
Water	90.9	47.5	713.9	41.2	323.1	18.8
Shallow draft	56.5	38.7	499.7	37.9	236.6	44
Great Lakes	0.8	n.a.	39.5	19.5	19.5	57.7
Deep draft	33.6	70.3	174.7	58.9	66.9	-29.7
Air (includes truck and air)	279.5	100.9	3.9	24	5.6	38.7
Pipeline	161.6	79.9	721.6	49.2	n.a.	n.a.
Total multimodal	1,111.00	67.7	198.5	-12.1	214.8	12.2
Postal service and courier	1,022	81.4	26.4	40	20.5	56.2
Truck and rail	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Truck and water	17.1	81.6	31.8	-53.2	59.1	45.6
Rail and water	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Other multiple modes	5.5	71.9	28	48.1	19.6	n.a.
Total other transport modes	319.2	31.8	496.2	-8.2	76.6	-17.3

Source: http://www.bts.gov/publications/national_transportation_statistics/2003/index.html

In both the European Union and the United States, short sea shipping has been identified by policy makers as a sector to be promoted. The reasons are based on economic and environmental grounds. Economic arguments favouring coastal and inland transport are based on the costs of road congestion. The expansion of road traffic is placing pressures everywhere for new highway construction and expensive remediation measures to overcome congestion. Estimates of the present congestion costs indicate the tremendous burden on the economy of countries. Water transportation is seen as a means of somewhat alleviating these pressures. It has been demonstrated that a standard 15-barge unit hauls the equivalent amount of cargo as 225 rail wagons or 870 trucks (COOSA, 2004).

The environmental grounds for favouring coastal and inland navigation are based on lower energy consumption rates of shipping and the general overall smaller externalities of water transportation. Figures produced by the United States Marine Transportation Advisory Board (MTSNAC) are very approximative, but indicate that the distance covered to move one cargo ton with 3.785 litres varies from 857 kilometres for inland water transport to 337 kilometres by rail and 98 kilometres by truck (MTSNAC, 2001).

5.4. Operational challenges confronting short sea shipping

The fact that public authorities are being called in to promote water transportation indicates that the system faces difficulties, despite its purported economic and environmental advantages. These problems need to be addressed if short sea shipping is to be supported and promoted by state actions. A number of studies have revealed a wide range of impediments to the expansion of this mode.

5.4.1. Regulatory issues

5.4.1.1. General factors

In North America, as elsewhere, one of the major impediments to the further development of coastal shipping is the limit on cabotage. In the United States the Jones Act (1920) is widely recognised as a serious constraint. Limiting traffic between two United States ports to ships United States-flagged, United States-built and manned by United States citizens results in the inevitable high cost of short-sea shipping. A study in 1993 suggested that the net cost of the Jones Act to the United States economy was US$ 4.4 billion per year (Hufbauer and Elliot, 1993).

An attempt by Canada to exempt Canada-United States trade from the restrictions of the Jones Act failed, and thus Canadian coastal shipping cannot trade between United States ports. In Canada the restrictions on cabotage are similar, although the restrictions are based on Canadian ownership rather than the flagging of the vessels. Foreign ships can trade between Canadian ports under waiver, when no Canadian owned vessel is available. The restrictions on cabotage in North America are not unique

Since the creation of the European Union, the former national restrictions in much of Europe have been lifted and trade between all European Union nations is open to European shipping companies, and is probably one of the causes of the recent expansion of short-sea shipping. Trade within the European Union itself is closed to foreign ships.

In South America, the United Nations Commission for Trade and Development, (UNCTAD) and the Economic Commission for Latin American and the

Caribbean (ECLAC), have been energetically urging the removal of barriers to short sea shipping between countries, and the MERCOSUR trading group now has an open policy for short sea shipping between Brazil, Argentina, Paraguay and Chile, as does the CARICOM trade grouping in the Caribbean.

New Zealand presents an interesting case. In 1995 the New Zealand government removed many cabotage restrictions in its move to deregulate the shipping industry. This was part of that country's massive reforms that sought to open the economy to international competition. Prior to 1995 New Zealand's cabotage rules were similar to those of Canada. Foreign vessels could only lift cargoes between two New Zealand ports with ministerial permission, when no local vessel was available. In 1995 foreign vessels were allowed to trade within New Zealand only if they were delivering imports or picking up exports. It was not a complete removal of cabotage regulations, but it opened up the trade to much greater competition. In 2000, in response to a declining New Zealand ship registry, the government commissioned a study to investigate whether cabotage regulations should be introduced to support the local industry (Cavana, 2004). After investigation, the study concluded that because freight rates had declined since 1995, the country's economy would likely suffer by re-introducing restrictions on foreign ships with regards to short sea shipping, although it might lead to gains for the national shipping industry. This brings to light an important issue: protection might sustain a locally-based coastal industry, but tends to weaken the competitive position of shipping compared with other modes. The remarkable growth of international shipping through cost reduction and operational efficiencies have come about in part because that sector of shipping is far less regulated.

5.4.1.2. Specific issues

A wide range of more specific factors have been identified as limits on short-sea shipping.

Tax legislation

There are differential taxes on companies that operate foreign and domestic shipping services. In New Zealand, for example, the foreign carriers engaged in coastal traffic do not pay the New Zealand taxes and compliance costs borne by the domestic carriers (Cavana, 2004). Duties must be paid in Canada for the purchase of foreign-built ships to be used on domestic services (Brooks, 2003).

Documentary procedures

Documentary procedures for short sea shipping are complex, particularly when trade between countries is involved, as for example in Europe. The European Union Commission has identified 50 different forms in use in Europe. This compares with the much simpler documentation involved in trucking. M. Jan

Bouman, senior logistics manager of Hankook Tire in Rotterdam, summed up this position: “If we have traffic to send to the United Kingdom or southern Italy, it is so easy to call up one of our preferred trailer operators, fix a pick-up and delivery time, and process the necessary documentation. With short sea operators, everything is more complicated and less frequent. What you need to bear in mind is that most shipping departments, such as ours, now work with much fewer people than before, so just can't handle a lot of administration” (Containerisation International, 2003).

Tolls on canals

Tolls on canals, such as the Kiel Canal between the Baltic Sea and the North Sea increase the costs of operation, and represents a user charge the trucking industry does not face.

5.4.2. Intermodal integration

Pricing information

There are significant difficulties in obtaining price information on short sea shipping as compared to road or rail. This is due to the lack of intermodal harmonization between operators delivering and receiving goods at the ports and the maritime transport operator (Taylor 2003). Coastal shipping operators see themselves as unique providers of service between two ports rather than as links in intermodal chains

Complexity of intermodal operations

Water transportation has a poor service image compared with other modes. It is still seen as a segmented industry (de la Lastra, 2003). Its reliability is questioned in many surveys of the industry (Zigic and Bison 1999). It is perceived as a complex system involving many actors – forwarders, terminal operators, different labour unions, land carriers, etc. (Paixao and Marlow (2002). Many short sea shipping companies are too small to operate total logistics chains and they are characterised by individualism that makes it difficult to cooperate with others in the industry (Saldhanha and Gray 2002

5.4.3. Physical constraints

Speed

Short sea shipping is perceived as a slow mode, and inappropriate for just-in-time delivery systems. This constraint is not just because of the inherent slowness of vessels, but is compounded by delays in ports. Transit times are cited in surveys more than any other factor as a major problem. Because of this it is claimed that shippers expect rates to be at least 35% lower than other modes to offset increased inventory costs (Paixao et Marlow, 2002).

Weather

Climate is an important constraint on short sea shipping in many regions. Thus navigation along the entire north-east coast of Russia requires icebreaker assistance eight months of the year. These constraints do not permit the rapid development of these maritime routes as commercial arteries. Seasonal limits on navigation in the Gulf of Finland Baltic and Sea of Azov are other examples that require users to seek alternate modes and routes. This constitutes a significant disruption in supply chains and affects industrial production. Other weather events such as fog and hurricanes may not have the same temporal effects, but nevertheless may cause problems for customers who are shipping time-sensitive goods.

5.4.4. Ports

Treatment by port authorities

Coastal shippers frequently complain that they are treated as second-class users, because the port authorities favour deep-sea carriers. There is a strong tendency in the port industry to lease or sell terminals to large corporations, including shipping lines that give priority to the large capacity users. This translates to delays in berthing, so that coastal vessels may have to wait many hours for berths, or are allocated to berths that are not well equipped. This is particularly problematic for container feeder services.

Port delays

Ports are seen as blockage points, where delays are encountered at all stages in the passage of cargo: arrival, storage, actual handling and onward distribution. Shippers see ports as obstacles to just-in-time business (Saldhanha and Gray 2002). The amount of time goods spend in port may be longer than the actual transit time because of problem within the port logistics chain.

5.4.5. Economics

Assigning benefits

If coastal shipping produces economies, who benefits? It is not clear where the savings will be realised – the carrier, the cargo owner or the consumer? (Brooks 2003). Thus it is hard to determine who should invest to make the necessary improvements to enhance the efficiency of coastal shipping.

Risks

The capital cost of a ship is so much greater than a truck. Therefore, the risk undertaken by a coastal shipping owner is much greater than that of the trucker for issues such as capital cost, amortization, capital cost allowances, and taxation (Weisbrod 2002, quoted in Brooks 2003). In uncertain or competitive market situations ship owners have a much greater risk undertaking than truck owners

5.5. Conclusion

The process of developing sustainable transport thus implies a constant adjustment of the equilibrium between the needs and practices of the maritime industry and social, economic and environmental conditions; it is a process that is both necessary for their individual evolution and their mutual impacts.

Short sea shipping is recognised for its superior environmental performance, and hence is an important instrument in promoting sustainable transportation.

The principal question is how may short sea shipping be promoted so as to achieve this goal?

6. INTERNATIONAL PORTRAIT OF THE POLICIES TO PROMOTE SHORT SEA SHIPPING

Short sea shipping is seen as a substitute for road transport where navigable waterways are available. This type of maritime transport already accounts for an important market share of total freight shipments in some parts of the world, Europe and China in particular. In this chapter the policies being employed to promote short sea shipping are examined. We focus in particular on short sea shipping promotion policies in Europe, North America and China, and on an assessment of the actual environmental impacts of this transport mode

6.1. Promotion policies for short sea shipping

6.1.1. European Union

It is in the European Union where the greatest progress has been made at the political level to support and extend short sea shipping, and where various policy developments at multinational and national levels have taken place over the last decade.

6.1.1.1 The Trans-European Transport Network

The goal of this intervention was to implement a transport network involving several major corridors (www.europa.eu.int/comm/ten/transport/revision/projects_en.html).

The project began in 1996. The total cost is estimated at € 400 billion and to be completed by 2010 (map 7).

Map 7 Priority projects of the Trans-European Transport Network, 2003

Source: www.europa.eu.int/comm/ten/transport/revision/projects_en.htm

In May 2001 the European Union amended the Trans-European Transport Network guidelines to integrate more fully seaports and inland ports (Decision 1346/2001/EC). An important part of these amendments to the project was the recognition of several maritime corridors for priority development. The so-called "Motorways of the Sea" are intended to relieve road bottlenecks and promote trade. Four "Motorways of the Sea" are identified: Baltic Sea, Atlantic Arc, Adriatic Sea-Ionian Sea-Aegean Sea and south-west Europe.

6.1.1.2. Short sea shipping program (2001)

Several transport networks of the Trans-European Transport Network project were road-based. Recognising the need to divert traffic away from the roads, the European Union in 2001 began a set of policy initiatives specifically for short sea shipping (www.shortsea.org). It has adopted a two-prong process.

First is the establishment of what are termed "Focal Points". These are highly qualified civil servants in national administrations, who are generally responsible for the mode. Working with the European Union Commission these national experts meet regularly to exchange experiences and see how short sea shipping may be improved. They have identified factors that retard the greater development of the shipping alternative, so called "bottlenecks". Each member is then entrusted to address these specific problems. Sometimes the problems are pan-European, and the short sea shipping group in the Commission has sought to resolve the difficulty. This as resulted in a number of recent directives:

1. Simplification of documentation related to short sea shipping (Directive 2002/6/EC);
2. Developing a common set of customs regulations concerning short sea shipping; and
3. Opening up access of short sea shipping to port services (COM(2002) 101 final, 19.2.2002).

In other cases individual national representatives have sought to resolve specific bottlenecks that were identified. A number of successful interventions have taken place:

1. Document problems between Antwerp and Rotterdam – cargo documentation required for traffic between Antwerp and Rotterdam (17 million tons per year) had to be original, requiring the original to be carried with the vessel, leading sometimes to delays. Now there is electronic documentation.
2. Mandatory imposition of agents - France used to impose French agents on goods transiting the country. Now operators can choose their own or dispense with agents altogether if they desire.

3. Customs clearance in Greece – All documents used to be in Greek and ships were not allowed to be unloaded prior to customs clearance. This has been resolved. Henceforth, documents can be written in English.

The second major approach was to promote short sea shipping by supporting national promotion centres. The European Short Sea Network (ESN) is intended as a clearinghouse and platform to promote projects and short sea shipping in general. While the ESN coordinates activity, much takes place at the national level. This is further detailed below.

6.1.1.3. Marco Polo I

This project arose out of the 2001 White Paper "A Time to Choose". It replaced the earlier PACT program (Pilot Actions for Combined Transport) which had a rail intermodal orientation. It commenced in January 2002 and its first phase will continue until December 2006. With a budget of € 75 million, its goals are to relieve road congestion by promoting projects that will divert traffic to other modes. It hopes to be able to return the modal split to 1998 levels, implying a shift of 12 billion ton-km to non-road modes. Marco Polo I comprises three programs:

Modal shift actions

These are projects to shift road traffic to other modes of transport by providing start-up aid for new non-road freight transport services. Regular maritime, rail and inland waterway services need a load factor of about 70% to 90% to be viable. The costs of setting up a new service may be co-funded up to a maximum of 30%. Financing comes from the budget of the European Union. The funding will provide € 1 for every 500 ton-km shifted away from roads. The minimum funding is € 500,000 or the equivalent of 2,500,000 ton-km. The road network containing the road traffic targeted for reduction must be within two European Union states or within a European Union state and an enclaved country. The actions must be achieved within 36 months.

Catalyst actions

These involve innovative measures to overcome structural barriers in the market. This might involve, for example, setting up "motorways of the sea" or high quality international rail freight services, operated on a 'one-stop shop' basis. These actions should change the way in which non-road freight transport operations are carried out and use trans-European transport networks or pan-European corridors. The maximum amount of aid is 35% of cost. The minimum grant is €1.5 million and must be completed within 48 months. The Catalyst actions must address several policy priority targets such as quality transport services, establishment of route-competitive service, central integrated control of the services, offering a "door-to-door" concept, high level of punctuality, client information and transhipment concepts.

Common learning actions

The goal here is to facilitate cooperation and exchange of know-how among operators in the freight logistics market in order to improve the sector's environmental performance. Community financial assistance is limited to 50% (EC, 2003a). The minimum grant is € 250,000 and must be completed within 24 months.

6.1.1.4. Marco Polo II

The second phase of the Marco Polo program was announced in 2003 and is due to continue from 2007 – 2013. The program applies to the 25 members of the European Union, and therefore includes the new members, unlike Marco Polo I. It also provides for additional counties if appropriate bi-lateral arrangements are in place. It has a very specific objective: to divert 144 billion ton-km from the roads between 2007 and 2013, a clearly much larger goal than Marco Polo I. Its budget is € 820 million. It has six proposed actions, three of which were carry-overs from Marco Polo I: modal shift, catalyst, common learning, “motorways of the sea”, rail synergies and traffic avoidance.

While continuing three actions from the previous program, the new package introduces several key elements. It recognizes that there are limits to the effectiveness of individual actions, that the best projects are immediately accepted by the European Union and that the marginal benefits from succeeding projects diminishes over time. The new program is more innovation-based. Under the Catalyst Action, infrastructure funding is allowed, and this funding is also permissible in the three new action areas. It is infrastructure spending that accounts for the larger budget of Marco Polo II, but this recognizes the fact that the ambitious goals of the European Union require expenditures on infrastructure.

In 2004 the European Commission undertook an *ex-ante* evaluation of the Marco Polo II program. This evaluation by the consultants Ecorys Transport assesses the costs, expressed in terms of investments and benefits of modal split. The report indicated that the modal split initiatives and the “Motorways of the Sea” components were likely to produce the largest proportion of the diversion from the road, and the “Motorways of the Sea” would account for the largest share of expenditures (Table 13). In all the potential diversion of 144 billion ton/kms is predicted. This was estimated to produce savings in externalities of € 4.98 billion.

Table 13 Expected costs and benefits of Marco Polo II, 2004

Actions	Traffic shift (billion t/km)	UE subsidies for services (€ million)	UE subsidies for infrastructures (€ million)
Modal shift	57.5	153.3	-
Catalyst	23.6	63	116.6
Common learning	-	15.2	-
Motorways of the sea	42	168	151.4
Rail synergies	10.5	42	61.8
Traffic avoidance	10.5	35	18.9
TOTAL	144.1	476.5	343.7

Source: Ecorys Transport, 2004

6.1.1.5. European Parliament

In 1993, the European Parliament created the Alliance of Maritime Interests in Europe (AMRIE). In 2002 it established Regional Action for Logistical Integration of Shipping across Europe (REALISE). The goal of REALISE is to develop strategies to promote short sea shipping for unitised cargo. It is a consortium made up of a shipping line, ports, and academics along with AMRIE coordination. It follows a bottom-up approach, organising meetings and exchanges between partners in logistics chains. It also undertakes research into basic elements such as pricing and environmental impacts (www.realise-sss.org). Its success is based on partnerships involving a wide range of interests, and in its concern for networking and identifying specific problems of the industry.

6.1.2. National responses within the European Union

The European Union's short-sea program established the ESN in 2001 to promote short sea shipping. It led to the Short Sea Promotion Centres (SPCs) at the national level. Each country's Short Sea Promotion Center (SPC) coordinates the national short sea shipping promotion activities (table 14).

Table 14 National Short Sea Shipping Promotion Centres of the European Union, 2004

Name	Internet Address
Belgium	www.shortsea.be
Denmark	www.shortsea.dk
Finland	www.shortsea.fi
France	www.shortsea.fr
Germany	www.shortseashipping.de/eng/wir/wir.html
Greece	www.shortsea.gr
Netherlands	www.shortsea.nl
Ireland	www.imdo.ie
Italy	www.shortsea.nl
Norway	www.shortseashipping.no
Poland	www.shortsea.pl
Portugal	www.geocities.com/shortseapt
Spain	www.shortsea-es.org
Sweden	www.maritimeforum.se
United Kingdom	www.seaandwater.org

Source: www.shortsea.org

6.1.2.1. The Netherlands

The Netherlands SPC is the most extensive site, and has an excellent survey of issues, problems and practices. It publishes the Short Sea Journal (available in Dutch) covering best practices and success stories. It linked to a progress report (MTPWWM, 2003) concerning the implementation of short sea shipping policies in the Netherlands and the rest of the European Union. Its activities are oriented in a number of directions.

Stimulating demand: promotion and information

The Centre believes that promotion and information will be used to bring about a considerable increase in awareness and improve the image of short sea shipping among the decision-makers (shippers, forwarders, chain managers) by pointing out the advantages of short sea shipping. This can lead to a change of attitude among the decision-makers, thereby bringing about an increase in the use of this modality. It has established the Short Sea Shipping Information Bureau which contributes towards increasing the awareness of and opportunities for short sea among shippers and forwarders in general. The

Bureau has an extensive database containing the various scheduled services (www.shortsea.nl).

Stimulating demand: influencing the decision makers

The Centre is involved in undertaking modal shift scans – analyses aimed at determining where policies should focus in order to ensure program efficacy. The scans provide a cost-benefit assessment, incorporating all costs, to determine whether shifting modes will be profitable, or at least worth the investment. In over a 100 scans since 1998 it was found possible for 80% of participants to divert freight flows or some of their freight flows from road transport to inland waterways, rail or short sea. This also resulted in cost-savings of between 5% and 12%. Short sea shipping proved to be an option in 12% of the analyses. Seventy new integrated modal shift scans have been planned in order to improve logistical efficiency, thereby strengthening the short sea shipping component.

Stimulating supply: cooperation

If short sea shipping is to be part of the logistics chain cooperation within the short sea sector itself, between the modalities and with other players in the chain, it is necessary to bring about a modal shift. Various previous projects, such as the Sea-River Shipping Project (1995) failed because of difficulties in securing cooperation. Present programs are looking into cooperation between forwarders and ship brokers to look for ways to make improvements in this area. Because port charges are seen as a major problem for short sea shipping, cooperation between the ports and ship operators is being carried out. Finally, the Centre is examining the possibilities for international cooperation between other countries to promote bilateral shipping relations, such as those already with Estonia, Latvia, Germany and Greece.

Stimulating supply: short sea shipping organisation

For some years the Netherlands have had Round Tables for Short Sea Shipping whose aim is the bringing together of all relevant market players in the short sea sector and the government, to make an inventory of bottlenecks and undertake joint action to solve them. The focus of the 2004 Round Table is the approach to solving bottlenecks. Short sea shipping is not yet discussed as a matter of course within contexts such as regional consultation. The short sea sector itself feels a strong need for the strengthening of its position.

Stimulating supply: subsidies and tax measures

Since 1996 a number of tax measures have been introduced aimed at making it more attractive for businesses to carry out their shipping activities from the Netherlands and to sail under the Dutch flag. Since the introduction of these measures, the Dutch fleet has increased by 25% and 20 new businesses have opened a location in the Netherlands. The success of the tax measures

package has led to the continuation of the national policy. However, because awareness of the subsidies available for the sector is relatively low, the government is taking action to publicize the various subsidy regulations in the Netherlands.

Because short sea shipping is relatively environmentally friendly and will have to maintain this advantage as a competitive factor, the Dutch Government is looking into which rebate policy suits these investments best: as part of Regeling Willekeurige Afschrijving Milieu-investering, a scheme for writing off environmental investments or as part of Regeling Energie Aftrek, an energy rebate scheme in order to stimulate research and innovation.

Stimulating supply: infrastructures

In order to increase the possibilities for short sea shipping, the infrastructure of the ports and shipping lanes should be organized in such a way that short sea ships only have to call at one terminal. This is still a long way from reality. While deep-sea ships only have to call at one terminal, short sea ships often have to collect their cargo at several locations within the port. What is more, at the larger terminals priority is usually given to deep-sea ships. Projects have been funded to collect together short sea shipping terminals in the port of Rotterdam, and in the new facilities at the port of IJmuiden at least half of its capacity is to be used for short sea shipping.

Stimulating supply: bottlenecks in regulations and procedures

In order to strengthen the competitive position of short sea shipping the Dutch Government recognizes that it is important to combat factors which make short sea shipping less efficient and raise the costs especially in the area of regulations, administration and procedures. Shipping involves many complex processes which generate an inordinate amount of paperwork. National bottlenecks have been identified in recent years and work has begun on solutions where possible. The issues dealt with include: obtaining frequency discounts on sea port charges for short sea at the Port of Rotterdam, reviewing the piloting system, and simplifying customs procedures particularly with regard to sea-river shipping.

Stimulating supply: telematics and information technology

More and more, the application of telematics and information technology is becoming an essential condition for participation in today's transport world. Companies engaged in short sea shipping are generally characterized by a very low level of information technology application. This not only affects communication with other companies in the logistics chain, but also communication within the shipping sector itself.

An EDI (Electronic Data Interchange) system is already in place, and the goal is to make its use more widely diffused in the short-sea industry. In addition,

there is an action plan to implement information technology further among shipping companies. The underlying principle of the project is that companies themselves determine which information technology applications best suit them based on their own objectives and learn how to implement these applications.

Stimulating supply: technology

In terms of speed, short sea is usually at a disadvantage compared to road transport. Shortening the transit time would considerably increase the competitive power of certain groups of shippers. A study was undertaken in the late 1990s to investigate if faster ships and better transhipment techniques could reduce short sea transit time in order to increase short sea's market potential. The study revealed that the market was not yet ready for super-fast container ships or revolutionary transhipment techniques. Faster ships also cause so many environmental problems that from a policy point of view it is not worth stimulating the use of such vessels. It also emerged that the speed of transport at sea is not the main time-problem for short sea shipping but that the over-land segment of door-to-door transport, including the transhipment, is by far more time-consuming. Attention should therefore be paid to the logistics chain as a whole. More recent activities have been directed at innovations geared towards creating a cleaner shipping sector. The short sea sector can further increase its favourable position with regard to the environment by anticipating more stringent legislation on issues such as emissions and waste management.

Monitoring

Present data indicate that the objectives of the Dutch government is that in 2010 approximately 40 million tonnes of containerized cargo will be transported intermodally, with the help of short sea. This figure will be reached by autonomous growth of 12.5 million tonnes and a modal shift of approximately 11 million tonnes. This objective would appear to be feasible on the basis of the growth figures already known. It is difficult to say whether the present rate of growth is due to modal shift or autonomous growth. It is not possible to make an accurate assessment of the quantitative contribution made by the various activities. Various monitoring projects are underway to verify these trends.

6.1.2.2. Other countries of the European Union

Most members of the European Union have policies favouring non-road transport. The need to develop intermodal alternatives has been seized by individual members. However, most countries are concerned with shifting freight to the railways. Thus the TAG program in the United Kingdom, the Flexible Transport Chain program in Germany, the MOVE program in Austria, the PREDIT program in France, and more general initiatives in Sweden and Italy are only marginally oriented towards short sea shipping.

6.1.2.3. Local initiatives

One interesting policy development is the proposal presently being studied by the Region de Bruxelles-Capitale (de Voghel and Fohal 2004). The port of Brussels is seen to be an inland port, being located on the maritime canal l'Escaut. In fact, small ocean-going vessels can gain access as far as Brussels. The objective is to promote this business, a typical short sea shipping goal, but it is nuanced by the main intention to develop direct links with other small ports. It is argued that if Brussels is just a spoke on Antwerp's hub, shipping will add to existing congestion in the main port. Direct services to smaller ports in Europe might be a more sustainable solution.

At present the Voghel and Fohal study (2004) has inventoried the existing services, and examined potential new markets. The short sea shipping group in the European Commission is itself examining the broader possibilities of using rivers and canals in this fashion. One of the bottlenecks identified for action by the Focal Points was that of customs clearance for sea vessels exiting the port of Duisburg in Germany. The vessels used to have to stop at the Dutch border to complete customs formalities, because technically that was the last border in the European Union. This resulted in delays and extra costs because of port dues. This has now been resolved with electronic reporting of documents for vessels licensed in Germany and the Netherlands. A surprising amount of traffic already is of this type, but the major problem is that many bridge clearances, while adequate for barge traffic, are too low for the higher superstructures of sea-going ships. In the case of Brussels port, agreements have already been signed to raise bridge heights whenever any major work has to be done in the future on the bridges.

6.1.3. United States

6.1.3.1. MARAD

MARAD (United States Department of Transportation Maritime Administration) has stated that it favours the development of coastal and inland shipping and that it would financially support coastal shipping, but there are no specific policy directives. It has gone on record as supporting the Jones Act, citing employment and security benefits. MARAD's plan for short sea shipping is still in embryo. In 2003 it supported the Canada-US Memorandum of Cooperation on Short Sea Shipping (http://www.tc.gc.ca/mediaroom/releases/nat/2003/03-h133e.html).

MARAD is establishing partnerships, particularly with private sector actors. One such initiative was the establishment with the United States Transport Secretariat of a consultative committee on maritime transport that included several private sector members. In 2004 this group presented a report to the Secretary of Transportation underlining the needs of short sea shipping. Its

recommendations included new budgetary allocations for the improvement of port facilities, the construction of new vessels to be deployed by short sea shipping, the promotion of this mode, and financing specific projects such as maritime services between Vera Cruz, Mexico and the Gulf Coast and others along the East and West Coasts. MARAD has also affirmed its support for the cooperation memoranda between the United States, Canada and Mexico.

6.1.3.2. Individual initiatives

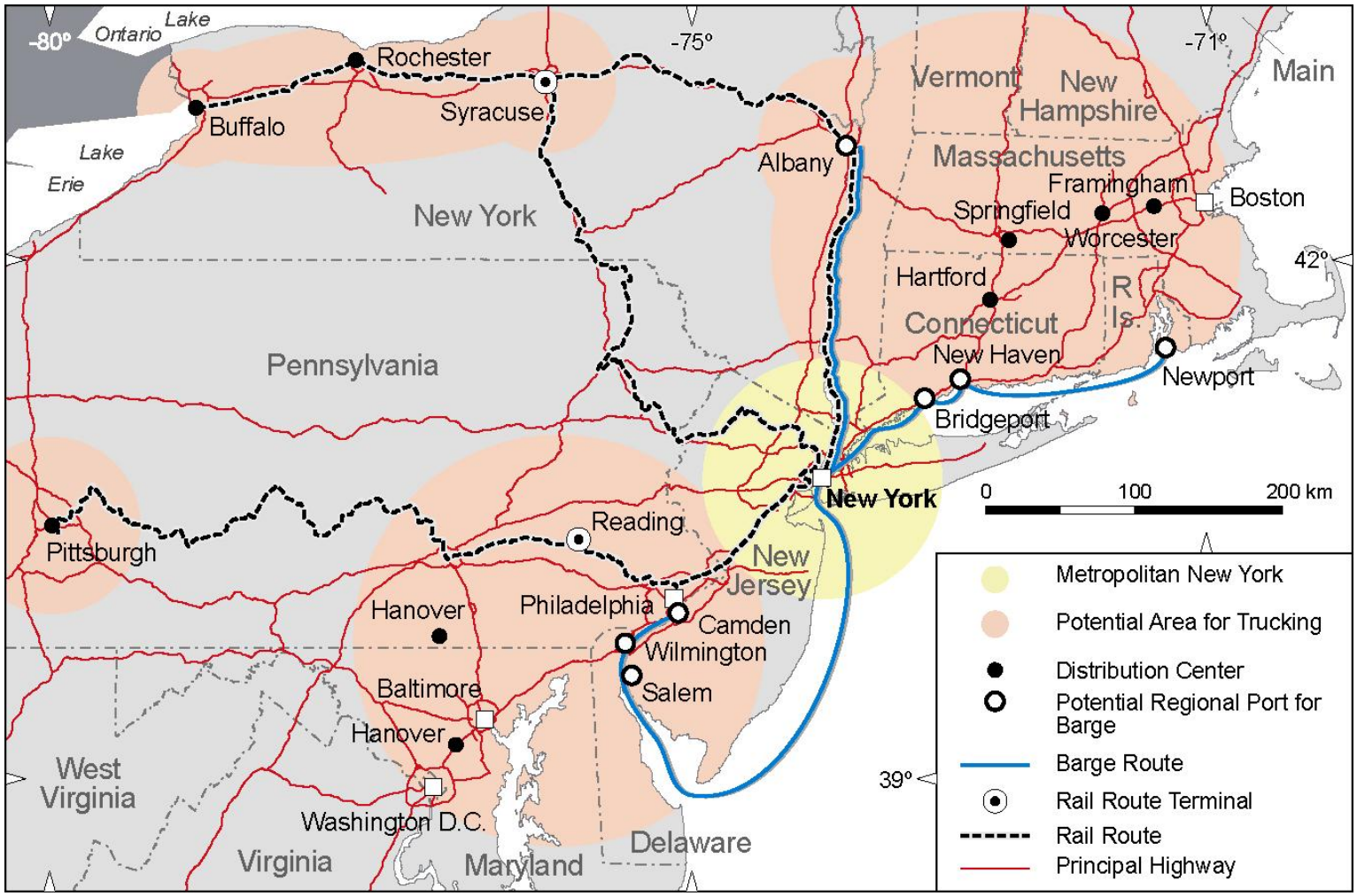
There have been interesting developments by individual ports in the United States. The Port Authority of New York and New Jersey (PNYNJ) in particular, has been active in promoting feeder services for containers in an attempt to reduce truck movements in and around the port.

Recognising the limitations imposed by the Jones Act, the Port Authority of New York and New Jersey (PNYNJ) has established the Port Inland Distribution System (PIDN). This is a new hub and spoke system designed to move freight by rail and barge from the port of New York and New Jersey to Albany, South Jersey, Bridgeport and New Haven, Davisville, RI, Wilmington DE (barge) and rail points along the Buffalo-Albany line and the New York-Pittsburgh line. The PIDN will reduce truck traffic in the 13 state region (NY, NJ, VT, NH, MA, RI, CT, PA, MD, DE, VA, WV, OH). The nodes of the network service cover 82% of the regional container market.

The program also aims to: 1) entice economic development in the feeder ports; 2) develop new short sea shipping terminals; 3) enhance value added of warehousing and distribution centres.

The project is funded by the Port Authority of New York and New Jersey (PNYNJ) and takes the form of subsidies paid to shippers who re-direct their shipments. A budget of US$ 6 million has been allocated for the period 2004-2008. It is a temporary measure designed to encourage shippers to consider alternatives to trucking. It gives barge companies such as Columbia an opportunity to build up a traffic base. The Port Authority is seeking additional public funding through the Congestion Management Air Quality Program (CMAQ) and the Transportation Infrastructure Finance and Innovation Act (TIFIA) (map 8).

Map 8 The distribution system of the port of New York and New Jersey, 2004



Source: www.panynj.gov/DoingBusinessWith/seaport/html/port_inland.html

6.1.4. China

Under its ninth Five Year Plan (1996-2000), China allocated US$ 2.8 billion to modernizing the 110,000 kilometres of its navigable inland waterways. The goal was to open up access for shipping to the less developed interior regions of the country in order to promote industrial development and reduce economic disparities with the coastal provinces. During this period the transport capacity of 4,267 kilometres of inland waterways was enhanced. A section of the imperial canal between Beijing and Hangzhou was improved to allow the passage of 500-ton vessels. More than 340 river quays were improved, adding 59.3 million tons of capacity to fluvial transportation. Access to interior provinces such as Hunan and Guangxi has been facilitated by improvements on the Pearl River delta and the Yangzi Jiang. In the inland southern provinces of Yunnan and Guizhou new waterway access has been provided to rail and road axes

In 2001, in consideration of the growing congestion on its roads and railways, China announced a “green solution”: the expansion of short sea shipping. This program, to be completed by the end of 2005 called for further improvements to the Yangzi Jiang, Zhujiang and Heilongjiang river systems, and the construction of interprovincial canals along the interior of major river deltas. This represented a total of 3,350 kilometres of new inland waterways, of which 950 kilometres would have a capacity to handle 1,000-ton vessels. Quay expansion continued, with the addition of 200 new facilities, including container and multifunctional cargo handling terminals at Chongqing, Wanzhou, Wuhan, Wuhu and Maanshan on the Yangzi Jiang, to add a further 25 million tons to inland port handling capacity.

The Chinese government is recognizing that environmental pollution is a major challenge, and has identified it as one of its priorities in the coming years. China is becoming one of the world’s largest producers of carbon dioxide. It is already contributing about 10% of all greenhouse gas emissions. Promoting short sea shipping is seen by the Chinese government as a key factor in promoting economic and social development while minimizing environmental impacts. If nothing is done, China’s greenhouse gas emissions will exceed those of the United States and Japan combined within 25 years. Policy goals consist of improving the management of freight transport, increasing capacity of the entire transport system, and ameliorating intermodal connections so as to keep pace with the rapid economic growth of the country. Short sea shipping is seen as an important part of this policy, particularly in the way it can improve access to interior regions and make them more competitive by reducing transport costs, while at the same time minimizing environmental impacts.

6.2. Environmental impacts

The belief that short sea shipping and inland navigation is more environmentally friendly than other modes of transport is well rooted in society.

Like other generalisations however, these assumptions are difficult to assess and verify in reality. This is becoming apparent when evaluations of policy initiatives are undertaken. If water transport is to be promoted partly on environmental grounds then there must be means to test how successful the policy has been based upon measurable environmental parameters. A great deal of research is being undertaken, especially in Europe, to find answers to these questions.

6.2.1. General observations

6.2.1.1. A focus on CO_2

Much of the recent research into the environmental impacts of transport is focused on CO_2 emissions. This has come about for two reasons. First, much research has dealt with the emissions from motor vehicles (Hensher and Button, 2003). Over the last twenty years through technological advances and legislation many of the other types of emissions from cars have been reduced. Second, the signing of the Kyoto protocol has put the spotlight on CO_2 as the major greenhouse gas.

6.2.1.2. Difficulties of measurements and comparison

Measurements drawn from national data frequently hide significant intra modal differences. Speed, weather conditions and size of vehicle greatly affect emission rates. Some studies are more specific and compare transport corridors (Bonnafous and Raux, 2003). Comparisons between routes are problematic because of different operating conditions. Inter-modal comparisons are difficult too, because of fundamental differences between the units of load and particular operating conditions. A number of studies take these problems into account and are producing a clearer picture about the emissions of shipping versus other competing modes (PACT, 2003).

6.2.2. Intermodal comparisons of emissions

A recent Danish Study (Kristensen, 2001) has compared different classes of ships with trucks. For each class of ship, container ships, bulk carriers, RoRo ships, RoRo-passenger ships, and fast ferries, the study has modelled the energy consumption and emission rates for varying sizes and differing speeds. The modelling produces results that demonstrate that energy consumption per unit load diminishes with increasing size, except fro RoRo ships, where specific energy demand is nearly constant (table 15). Explanation resides in the availability of space on RoRo ships that does not generate the same economies of scale.

In order to calculate the energy and emissions from trucks, European emission standards were used, and were based on a weight of 48 tons. The modelling was based on specific loads and the number of truck equivalents required to

transport the same amount of cargo. Based on this modelling it was confirmed that container ships and bulk ships (including tankers) of all sizes have specific energy consumption (per ton/km) four or five time less than trucks, a pattern that is repeated for CO_2 levels.

For NO_x, the emissions for container ships and bulk carriers were still lower than for trucks, but new European stricter standards for NO_x will make trucks comparable to container ships but lower than bulk carriers.

For SO_2 emissions, container ships and bulk carriers were higher than trucks. RoRo ships make a special case. RoRo ships only carrying vehicles have an energy consumption rate similar to trucks, while rates for combined vehicle and passenger ships are higher than trucks. All types of RoRo ships have emissions higher than trucks. This latter point becomes quite significant for major changes have been made to ferry services to utilise fast ships, where the energy and emissions rates are very high.

Table 15 Energy consumption and polluting emissions between different ship and truck classes in Europe, 2001

Ship type	Length (m)	Speed (knots)	Energy Demand (MJ/t/km)	CO_2 Emission (g/t/km)	NO_x Emission (g/t/km)	SO_2 Emission (g/t/km)	Particulates Emission (g/t/km)	CO Emission (g/t/km)	HC Emission (g/t/km)
Energy and emission data assuming 10 tons weight per container									
Cont. ship 100 TEU	64	12.3	0.242	18.9	0.60	0.38	0.049	0.056	0.018
Cont. ship 500 TEU	103	15.2	0.212	16.5	0.52	0.33	0.042	0.049	0.015
Cont. ship 1,500 TEU	160	19.0	0.165	12.9	0.41	0.26	0.033	0.038	0.012
Cont. ship 3,000 TEU	220	22.0	0.145	11.3	0.36	0.23	0.029	0.034	0.011
Cont. ship 6,000 TEU	304	26.0	0.143	11.1	0.35	0.22	0.029	0.033	0.010
Energy and emission data are function of tons payload									
Bulk carrier 2,000 t	72	10.4	0.143	11.1	0.35	0.22	0.029	0.033	0.010
Bulk carrier 10,000 t	119	13.0	0.103	8.0	0.25	0.16	0.021	0.024	0.008
Bulk carrier 20,000 t	144	13.6	0.072	5.6	0.18	0.11	0.015	0.017	0.005
Bulk carrier 40,000 t	180	14.2	0.046	3.6	0.11	0.07	0.009	0.011	0.003
Bulk carrier 80,000 t	242	15.0	0.031	2.4	0.08	0.05	0.006	0.006	0.002
Bulk carrier 150,000 t	279	15.5	0.027	2.1	0.07	0.04	0.005	0.006	0.002
Energy and emission data for RoRo are function of the weight of cargo on the truck A truck of 18 m has a capacity of 24 t and marine diesel oil has a 3% sulphur content									
RoRo cargo ship lane of 1,000 m	110	16.3	0.89	66.0	1.32	1.31	0.169	0.176	0.055
RoRo cargo ship lane of 1,500 m	130	11.6	0.91	67.1	1.34	1.34	0.172	0.179	0.056
RoRo cargo ship lane of 2,000 m	150	18.9	0.96	70.8	1.41	1.41	0.181	0.188	0.059
RoRo cargo ship lane of 2,500 m	170	20.2	1.02	75.7	1.51	1.51	0.194	0.201	0.063
RoRo cargo ship lane of 3,000 m	190	21.5	1.09	80.7	1.61	1.60	0.206	0.214	0.067
RoRo passenger ship 20 cars	33	10.9	8.96	663	13.2	13.19	1.696	1.763	0.551
RoRo passenger ship 50 cars	51	12.3	5.02	371	7.4	7.38	0.950	0.987	0.308
RoRo passenger ship 100 cars	80	14.6	4.08	302	6.0	6.01	0.773	0.803	0.251
RoRo passenger ship 200 cars	103	16.4	2.85	211	4.2	4.19	0.539	0.560	0.175
RoRo passenger ship 400 cars	139	19.3	2.34	173	3.5	3.45	0.443	0.461	0.144
RoRo passenger ship 600 cars	160	20.9	2.35	174	3.5	3.46	0.444	0.462	0.144
Euro 2 truck (20 t)	-	-	0.69	50.4	0.52	0.0016	0.011	0.059	0.026
Euro 3 truck (20 t)	-	-	0.69	50.4	0.42	0.0016	0.008	0.050	0.022

Source: Kristensen, 2001

As controversial as these results may be, they are clearly narrowly focused on a small set of sustainability measurements, namely air pollution and energy consumption. Adding impacts on other elements such as land use, congestion, safety etc, tend to push the advantages of shipping much further. A big issue, however, is how to measure such impacts.

6.2.3. Environmental assessment of the PACT program

In 1997, DG TREN (Direction générale de l'énergie et des transports) of the European Union implemented a program to promote combined transport in Europe. This policy initiative, Pilot Actions on Combined Transport or PACT, was the precursor of the present Marco Polo project. Since the program has ended the European Union has sought to assess its impact. It has endeavoured to measure the results based on CO_2 reduction However, the goal of the program was to shift road transport to combined systems and there was no consistent recording of CO_2 reductions.

Evaluations reveal that CO_2 emissions increased during the PACT program, but the increases were lower than had a shift to non-road alternatives not existed. The evaluation brought to light a number of problems. The reported data was not reported in a standardized form, and there were gaps. For example, only 9 of the 63 projects provided accurate data in the format necessary for the PACT assessment (EU, 2003:43). These gaps were filled with estimates, which reduce the accuracy of the assessment. It only covered CO_2 emissions, neglecting to assess other critical air pollutants. Furthermore the role of short sea shipping in the PACT assessment was extremely limited.

6.2.4. Environmental assessment of the MARCO POLO II program

Although the program has still to be implemented, the *ex-ante* evaluation has learned from the problems of PACT, and has considered a wide range of sustainability issues. The results of the programs allow the congestion savings for each mode of transport to be measured and estimated. The projected results of PACT and Marco Polo I have been translated into specific external benefits, in which savings in congestion are clearly the largest (table 16).

Table 16 External impacts of modal shift actions of Marco Polo II, 2003 (€ billion)

Action	Air Pollution	Global warming	Noise	Safety	Congestion	Infrastructure	Total
Modal shift	0.22	0.02	0.14	0.21	1.30	0.04	1.92
Catalyst	0.08	0.03	0.06	0.09	0.54	0.02	0.81
Common learning	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Motorways of the sea	0.14	0.08	0.11	0.15	0.95	0.03	1.46
Rail synergies	0.05	- 0.02	0.02	0.03	0.24	0.01	0.32
Traffic avoidance	0.09	0.03	0.03	0.05	0.24	0.05	0.48
TOTAL	0.58	0.12	0.35	0.52	3.26	0.14	4.98

Source: ECORYS TRANSPORT, 2004

6.3. Strategies for the development of short sea shipping

The international survey of short sea shipping promotion demonstrates that the policies and programs are intimately linked to the issue of sustainable development. From all the experiences and cases reviewed, nine conditions favouring the development of short sea shipping can be drawn.

1. Sustainability is at the heart of most interventions to promote short sea shipping, but environmental objectives remain secondary.

Discussions with many of the actors involved in promoting short sea shipping indicated that the policies and interventions have come out of a desire to find alternatives to road transport. This is mainly because of the congestion effects, and the resultant impact on the economy, and also because of social impacts on the quality of life. Environmental considerations were secondary. In Europe, policies developed in the 1990s sought to promote rail transport as the alternative to roads, and this is reflected in the Trans European Network and PACT programs. It was only after a general disillusion with the ability of rail in Europe to meet the growing demand for freight transport and mount a competitive challenge to road transport that the European Commission and some national governments have turned to consider short sea shipping.

2. Diffusion of best practices is a critical factor in the promotion of short sea shipping.

At all levels, examples of best practice were cited as key elements in promoting short sea shipping. In the European Commission, for example, the success of Grimaldi Line in expanding short sea services between Barcelona and Genoa and within the Mediterranean Sea was a demonstration of the

possibilities of the mode. In the national promotion centres best practices are seen as an essential factor in convincing companies to consider short sea shipping.

3. Promotion of short sea shipping should emphasise the transport chain.

One of the biggest challenges to short sea shipping is its traditional perspective as a mode involved in transporting goods from port-to-port. The European Commission in particular is trying to change this perspective. One of the reasons for its use of Grimaldi Line as a best practice is that company's integration of its services and offer to customers of through transport rates. For the Commission, carriers must insert themselves in supply chains and establish intermodal links. This is at the heart of Marco Polo II and "Motorways of the Sea" initiatives. If short sea shipping is to be able to divert traffic from the road it must give shippers the advantage of one stop shopping, even if it involves multiple modes

4. Although environmental considerations remain secondary, measuring environmental benefits and costs has become an important criterion in evaluating projects and policies.

Major projects (for example Marco Polo II) now make an evaluation of environmental benefits and costs mandatory. In many cases this is a limited assessment, based upon estimates of the amount of traffic diverted from the road and the expected CO_2 savings. Although the major criterion is the commercial and economic viability of the project, the environment has become one of the factors considered in the pre and post evaluation process. This necessitates careful attention to the data requirements reporting procedures. The experience with the PACT program in Europe demonstrated that because improper and incomplete instructions for recording environmental parameters were given it was impossible to compare and assess fully the different projects.

5. Political action is important.

Part of the promotion role undertaken by public agencies has to be directed at elected officials. The short sea shipping group in the European Commission have been successful because they have been able to keep the issue before the transport ministers of the member countries. Local representatives have to be brought onside, and their influence brought to bear on executive branch decision-makers. We were told of how short sea shipping, as a relatively little understood sector, loses out when budgets are allocated. The budget for Marco Polo II has been trimmed, partly because of pressure from the road lobby.

6. The promotion of short sea shipping has to take place at several levels of governance.

The challenges facing short sea shipping are complex. This requires a multi-level administrative approach. Governments at all levels have to coordinate their actions. As has been demonstrated in the Focal Points approach of the European Union, the number of public officials with responsibilities and experience in short sea shipping is small, but this makes coordination easier than in other multi-jurisdictional cases. At the same time local and not-for-profit public authorities have a role to play in short sea shipping promotion, since an agency emanating only from the industry would suffer from of loss of objectivity and credibility.

7. Local promotion has the potential to achieve small but important successes.

There is no magic wand, but vigorous local centres promoting short sea shipping have proved to be very important in Europe.

Several key factors came out of our discussions. First, the centres have to be seen to be independent. This applies at several levels. In Flanders, for example, short sea shipping promotion originally was undertaken in conjunction with inland navigation (barges). It was felt that the interests of the two modes were sufficiently different that separation was necessary. It was also recommended that the promotion centre not be seen to be dominated by one company or sector, forwarders for example. It must be credible to the industry. Second, it must perform a useful function. There must be a reason for the industry to use the centre. For the Danish, Dutch and Flemish centres this has been their maintenance of a data base of short sea shipping, providing real time lists of sailings and arrivals, along with names of people in the industry to contact. Third, the most difficult challenge, and a key to the success of short sea shipping, is in engaging shippers. This is done one at a time. Although presentations at shipper's conferences are important to propagate awareness of short sea shipping, experience is that a company-by-company approach is best; since it is rare in fact the companies targeted attend such events.

8. The opportunities for policy intervention are necessary.

In Europe, the Commission and Parliament have been struggling to make transportation more transparent, by opening access and seeking to remove subsidies. This is tending to reduce the opportunities for Community and National governments to intervene as they once did. The major financial intervention in transportation in the European Union is the Trans European Network program, which is largely infrastructure-based.

Although the "Motorways of the Sea" concept has been integrated within this program, it faces formidable difficulties, notably the coastal origin and

destination of these “motorways of the sea”. It is important to underline that some of the proposed routes end some way from ports. A very large question is whether ships can be regarded as infrastructure, since if financial assistance from the TEN budget is allocated to upgrade coastal ships, the trucking industry would claim the same advantage. Because the shipping industry is relatively lightly regulated, and public administrations have few legislative tools, the major successes in the development of short sea shipping have “come at the edges”, solving bottleneck problems, documentation, pilotage, etc.

But the Chinese experience demonstrates that public administrations have legislative tools that not only permit an improvement of marine infrastructures but the development of short sea shipping.

9. Outside forces are important.

As necessary as effective policies and promotional activities are, external elements are also often critical in promoting short sea shipping. In Europe for example, short sea shipping has achieved awareness because of pressures being brought to bear on road transport. Swiss restrictions and charges on road transport through the Alps, congestion at trans-Pyrenean crossings, and in particular the threatened road tax imposition on trucks in Germany are causing shippers to consider alternatives. It is difficult to measure the impacts of these pressures, but nearly everyone involved in short sea shipping in Europe sees these as opportunities for the water transport mode.

6.4. Conclusion

The development of short sea shipping is a reality. This reality is reflected in the range of practices being carried out at a range of geographical scales: international, national, regional and local. This survey has thrown the spotlight on the preoccupation of governments and some shippers in diverting freight from land transport modes to short sea shipping. It is significant that it is becoming possible to measure the environmental impacts of the modal shifts in Europe, United States and China and to demonstrate the advantages of promoting short sea shipping.

7. APPLYING SUSTAINABLE DEVELOPMENT STRATEGIES TO THE MARITIME INDUSTRY

The contexts in which the port and shipping industries are evolving are complex in both industrialised countries and those undergoing development. The strategies of the maritime industry need not be at variance with the principles of sustainable development. Our survey has revealed that sustainable development is a fundamental component of economic growth. The strategies for attaining sustainable development are frequently linked to growing environmental legislation.

This chapter has several objectives: 1) to briefly summarize the main findings of our international survey of best sustainable development practices; 2) to present an overview of the main environmental management systems, their constraints and management strategies; 3) to measure the economic impacts of the application of sustainable development strategies; and, 4) to propose a model program of sustainable development that is applicable to ports and shipping.

7.1. International overview

Ports and shipping are intimately related to sustainable development at all geographical scales. This study emphasizes the importance of learning from the knowledge and experiences of sustainable development elsewhere for the ports and shipping industries. Over the last several years concepts of sustainable development have led port managers and shipping lines to integrate sustainability as an integral component of the policy of the enterprise and to limit the environmental impacts of the firm.

There are three main elements to this objective:

1. ensure that the activities of the enterprise conform to all environmental legislation;
2. assume responsibility for environmental costs; and
3. set in place and operate an environmental management system to oversee the activities of the enterprise.

The 800 port authorities and 120 shipping lines surveyed in this study exhibited a wide range of organization, sources of funding, types of activities and traffic. Despite this diversity port authorities and shipping lines recognize a limited set of environmental issues. The 15 elements identified in the survey represent important components of sustainability. However, it is important to recognize that the environmental legislation associated with these 15 elements and the sustainable development strategies that have been developed to address them are frequently interdependent.

Recognizing the environmental consequences of shipping and port activity and inserting actions into the decisional process of enterprises requires a structured process. One such process is an environmental management system (EMS). Such a system provides a global perspective of the interdependency between environmental problems and a means of bringing the issue of sustainability to the general business decision-making process of the enterprise.

7.2. Environmental management systems

There are several environmental management systems available. Our survey suggests that the choice depends upon the particular needs of the different enterprises, reflecting in part the recognized environmental risks and the particular commercial, political and cultural climate in which the company operates. The most frequently employed EMS systems include EMAS, ECOPORTS, EMH and ISO 14 000.

EMAS

In 1993, the European Union created a standard measuring system, the Eco-Management and Audit Scheme (EMAS). It was established to provide European firms with a means to assess and manage their environmental impacts. EMAS uses a guide entitled “Identifying environmental aspects and evaluating their importance”. EMAS calls upon businesses and organizations to identify the full range of ecosystems and environmental elements that are affected by the activities of the enterprise. Impacts are assessed in a stepped procedure based on criteria established by the company and taking into account: 1) the potential environmental damage; 2) the fragility of the environment; 3) the scale and frequency of the impact; 4) the importance of the particular activity for the firm, the employees and the community; and, 5) the obligations imposed by environmental legislation (http://europa.eu.int/comm/environment/emas/pdf/guidance/guidance06_en.pdf).

ECOPORTS

In 1994, the European Seaports Organisation (ESPO), which embraces all the port authorities in the European Union, developed a code of environmental practice for its members to reflect the issue of sustainable development. In 2000, in association with the ECOPORTS foundation, ESPO introduced an environmental management system for ports. The ECOPORTS foundation is a non-profit group founded in 1999 to develop an EMS that would be applicable to European seaports. Its board members are drawn from nine European ports. The essence of the ECOPORTS model is that each port undertakes its own voluntary environmental assessment and promotes best practices through the use of an Internet platform where participating European port authorities can exchange their environmental experiences. The ECOPORTS Foundation has elaborated a Self Diagnosis Method (SDM) in order to evaluate the

environmental performance of ports. The model identifies the main issues and undertakes an assessment process, and the Port Environmental Review System (PERS), a method that allows successful ports to obtain the ESPO environmental certificate (ECOPORTS, 2002; 2003).

EMH

The American Association of Port Authorities (AAPA), which has 150 members from North, Central and South America, has developed a guide for environmental management, the Environmental Management Handbook (EMH). The guide offers information on: 1) the environmental issues associated with port development; 2) practices and techniques of environmental management; 3) public relations programs; and, 4) the means to implant an EMS program. In addition, the guide proposes one method to evaluate and organise environmental management. The section dealing with the practicalities of environmental management provides a detailed description of each environmental parameter, how to measure each pollutant, lists of resources and media providing further information, and an inventory of environmental legislation that has to be considered in the formulation and application of a management system. The overall goal is to provide port administrators with the information required to improve their environmental performance, and thus to reduce the negative impacts that arise out of carrying out normal port operations. When a program is put in place by a port authority it receives a performance certificate (Performance Track Certification) issued by the ports association. It is awarded to those ports that have a proven record of conforming to environmental laws and who have established strong links with their local communities
(http://www.aapa-ports.org/govrelations/env_mgmt_hb.htm).

ISO 14 000

The International Standards Organisation (ISO) has established a family of norms (14 000) which represent the principal industrial reference for environmental management. ISO 14 000 offers three categories of performance indicators to measure environmental performance that can be applied to any business or public sector organization. The Indicators of Environmental Conditions (IEC) provide information on environmental conditions that allow a better understanding of the actual or potential impacts of port or shipping operations. The Management Performance Indicators (MPI) measure the effectiveness of the management policies adopted to influence environmental performance. Operational Performance Indicators (OPI) provide information on the environmental performance that is the result of carrying out port or shipping activities. In general these indicators allow: 1) identification of the most important environmental impacts associated with port or shipping activities; 2) assessment of the environmental performance of a port or shipping organization; 3) determination of the new policies and actions that would be required to improve environmental performance; and, 4) collect and

make available for publication credible information on the environmental performance and policies of the enterprise (André, 2004; Boutin, 2004).

7.3. Constraints in applying EMS

Evidence suggests that the adoption of an environmental management system is a major factor helping ports and shipping companies conform to environmental legislation. On the other hand our survey reveals that there are several difficulties in adopting and applying an EMS.

7.3.1. Data inventory problems

Data collection is frequently a major constraint in establishing an EMS. Developing a management system requires identification and measurement of a large number of variables representing environmental conditions, shipping operations, and environmental legislation. This represents a major undertaking, and few enterprises have the knowledge or capacity to undertake such studies. Our survey suggest that the process frequently begins by a port administration or a shipping company identifying one or more environmental challenges it faces and then develops at its own pace its own particular responses to the problem. Businesses require a great deal of flexibility. They prefer to address problems and improve environmental performance at their own rhythm. However, the experienced gained in addressing a narrow range of problems frequently leads to the application of a full environmental management system with certification.

7.3.2. Costs

Developing and maintaining an environmental management system is costly in terms of time, personnel and resources, which are not always available to smaller ports or shipping lines. Data collection and evaluation is an ongoing process and in an EMS is integrated into the organizational structure of the enterprise. It requires experts to assess impacts and develop remedial strategies. Frequently it involves developing computer-based information systems to measure environmental performance. The high demand for resources results in a number of responses. Many firms purchase commercially-available environmental management software to be operated by their own personnel. Others develop in-house systems tailored to their own particular circumstances. There are also consulting firms specialized in the field who prepare and maintain EMS under contract. As costly as these solutions may be, they result in improved environmental performance that frequently translates into improved economic performance.

7.3.3. Risks of prosecution

One of the factors that reinforces the advantages of adopting an environmental management system is the need to undertake periodic audits to measure

conformity. Certification represents one of the most powerful means to diffuse EMS. A certified port can request vessel berthing to seek certification while a certified ship can put pressure on port authorities to get an environmental certification. One of the advantages of certification consists in being able to compare different shipping lines and port authorities in relation to their performance, independently from the environmental report of the firm. Our interviews indicated that such audits and the obtaining certification is seen as a means of avoiding prosecution should environmental laws be broken accidentally. This is confirmed in a number of published reports (Biondi, Frey and Iraldo, 2000; Freimann and Walther, 2001).

7.4. Applying management systems to sustainable development

The trajectory of sustainable development depends on the role ports and shipping lines should or can play. We suggest that there are six major elements that need to be considered by the maritime authorities in fostering sustainability.

7.4.1. Quantifying the environmental indicators

The maritime industry operates in a wide range of geographical conditions, with different types of commercial partners, with a broad set of technologies and within a very wide spectrum of political and environmental conditions. Ports and shipping companies cannot be expected therefore to limit themselves to simple environmental objectives. Sustainable development in the maritime industry is complex, and requires a very large set of data on complex environmental linkages and the dynamic commercial conditions within which the ports and shipping companies operate.

Our survey reveals that the best performers in sustainable development are those that have been capable of disaggregating their environmental objectives. This requires collecting units of measurement that are credible and homogeneous, and because they allow international comparison, should be in metric units of measurement. The key is to provide quantified measures of environmental parameters that can be compared over time from base line values by sector and geographical scale. The extent to which performance is meeting the goals that were established can be ascertained. The broader the data sets, the better it is possible to assess the complex interrelations between company goals and actual performance.

7.4.2. Formulating a timetable

Our field surveys indicate that attaining sustainable development goals are complicated for a number of reasons: 1) lack of data on environmental parameters and costs; 2) importance of strategies and actions at the international level; 3) absence of realistic solutions to problems identified; 4) conflicts over responsibilities and abilities; or 5) increasing magnitude of the

environmental problems. The ability to respond to environmental problems is increasing as the knowledge base expands and technologies improve. Our surveys indicate that the most successful programs are those that set realistic objectives and define the time scales required to achieve them. Short, medium and long term goals need to be established along with specific indicators that will be used to measure compliance. All programs require flexibility, to facilitate adjustments to unanticipated problems and new solutions and technologies that may arise.

7.4.3. Establishing standards of environmental quality

The surveys reveal that the most successful ports and shipping lines have established clear standards of environmental quality that their management programs seek to attain. Standards are essential in specifying policy goals and objectives. They must reflect specific qualities of air, water and land conditions in precisely defined geographic areas. Standards facilitate the setting levels of pollution and other impacts that are tolerable. The best practices involve: 1) fixing standards according to recognized scientific criteria; 2) setting policies that allow the maritime industry to conform to environmental legislation; and, 3) integrating standards within policies applied to specific geographic areas.

7.4.4. Fixing a schedule of conditions

Governments have a major role to play in developing policies, strategies and measures necessary to attain sustainable development. In recent years, many governments have presented and adopted a wide range of laws covering a wide range of issues related to sustainability. Examples include legislation in the fields of energy consumption, transport development, pollution emissions, ecosystem protection, etc. These laws and regulations are greatly widening the scale and scope of interventions destined to improve environmental conditions.

The most efficient way to implant strategies of sustainable development established by governments is to transfer responsibility for their practical implementation to the actors themselves; in this way the businesses and institutions responsible for the economic activity are made responsible for their actions and can tailor make their responses to the particular circumstances of their operations and geographic locations.

Port authorities and shipping lines must be held responsible for any environmental damage. Failure or inability to act might result in sanctions, fines or revocation of permits.

In 1990 the United States adopted a law on hydrocarbon pollution (OPA-90) stipulating that all oil tankers calling at United States ports must possess double hulls, and that they must possess certificates of financial responsibility

(COFR), demonstrating that the operator of the ship possess sufficient financial resources to cover any spills of oil.

In Sweden, in 1999, the government adopted an environmental code that requires all Swedish ports to acquire an exploitation permit before 2006. To obtain the permit, ports must complete a comprehensive environmental impact assessment of all maritime activities related to transport – navigation, rail, road and pipeline -, energy consumption, and waste disposal. In addition they are required to have identified the measures by which they intend to improve environmental performance. All the study costs required to obtain the permit have to be paid for by the port operators themselves (plate 4).

Plate 4 Environmental code of Sweden, 2004

The environmental code contains 10 principles and rules targeted at the shipping industry.

Operators must demonstrate that their operations are undertaken in an environmentally acceptable manner.

Operators must possess the relevant industrial expertise and the knowledge both of the operation and the area in which it will be undertaken to prevent damage and detriment.

Operators must adopt the precautionary principle to limit the risk of emissions and adopt measures to combat adverse health and environmental effects.

Operators must adopt the best possible environmental technology.

Operators are subjected to the polluter pays principle to protect the environment.

Operators are subject to the appropriate location principle where the choice of site for land and marine operations is compatible with the environment.

Operators must conduct their operations in accordance with the resource management and ecocycle principles to ensure efficient use of raw materials and energy and minimize consumption and waste. It must be possible to use, reuse, recycle and dispose of all materials extracted from the environment in a sustainable manner with the minimum use of resources and without damaging the environment.

Operators are subject to the product choice principle which consists in refraining the use of chemical products that may involve hazards to human health and the environment.

Operators must adopt a result-based management in the light of benefits and costs in applying environmental quality standards that must be achieved by sector, region or date.

Operators must cease all operations causing environmental damage despite the adoption of necessary precautions. The stopping rule sets an absolute minimum level of acceptable health and environmental protection regardless of economic concerns.

Source: Sweden, Ministry of the Environment, 1999.

7.4.5. Planning control measures

For each environmental component it is important to establish specific quality standards. In particular, the overall goal must be the elimination of emissions and toxic substances that threaten health and the environment. In applying measures to the transport industry it is important to build in flexibility to the process to reflect the complexity of the environmental impacts, the rapid technological adjustments being made, and the dynamic nature of the industry itself.

Whatever standards are established, our studies reveal the importance of frequent inspections. In this way changes in legislation, working conditions and technological advances can be adjusted to.

Certification provides a most useful instrument to control maritime industries. Thus ships that conform to the directives contained in Annex 6 of MARPOL may receive an international certificate of prevention of atmospheric pollution (IAPP Certificate). Companies that respect the directives on ship recycling can obtain a “green passport” from the IMO.

7.4.6. Instruments to attain sustainable development

There exist a large number of strategies that ports and shipping companies can employ to achieve sustainable development. From our survey, seven types of instruments may be employed:

Leadership

All strategies to attain sustainability must be based on a consideration of social, economic and environmental dimensions, define orientations and interact with existing policies. In order for an enterprise to successfully develop sustainable policies it must first secure the support and leadership of its most senior executives. Leadership is essential in developing sustainability. Our studies reveal that if the top executives espouse visions of sustainable development it becomes possible to: 1) integrate sustainability in management practices; 2) seek and obtain government support and the participation of partners in building policies; and 3) facilitate the elaboration of strategies seeking equilibrium between environmental and industrial concerns.

Legal instruments

Legislation is one of the most important instruments in moving toward sustainable development. Best practices frequently arise out of regulations and laws established at all levels of government – international, national, regional and local.

Spatial planning instruments

There exist a wide range of geographical and cartographic techniques that contribute greatly to the analysis and interpretation of sustainability. Geographic Information Systems are a vital tool in allowing ports to measure, locate, assess and predict environmental, economic and social impacts. Inventories are a critical step in developing sustainable policies and practices, and GIS is the means by which such data can be manipulated.

Economic instruments

Our survey reveals the importance of economic studies, such as cost-benefit analysis, in assessing prices, taxes, costs, quotas, and subsidies – key parameters in evaluating sustainability. One of the contemporary challenges is to apply monetary values to the environment and to make the costs visible. "Green taxes" are a means of placing a monetary value on an activity that impacts negatively on the environment. Such taxes may become a vital competitive advantage for the maritime sector because of their relatively benign impact when compared with other modes.

Communication instruments

From our studies the importance of communication within the organization is very apparent. Personnel have to be continually trained and informed, and documents have to be prepared for internal use and for wider dissemination. It is important to pass on to customers, suppliers and the local community information about the sustainability practices of the company. This requires a constant improvement in the knowledge of personnel and their responsibilities need to be continually adjusted.

Cooperation instruments

One of the key factors in enhancing the sustainability practices of organizations is their need to improve and expand their institutional capacities for learning and integration of sustainability at the heart of the institution. However, it is not just ensuring that the different parts of the same enterprise work together. Our studies reveal the importance of cooperating with governments and other enterprises, whether clients or competitors. It is through cooperation and collaboration that sustainable development in the maritime industry is likely to be achieved.

7.5. Positive economic impacts

Performance indicators are already used extensively by port operators and shipping companies. They allow the organizations to measure human and financial productivity, to compare economic performance over time and to

communicate their commitment to shareholders, local community and governments.

Extending indicators to include measures of environmental and social performance allows the maritime industry to integrate environmental management within its traditional commercial concerns and to move towards greater sustainability.

Investments

Port authorities and shipping lines have to make significant investments to improve their environmental performance – pollution control equipment, water treatment equipment, energy consumption devices, waste disposal facilities etc. Often these investments are offset by improved economic performance and savings. Thus energy consumption may decline, operations may become more efficient, waste may be reduced, and recycling may produce income.

Tax credit

Taxes and interest levels on borrowed capital may become sensitive to environmental performance. For example, the port of San Diego has installed a program of low-interest loans for businesses renting space that improve their environmental performance.

Insurance

Environmental costs are affecting insurance premiums to an increasing degree, and the trend is likely to grow further. In Sweden firms whose activities impact on the environment are required to pay a premium to cover the expected costs and to cover the costs of environmental remediation. Firms that have developed sustainable development policies may find themselves at an advantage. Already Lloyd's Shipping Register, the marine insurance company, is lowering premiums for shipping companies that possess a recognized environmental management certificate, such as ISO 14001.

Capitalization

In our survey we encountered increasing evidence that adopting environmentally sustainable policies is becoming an advantage in stock market capitalizations. Nearly 15% of the capitalization of Associated British Ports was held by shareholders who seek investments in green companies.

Revenues

Market instruments, such as government financial incentives and subsidies to purchase green technologies, are being exploited by some port authorities and shipping lines to realise economies by becoming more environmentally compatible. A variable rate of tarification is applied by Sweden for passage on

port access channels, enabling green shipping companies to reduce costs, and thereby augment revenues

New markets

We found evidence of new market opportunities opening up because of green policies. The port of Stockholm recognizes shipping lines that operate in a green manner. It awards a “green buoy” to the cruise ship that has made the greatest improvement in its environmental actions over the past year. This award is highly prized by the cruise lines that see it as a marketing tool to attract the growing number of passengers who are concerned about the environment. Port authorities that gain expertise in environmental management not only gain skills that may be commercially marketable to others, but become important resources for improved coastal management in zones beyond the confines of their jurisdiction. In this way port authorities become catalysts for expanded coastal management as well as leading managers of coastal environments. Examples include the port of Le Havre in the Seine Estuary and the port of Rotterdam in the Rhine Scheldt.

Strategic alliances

The port and shipping industries are being marked by a wave of mergers, acquisitions and alliances. A growing number of companies that have adopted environmental sustainability as a strategic goal may be reluctant to embark on an association with others that have not. The threat of taking on liabilities because of a lack of health or environmental policies may deter association. Being green is an advantage in global transactions.

Responsibilities

The question of taking responsibility is at the heart of sustainable development. The policies, practices and directives of the IMO are based on a flexibility of standards and practices that has given rise to a wide range of new techniques and approaches to sustainable development, such as voluntary repair programs, and flexible solutions for technology and financing. The principal advantage for adoption is that the threat of penalties resulting from prosecution is reduced, penalties that would otherwise reduce operating profits. Despite progress the IMO does not retain any powers of sanction, and depends upon securing an international consensus. It must be recognized that there exists considerable regulatory fragmentation in part because there is a wide range of different regional conditions and ecosystems, as well as types of transport. Many countries apply the regulations that conform to the MARPOL convention to ships sailing in their waters in order to avoid risks to health and to protect fauna and flora along coastal environments. Other countries apply national legislations that mandate conditions that are stricter than international standards. In Chapter 4 we demonstrated that there are many environmental impacts not covered by the MARPOL convention. Furthermore, it is difficult to achieve complete consensus to normalize the regulations of the IMO, and

several countries refuse to submit themselves to its rules. Unfortunately many oil producing and exporting countries have refused to sign the MARPOL convention. Nevertheless, our survey has identified circumstances in Europe and East Asia where several national industries that have suffered losses due to their governments signing onto emission reduction agreements have reserved the right to discriminate against maritime companies from countries that have refused to sign the Kyoto protocol.

Research

Several companies are devoting important financial contributions to research and development into techniques of improving environmental performance of port sites and vessels.

Corporate sponsorship

Several enterprises have established foundations to finance historic, natural and community activities, for example by renovating historic buildings, protecting natural sites such as wetland, or creating pedestrian and bicycle paths.

Social responsibility

Several maritime organizations contribute to humanitarian aid, for example by storing and transporting equipment without charge.

7.6. Structure of a sustainable development program applied to ports and maritime transport

The structure of a program of sustainable development applied to ports and maritime transport is highly complex. Figure 2 presents certain of the essential elements that need to be considered in developing a program of sustainable development. While these steps represent distinct stages, it is clear that they are highly interrelated.

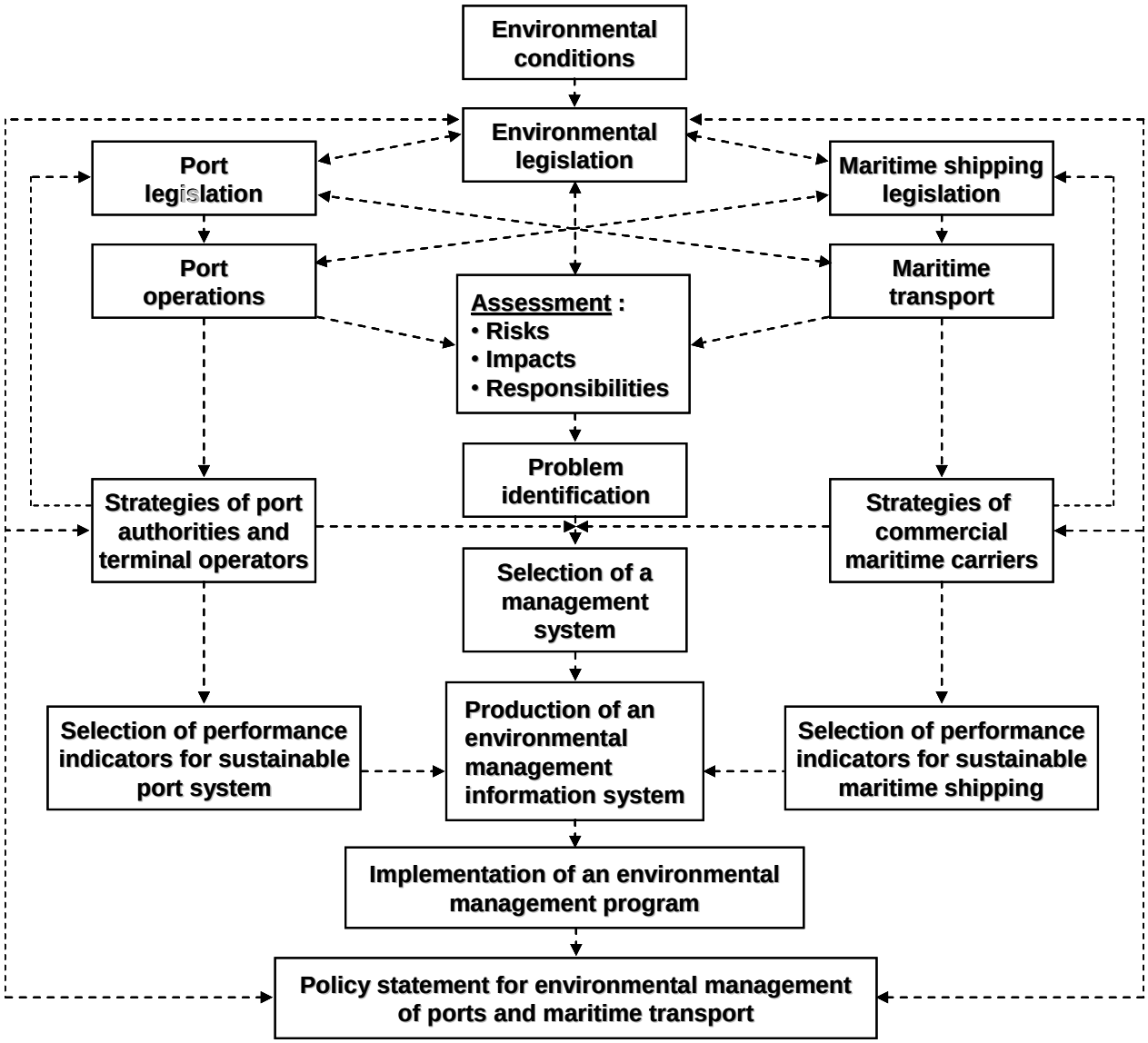


Figure 2 Structure of a sustainable development program applied to ports and maritime transport

- Draw up an inventory of environmental conditions

This step involves establishing an inventory of the geographic, hydrological, climatic etc. factors that are affected by ports and shipping.

- Prepare an inventory of port activities

This step involves inventorying all the activities that take place in a port. An environmental certification of these activities is one of the elements suggested to help structure such a program.

- Draw up an inventory of maritime transport

This step involves setting up an inventory of all activities related to maritime transport. Analysis by traffic type and by network is one approach suggested in preparing the inventory.

- Prepare an inventory of environmental legislation

This step involves identifying all the environmental laws and regulations.

- Draw up an inventory of laws and regulations affecting port operations

This step involves identifying all the laws and regulations that apply to ports.

- Prepare an inventory of laws and regulations affecting shipping activities

This step involves identifying all the laws and regulations that apply to shipping.

- Assess the degree of compliance with the laws and regulations

This step requires a detailed evaluation of the extent to which the ports or shipping industries are in conformity with environmental legislation and an assessment of the impacts of the legislation.

- Evaluate the impacts, risks and responsibilities

This step involves an examination of the trends in the port and shipping industries, such as growth in traffic or vessel size and an evaluation of evolving legislation and government regulations that might impact on the changing port and shipping industries. The specific environmental risks for the industries must be evaluated.

- Determine the capacity of existing programs to limit the risks

This step involves an assessment of the capacity of existing structures to minimize or eliminate negative environmental impacts in an efficient manner. If the impacts are being managed and controlled efficiently, no action is required. In any event this step will determine the importance of modifications and facilitate the elaboration of programs or additional procedures.

- Identify and present the problems to the decision-makers

This step involves identifying the types of activities involved in port and shipping operations and indicating the nature of their impacts on the environment. It should include an estimate of the potential costs and savings involved in adopting an environmental management program, and an elaboration of the risks involved in non-compliance with environmental legislation and regulations.

- Draw up actions to minimize risks

This step involves preparing a set of orientations to guide future actions of the maritime industry, once the real and potential risks have been identified. These orientations can be general or specific, and may incorporate one or several solutions to the resolution of one or more environmental problems.

- Develop and put in place a strategic plan of action

This step involves setting up a series of procedures to carry out each of the previously agreed actions. All the different components should be integrated into a strategic action plan that fixes a timetable for program implementation, draws up a budget, allocates responsibilities for carrying out the action plans, and identifies the means by which progress will be disseminated within the enterprise and without.

- Select and implement an environmental management system

This step calls for the selection of an EMS. Several different models may be considered (see section 7.2):

- EMAS (Environmental Management and Audit System)
- ECOPORTS
- EMH (Environmental Management Handbook of the American Association of Port Authorities)
- ISO 14 000 (International Organization for Standardization in Environmental Management Systems and Sustainability)

- Identify and select appropriate performance indicators from an appropriate environmental management system

This step allows managers to select the principal indicators to be used in implanting an EMS or revising such a program in accordance with the particular standards the enterprise is adopting.

- Produce an environmental management information system

This step consists of constructing: 1) an information database of port and shipping activities; and 2) an ensemble of data analysis methods. These two elements should be organized together in the form of a decision support system to facilitate planning and decision-making in the maritime industry. Not only should it be used within the firm, but be of a format that would allow exchanges with others in the transport community.

- Training personnel involved in all aspect of environmental management

This step involves training personnel in strategic management and planning involved in environmental management. Although this step could be carried out within each enterprise separately, in the long run it would be advantageous for this type of training to be carried out more widely and across the maritime industry. Significant advantages would accrue if there were common approaches to comparable environmental problems

- Elaborate and disseminate an environmental mission

This step, the most important in the planning process, consists of defining an environmental mission for ports and shipping companies. The mission should specify the objectives of the industry whose interests are often divergent because of varied environmental conditions. It should stress the commitment to environmental quality implicit in the maritime industry's management policies.

- Undertake an annual review

This step consists of a continual assessment of the improvements achieved by the environmental management strategic action plan.

7.7. Conclusion

It is likely that in the future the maritime industry will be compromised unless it recognizes and introduces strategies and practices of environmental sustainability. Our study provides an understanding of the means to implement sustainable development for the port and shipping industry and the interrelationships between the economic, social and environmental elements that are at the heart of concept. The survey is international in scope and has demonstrated the commercial impacts of improved environmental performance

for the maritime industry. This evidence suggests there are significant opportunities for port administrations and shipping companies on the Saint Lawrence-Great Lakes system to adopt and implement strategies for achieving sustainable development.

8. THE GREAT LAKES-SAINT LAWRENCE SYSTEM

Before proposing steps to implement sustainable development on the Great Lakes-Saint Lawrence System in Chapter Nine, this chapter reviews the background conditions. The review includes: 1) a brief profile of the Great Lakes-Saint Lawrence System; 2) an outline of the actions of the Ministry of Transport of Québec; 3) a description of the recent initiatives of Transport Canada; and, 4) a survey of the joint initiatives of Canada and the United States.

8.1. Great Lakes-Saint Lawrence System

Great Lakes-Saint Lawrence System is indubitably one of the great navigable arteries of the world. The 26 ports on the Saint Lawrence section handle 100 million tons of cargo a year.

Overall, 70% of the traffic of the Saint Lawrence is international in character, and thus does not involve multi-port services on the river. Four ports dominate this international traffic: Sept-Îles, Port Cartier, Montréal and Québec. The explanation for this lies in the nature of international commerce that relies on scale economies. Most of the smaller ports play a minor role in international traffic because they have neither the traffic base nor the necessary port infrastructures to make a significant contribution to international marine transportation.

National traffic (the commerce between Quebec ports and the rest of Canada) accounts for only 15% of the total. Even here, a portion is involved in international trade, being bulk cargoes received from Canadian Great Lakes ports that are ultimately destined for overseas markets after transhipment at deep-water ports on the North Shore. This traffic between Quebec and Canada is constrained by water depth restrictions on the Saint Lawrence Seaway, and Canadian policy favouring grain shipments via West Coast ports. Québec's small and medium size ports play a minor role in the traffic between Québec and the rest of Canada. Their share of the market confirms their marginality in the major shipping flows that are oriented towards exports and transfers of the major commodity groups.

Regional traffic (shipments between Québec ports) accounts for a further 15% of the total. While Sept-Îles, Port Cartier, Montréal and Québec are the gateways between Québec and the rest of the world, the small and medium size ports are the principal participants in regional traffic. This relationship between the spatial scope of the links and port size is not unexpected. The largest ports possess the physical capacity and the organizational ability to carry out the complex commercial transactions involved in international trade. They are integrated into several commodity chains: iron ore to the Great Lakes, exports of industrial products and grain from the heart of the continent overseas, and container flows from the United States Mid-West to Europe.

Smaller ports lack the capacity to participate in these massive chains. Rather, they play an important role in the coastal trade within Québec. This traffic is characterized by two distinct functions. The first involves the shipments of raw materials and goods between local industries. In this way the small and medium size ports play an important role in the maintenance of local industrial infrastructures and local communities along the shores of the river. The second function is the regional distribution of products such as petroleum products, salt and general cargo. Within these two groups there exist important differences, notably in terms of traffic growth. Many small and medium size ports are experiencing traffic declines, particularly in the second category of traffic because of competition from other modes, especially road traffic. Small and medium size ports largely involved in industrial shipments on the other hand have recorded traffic growth.

Concerning short sea shipping on the Saint Lawrence River, it is important to distinguish between traffic downstream and upstream from Montreal. Downriver, there is a marked difference of traffic between the north and south shores of the river. On the north shore short sea shipping is more developed and in some cases is the only freight transport mode available. On the south shore, there is intense competition from other modes, including the railway, but most notably trucking. Short sea traffic is dominated by forest products.

Upriver in the direction of the Great Lakes, short sea shipping has registered important declines. The exception is general cargo. But cargo traffic is more and more containerized. Rail transport has the most important market share being very competitive since rail can deliver freight in less than 48 hours.

It must be recognized, that despite the presence of 90 million people living along the shores of the Saint Lawrence-Great Lakes system and despite the fact that it generates 30% of the GDP of the continent, the fluvial axis is less intensively utilized than comparable systems elsewhere in the world, such as the Rhine in Europe and Yangzi Jiang in China. This underdevelopment has been recognized for more than 50 years.

Several reasons have been put forward to explain the underdevelopment, including:

- modal competition, in particular truck transport for regional and transborder shipments;
- competition from other routes, particularly the Mississippi;
- the physical limits of the Saint Lawrence Seaway because of the dimensions of the locks, the length of transit times to pass through the system, channel depth limitations, etc.; and
- closing of the Saint Lawrence Seaway during the winter months.

8.2. Initiatives of the Québec Ministry of Transport

Ever since the opening of the Saint Lawrence Seaway in 1959, the federal governments in Canada and the United States have largely ignored the system.

The government of Québec began to play a leadership role in trying to remedy the situation and has acquired an expertise that has been recognized by several national and international organizations. During the 1980s, the Québec government established the Secrétariat à la mise en valeur du Saint-Laurent, a body set up to promote the river system as a means of furthering the economic development of Québec.

In 2001 the Québec Ministry of Transport along with several partners launched a Maritime and Fluvial Policy, one component of which was to remedy the historic underutilization of the river and to fill the void created by the withdrawal of the federal government from many marine activities. Over the previous decade the Canadian government had withdrawn its financial support for navigation and for the maintenance of ports, many of which on the Saint Lawrence River had closed. Responsibilities for port management and planning had been transferred to local bodies, many of which are poorly equipped to respond to the challenges of sustainability. In 2002, Transport Canada transferred jurisdiction over 10 ferry terminals to the government of Québec that has delegated responsibility for their management and operation to la Société des traversiers du Québec. This new body is also charged with considering new strategies to respond to the challenges.

The Maritime and Fluvial Policy adopted by the Québec Transport Ministry and its partners recognize the need to develop sustainable maritime transport. One of its objectives is “to manage in a concerted and integrated way maritime and port activities in a perspective of sustainable development”. Many actions have come about as a result of this engagement, some within Québec such as the National Water Policy, others involving cooperation between Canada and Québec, such as the Saint Lawrence Action Plan, while others have been at a regional bi-national scale, the Great Lakes Commission, for example.

Over the last five years, in assuming the co-presidency of the Navigation Consensus Building Committee (NCBC), the Ministry has invested a great deal of energy in developing a Sustainable Navigation Strategy (www.slv2000.qc.ca). This strategy, launched in 2005, presents the actions that will be put in place by the maritime community of the Saint Lawrence River that will respond nine challenges confronting sustainable maritime transport: cooperation; integrated management for dredging and sediments; the options available to adapt navigation to variable water levels; improving the management of waste used water; erosion; risks of the introduction of exotic species in ballast water; collaboration between shoreline communities threatened by oil spills; and the promotion of maritime transport because of its

environmental and social advantages. The NCBC, as indicated by its definition of sustainability, is focused on commercial navigation and recreational boating, including the operations of vessels at berth, but it does not consider port activities in general. Thus, the maritime community of the Saint Lawrence can be seen to have made a partial response to the challenges of sustainable development.

After all the interviews we undertook in carrying out this study, one fact stood out: only the port of Montréal had an environmental program. The administrations of small and medium ports appear to lack any sensitivity to the environment, or if they do they see it is the role of the commercial shipping operators to respond. Not one member of the maritime community on the Saint Lawrence River possessed an environmental management system in 2005.

8.3. Recent initiatives by Transport Canada

Canada has for many years recognized the importance of protecting the marine environment. It became a member of the IMO in 1948. It is signatory to Annexes 1, 2, and 3 of MARPOL 73/78. The minimal nature of this engagement is explained by the fact that Canadian legislation in marine affairs is stricter than the IMO regulations. In 2002 Canada ratified the Kyoto Protocol. In 2004, Transport Canada presented its third sustainable development strategy, the first having been presented in 1997 and the second in 2001.

It was not until 2003 that the Canadian government responded to the issue of the underdevelopment of the Saint Lawrence-Great Lakes system. It came about by the realisation that short sea shipping needed to be promoted. Transport Canada subsequently published a report “Straight ahead, a vision for Canadian transportation”. It undertook to explore ways of expanding short sea shipping in order to promote trade, improve the utilization of waterways, relieve road congestion, and reduce greenhouse gas emissions. The major impetus for this policy was the increasing environmental problems generated by trucks, and the need to divert truck traffic to “greener” transport modes.

Since the fall of 2003, regional meetings have been held in several cities across the country including Edmonton, Halifax, Montréal, Oakville, Thunder Bay, Windsor and Winnipeg. These meetings brought together shippers, transport providers, intermediaries and civil servants to identify problems and discuss solutions to promote short sea shipping.

These meetings identified many obstacles, including:

- regulatory barriers including obligatory pilotage, seasonal traffic, restrictions on night sailings, electronic documentation for United States shipments, restrictions of the Coastal Shipping Act, United States ship inspections and the Harbor Maintenance Tax;

- competition from trucking which does not pay the real costs of utilizing public highways, when ships are being called upon to pay user fees;
- high capital costs for replacing ships and maintaining ports;
- complexity of intermodal transport compared with unimodal shipments;
- absence of intermediaries to organize commerce;
- physical barriers, such as water depths, the length of the navigation season;
- absence of cooperation between members of the industry;
- absence of short sea shipping promotion.

In the regional workshops specific markets for short sea shipping were suggested. From the Québec meetings came the following markets:

- Aluminium
- Waste products
- Petroleum products
- Forest products

Specific routes that could be promoted were identified. From the Québec meetings came the following suggested routes:

- Montréal–Sept-Îles
- Baie-Comeau–Trois-Rivières

8.4. Canada–United States initiatives

Canada and the United States signed a Memorandum of Cooperation on Short Sea Shipping in July 2003. It called for a sharing of information and research, for an exchange of experiences with the elaboration of policies and cooperation with other partners in the maritime industry directed at promoting short sea shipping. In November 2003 the Memorandum was modified to include Mexico.

8.5. Conclusion

The Saint Lawrence-Great Lakes system is something of a paradox. It represents a unique fluvial artery connecting the Great Lakes to the Atlantic Ocean. International traffic on the system has registered growth over the last 50 years, but domestic traffic has declined. The Saint Lawrence-Great Lakes system is relatively underdeveloped and underutilized. The decline of traffic within the system is in marked contrast to other great internal waterways in the world, such as the Rhine in Europe, the Mississippi in the United States, and

the Yangzi Jiang and the Zhujiang in China. In many coastal areas of the world not favoured by inland waterways, coastal shipping is extremely important, such as around Singapore, the Bohai Sea, the Sea of Japan, the Baltic Sea and the Mediterranean Sea. In all these examples inland and coastal shipping are exploited because they possess high carrying capacities, in contrast to land transport modes that are becoming increasingly congested.

The relative underdevelopment of the Saint Lawrence system has many causes. The shippers, shipping industry and port authorities are certainly competent, but they have largely failed to respond to the opportunities presented by the challenges of sustainable maritime transport. The great majority of shippers rarely consider maritime transport as an alternative to their existing modal choices. The shipping lines, while recognizing environmental concerns, tend to be reactive and devote resources to international cargoes where there is little modal competition. Ports play important roles in logistical chains but port authorities have been largely reactive in their responses to environmental and social challenges.

Improving the value added of the Saint Lawrence system requires the contributions of all the participants. Their own competitiveness depends on such cooperation. New markets must be exploited, particularly in the domestic area in order to effect a modal shift in favour of water transportation. At the same time each participant must move towards adopting an environmental management system in order to integrate transport operations with environmental imperatives and to introduce best practices.

9. SYNTHESIS AND RECOMMENDATIONS

9.1. Introduction

The Québec Ministry of Transport has suggested that an international portrait of the sustainable development strategies and practices applied to ports and shipping would make a contribution to the process of elaborating policies and making decisions concerning the application of the principles of sustainability to the Saint Lawrence-Great Lakes system. This study provides an original contribution to the diverse forums presently considering regional actions for the Saint Lawrence-Great Lakes system. It provides input for a reflection concerning issues of sustainability at both the global and the local Laurentian scales.

The recommendations discussed below are addressed to the maritime community of the Saint Lawrence system to encourage port administrations and shipping companies to apply sustainable development strategies. This chapter provides a summary of the salient facts and provides a number of recommendations. The salient facts and recommendations 9.2 to 9.8 correspond to each of the chapters in this report, and address issues relating to the Saint Lawrence system. Recommendation 9.9 concerns research needs at the international level.

9.2. Contemporary conditions shaping the development of transport systems

9.2.1. Salient facts

Transportation is basic to all economic activities. All the scenarios of economic growth are based on increases in freight traffic, passenger and information flows. Between 1996 and 2000 international commerce grew faster than the increase in the size of the world's fleet. This suggests an improvement in world shipping productivity, achieved by an increase in load factors. It equally spotlights the accumulation of ties between infrastructures, industrial production and the built environment.

In this context, no region of the world can escape the importance of intermodality. It involves the largest markets, generates high returns, and offers considerable potential for growth. In addition, the organization of transport linked to intermodal and technological progress is increasingly based on the quality of logistics services.

Logistics and intermodality give rise to economic, social and environmental change. Transportation needs to be economically viable while being considerate of the social and environment conditions of the host communities. In this regard maritime transport has a major role to play. It is an efficient mode, capable of handling large quantities of freight, and with the capacity to

take on traffic diverted from overloaded land transport systems. Maritime transport is particularly well suited to play a major role in achieving sustainable development. However, despite being perceived as a "green" mode of transport, it does generate some negative effects on the environment.

9.2.2. Recommendations

Enhance the development of intermodality – Ports need to be supported. Port access is one of the major factors that influences freight flows. Public policies and programs must not lose sight of this fact. Improving the interface between maritime transport and rail transport is an important step in promoting shipping and widening intermodal options. The Québec Transport Ministry should continue to explore and increase partnerships between short sea shipping and the railways.

Integrate logistical chains – The promotion of maritime transport involving the groups most involved with the industry must not ignore the nature of freight flows, freight handling companies, and the economic competitiveness of logistical chains. Because of the importance of logistics in the commercial strategies of companies active in international commerce, members of the maritime transport industry must work to integrate short sea shipping into logistics chains.

Place maritime transport at the heart of green logistics – Our international survey indicates that short sea shipping must integrate itself into logistical chains and further improve its environmental performance. Truck manufacturers are already making significant investments to improve the fuel consumption and gas emissions of vehicles. As green as maritime transport may be, it must confront its problems, notably SO_2 and NO_x, and the efficiency of roll-on roll-off ships. Programs must be introduced to respond to these problems in order to permit the shipping industry to compete with trucking in just-in-time operations.

9.3. Sustainable maritime transport

9.3.1. Salient facts

The literature review and the international data collected between April 1, 2003 and March 10, 2005, demonstrate that long-term sustainable development includes environmental, social and economic dimensions. There is widespread consensus on the importance of these three dimensions. The environmental dimension requires a balancing of the interactions between human activities and the natural environment. For the social dimension, the objective is to find solutions to contemporary problems raised by technology and economic growth in order to channel changes to respect present and future societies, in the context of democratic participation and international legislation. For the

economic dimension, the objective is to orientate progress in the direction of economic efficiency.

Through the literature review, we have demonstrated that environmental conditions may complicate, delay, or constrain maritime transport. The competitiveness of ports and shipping companies is partly determined by the physical geography of coastal zones and passages, which may limit port expansion and the ability to accommodate ever-larger ships. Technology has given the maritime industry the ability to modify the environment. These modifications that impact on the biophysical environment engender costs: vulnerable ecosystems may be transformed, others may be destroyed, while in some other cases artificial ecosystems may be created.

Our study has demonstrated that the paradigm of sustainable development is increasingly taking root and has become an essential factor in the functioning, organisation and performance of the maritime industry – port administrations and shipping companies.

In a very large number of countries adjustments to legislation are being undertaken to conform to the rules and regulations of the IMO. This study stresses that compliance with international conventions involves both the private sector and the signatory states who may apply the rules in many ways, notably by self-regulation of the industry, or by the controls established by the coastal state, the flag state of ships, or the state in which the port is located. It has been demonstrated that these means of control are favourable for port operations and shipping.

In addition, our study reveals that port administrations and regular shipping lines that are preoccupied by economic and market concerns, increasingly must consider social and environmental factors in their business strategies in order to respond to the increasing concerns of their customers and the communities in which they operate. Adopting a strategy of sustainable development may give ports and shipping lines a competitive advantage, and enhance efficiency and profitability.

Our study has demonstrated the intense links between the environment and the maritime industry. The recent growth in global commerce has raised concerns about the negative environmental impacts of port operations and shipping. Two different approaches to the problem are evident. The first is a “top-down” approach; the second is seeking solutions from the “bottom-up”. In the first approach, international organizations and governments assume a leadership role in mitigating environmental impacts. Over the years environmental legislation has grown to touch a wide range of issues in the context of sustainable development. At the same time, some port authorities and shipping lines have begun to introduce environmental performance in their business strategies. This is a “bottom-up” decision making process.

9.3.2. Recommendations

The need to recruit qualified personnel – The scope of a sustainable maritime transport industry is immense. The environment has become an integral component of the industry in terms of its obligations, responsibilities and competitiveness. Governments and the industry must ensure that personnel members qualified in environmental assessment and management are employed.

Support research and development – Governments, port authorities and the shipping companies have to develop the means to achieve equilibrium between access to infrastructures and environmental protection. It has been demonstrated that research and development can provide the means to respond to environmental challenges. This requires governments, port authorities and the shipping industry to support research and development as well as requiring professional and scientific training for some of their personnel.

Promote partnerships with universities at an international scale – Given the international character of the challenges confronting the maritime industry, the literature review confirmed that it is multi-disciplinary teams that have produced the best results. Supporting the collaboration with existing colleagues in Europe and Asia is important. It is also necessary to establish strong links with other international networks and research centres.

Reinforce university – industry partnerships – The literature review on sustainable development and the interviews undertaken in Europe, Asia and North America indicated that in several cases university representatives sat on the boards of port authorities and shipping lines. This provided the industries with privileged access to university research, and brought industry concerns to the attention of university researchers. This is one means of integrating research products with real and practical situations.

9.4. Global overview of sustainable development practices applied to ports and shipping lines

9.4.1. Salient facts

With the goal of determining the sustainable development perspectives of the maritime industry, we constructed a database comprising 800 ports and 120 shipping lines. These enterprises differ greatly in terms of ownership, sources of financing, types of activities and traffic volumes.

From the evidence collected it is clear that the maritime industry will face many challenges, problems and legislative obstacles in achieving the goal of sustainable development. Nevertheless, there appears to be a consensus about the relative importance of the different challenges. Through the international survey we ranked and examined the most important challenges

identified by the industry itself. Many of these challenges were shared by port authorities and the shipping companies (water quality, air quality, waste management, resource conservation, energy consumption, emergency plans, oil spills, antifouling paints, dust emissions), while others were specific to one or the other. Thus, noise, dredging, soil contamination and odours were problems identified by port authorities and the transportation of hazardous materials were issues raised by shipping lines.

Port authorities or shipping lines that fail to respond to these challenges will be marginalized. This eventuality will apply across all geographical regions to all port authorities and shipping companies.

The results of the international survey of sustainable development practices by ports and shipping lines reveal a wide range of strategies and practices. Several maritime industry leaders have adopted sustainable development as one of their major concerns. At the international level, the port authorities that exhibit the best examples of environmental leadership are found in Australia, Northern Europe and the West Coast of North America. The best performers among shipping lines include MOL and NYK of Japan, P&O Nedlloyd of the United Kingdom and Wallenius Lines of Sweden.

9.4.2. Recommendations

Set standards by legislation – Given the continuing need for environmental legislation, the Québec Transport Ministry should work in close collaboration with the Ministère du Développement durable, de l'Environnement et des Parcs of Québec in order to: 1) identify the legislative lacunae in resolving the environmental challenges that are under provincial jurisdiction; 2) develop a regulatory framework addressing the principal environmental preoccupations of the international maritime industry; 3) work in partnership with other federal ministries to set the standards to at least international levels; and 4) collaborate with the federal government to raise international standards.

Reinforce the legislative framework – To respond to environmental challenges, Canada has favoured voluntary actions. Our study reveals that on the international scene sustainable development policies are becoming more and more restrictive. Transport Canada and the Québec Ministry of Transport should collaborate to become even more pro-active in implementing sustainable development strategies.

Ensure the actions of the industry respond to international priorities – Given the complexity of regulations (international, federal, provincial) and the difficulty faced by port authorities and shipping companies in Québec in setting in place strategies of sustainable development by themselves, the Québec Transport Ministry should: 1) promote the importance of internationally recognized environmental challenges and sustainable development in the competitiveness of the maritime industry; and 2) identify the problems, the regulations and

obligations that must be taken into account in order to improve the performance of the maritime industry.

Identify and support industry leaders – Our survey in the Saint Lawrence-Great Lakes system demonstrates that important steps have been made to establish partnerships to support decision-making in the context of sustainable development. As praiseworthy as these steps may be, our study indicates that at the international level, leadership from specific enterprises is instrumental in ensuring the success of sustainable development practices.

9.5. Short sea shipping

9.5.1. Salient facts

Short sea shipping appears to be the transport mode most capable of resolving many of the problems brought about by the increased use of transport in the context of sustainable development. Many countries around the world have recognized the importance of promoting short sea shipping because it possesses a number of commercial and environmental advantages. More detailed analysis reveals, however, that this perspective has to be nuanced. Inevitably, different components of the industry give rise to a wide range of environmental benefits as well as drawbacks. Moreover, the tools available to promote the industry differ considerably. Any promotion has to recognize the strengths and weaknesses of short sea shipping, especially in terms of taxation and administrative procedures. Developing short sea shipping also requires that the links with other modes be harmonized, which in turn raises problems of investment allocation.

9.5.2. Recommendations

Maintain an active presence – Given that the Saint Lawrence River constitutes a major maritime and fluvial corridor, the government of Québec should maintain an active and on-going presence in Canadian and North American government agencies to promote the principles, practices and policies relating to sustainable development applied to the port and shipping system.

Promote short sea shipping – In consideration of the complexity of administrative procedures that have already been identified in Europe and Canada, the Québec Transport Ministry and its partners should: 1) specify the particular problems that are constraining short sea shipping; 2) seek to resolve them; and, 3) pursue steps to promote short sea shipping. Such promotion should focus on decision makers in the private sector, since they are likely to be influenced by evidence of best practice by their competitors.

9.6. International portrait of the policies to promote short sea shipping

9.6.1. Salient facts

Sustainable development is at the heart of the main interventions promoting short sea shipping, but we have observed that environmental concerns remain secondary. The diffusion of knowledge concerning best practices has been a critical factor in the promotion of short sea shipping, particularly if this promotion provides evidence of integration in transport chains. Promotion requires the participation of all levels of government, and administrative as well as political action is required. The evidence points to the greatest success being achieved by a relatively small number of government agents who have experience and responsibility for short sea shipping.

9.6.2. Recommendations

Strengthen promotion at the provincial level – Short sea shipping requires promotion. The European short sea centres represent an excellent model. These local centres appear to be well placed to carry out promotion. However, the lessons learned indicate that promotion should not favour one type of enterprise or one route, but rather serve as catalysts for the development of the entire short sea shipping system. The local actors representing the industry must be assembled to identify specific problems and work on collective solutions. In addition, there must be cooperation and collaboration with other short sea promotion centres

Strengthen the Québec Round Table on Short Sea Shipping – At each level of government, federal and provincial, an individual or group should be recognized to carry out specific responsibilities concerning short sea shipping. Given the complexity of jurisdictions governing the Saint Lawrence River, these individuals and groups must cooperate regularly. Established at the instigation of the ship owners of the Saint Lawrence, the Round Table on Short Sea Shipping is a group whose increased role should be considered.

Evaluate the environmental impacts of transport modes – Politicians and future clients of short sea shipping are influenced by its merits not only from success stories but also by comparisons between the modes that consider congestion and costs and environmental benefits.

Obtain political support – Chinese experience demonstrates that public administrations possess the legislative means to further the development of short sea shipping. However, the transport ministers need to be convinced of its merits. Civil servants may make important contributions in this regard, but it is also necessary to gain the support of members of the legislatures. A small number of members can play important leadership roles in promoting short sea shipping. The local short sea shipping committees can serve as information

providers to the politicians to ensure that they are kept abreast of the problems, needs and strengths of the industry. Given the large number of federal and provincial ridings that touch the Saint Lawrence River, this action should be a realizable objective.

Integrate short sea shipping within transport chains – In North America, the railways represent a more efficient mode for freight transport than is the case in Europe. This suggests that partnerships between rail and short sea shipping should be explored and developed in the case of the Saint Lawrence system.

Convince the shippers – While this study demonstrates the importance of legislation, it clearly identifies the shippers as being the key decision makers affecting modal choice and routing. Ultimately the success of short sea shipping depends on the ability to convince more shippers to utilize this mode. This is unlikely to be achieved without difficulties. European experience suggests that shippers do not attend promotion meetings or conferences. Furthermore, it is sometimes difficult to identify who within a company actually makes transport decisions. The largest firms may have several independent shipping departments that are sometimes in competition with each other. The best solution appears to be an individual approach, in which precise and reliable cost data are presented to potential users. Here the local promotion centres can play a major role.

9.7. Applying sustainable development strategies to the maritime industry

9.7.1. Salient facts

Relations between ports, maritime transport and sustainable development take place at many geographical scales. Our study demonstrates the particular relevance of importing knowledge, experience and practices of sustainability applied to ports and shipping. For several years the concept of sustainable development has led several port administrations and shipping lines to adopt sustainability as a fundamental principle of their business policies and to implement measures to reduce the environmental impacts of their activities. Our study indicates that there are many ways in which to implement sustainable development that take into account social, economic and environmental factors. One of the bases of all these methods is an environmental management system, to which social and economic dimensions are added. Our detailed interviews reveal the increasing adoption of environmental management systems by port authorities and regular shipping lines in many parts of the world.

There exist many different environmental management systems. Our study suggests that the choice is particular to each enterprise, based on the risks measured or perceived by the enterprise and on the geographic milieu of the company's operations. The structure of an environmental management system

for ports and shipping lines is complex. However, several basic interrelated factors need to be considered in the elaboration of a management program. The adoption of an environmental management system (EMS) requires the conformity of marine operations with environmental legislation. The most elaborate EMSs involve international certification.

All environmental management systems are influenced by constraints of application and by management strategies. The trajectories of sustainable development depend upon the roles port authorities and shipping companies can or should play in the process. There are several measures that need to be put in place to facilitate the administration of a system in the maritime industry. These include quantifying indicators, formulating a schedule of operations, establishing environmental standards, fixing responsibilities, planning control mechanisms and selecting sustainable development measures.

Our analysis underlines the important role of governments in elaborating policies, strategies and measures to attain the social, economic and environmental goals of sustainable development. Having defined these goals, the best way to implement them is to transfer the responsibility to port authorities and shipping companies themselves. These actors can thus apply the policies in light of their particular geographical and sectoral conditions.

Our study has revealed a great interest of port authorities and shipping lines in performance indicators. These indicators should: 1) measure the human resource and financial implications of existing environmental and sustainability efforts; 2) compare this performance over time; and 3) communicate the results to shareholders, the community and the government. Applying performance indicators is a means of integrating environmental management within the traditional commercial interests of the enterprise.

9.7.2. Recommendations

Develop tools to help implement the best sustainable development practices – Given the complexity of implementing sustainable development strategies for ports and shipping lines, the Québec Transport Ministry should work in partnership with Transport Canada to develop computer-based information system manuals that would: 1) identify the linkages between ports and shipping and components of the environment; 2) identify the links between environmental legislation and components of the environment; 3) outline techniques for evaluating risks; 4) provide methods to measure impacts; 5) help identify responsibilities; 6) identify particular environmental impacts that must be addressed; 7) consider the commercial strategies of port authorities and shipping companies; 8) help introduce best practices; and 9) demonstrate how to undertake an on-going process of review and assessment.

Undertake pilot projects – Given the diversity of geographical conditions, the diversity of maritime traffic and the different types of shipping lines, the tools

suggested above should be tested by the Québec Transport Ministry and Transport Canada on a small sample of ports and shipping lines on the Saint Lawrence, prior to its wider distribution.

9.8. Saint Lawrence-Great Lakes system

9.8.1. Salient facts

Comparing the grand axes of fluvial transport in the world reveals that the Saint Lawrence is a privileged system, but is one that is under-utilized for freight transportation.

Important progress towards sustainable development has been made by different levels of government in Canada over the past few years. In Québec, this is manifest with the publication of the Maritime and Fluvial Transport Policy. Nevertheless, important lacunae in laws and policies are evident. Certain problems that have been recognized internationally, such as soil contamination, dust emissions, odours, noise etc. have not been properly addressed by legislation in Canada.

Interviews undertaken in Québec reveal that only the port of Montréal has an environmental program. The other port administrations on the Saint Lawrence ignore the challenges of sustainable development or assume it is the responsibility of the commercial terminal operators. Moreover, no port administration or shipping line in 2005 possessed an environmental management system.

The complexity of international, federal and provincial legislation and the frequent changes constitute a brake on implementing sustainable development strategies in the port and shipping industry and in the development of short sea shipping on the Saint Lawrence River.

Small and medium size ports do not appear to demonstrate an environmental sensibility.

9.8.2. Recommendations

Increase the role of government – Given: 1) the positive results observed internationally that are the outcome of strong government leadership in sustainable development; 2) the number and diversity of ports in Québec; 3) the extent of the maritime facade of the province; 4) the volume of international, national and regional traffic; and 5) the presence of a large fleet of regular shipping lines that navigate the Saint Lawrence, the Québec Transport Ministry along with its partners should enhance its involvement in drafting strategic policies and plans for achieving transport sustainability on the Saint Lawrence River.

Incorporate international best practices – The Saint Lawrence system is unique in many ways, notably because of its geography, its population distribution, the spatial structure of its economy, and its ecosystems. Thus local solutions must be sought to reflect the particularities of the system. Nevertheless, this study has revealed that successful actions undertaken elsewhere in the world need to be considered as well.

We have demonstrated that a comparative study that is international in scope is a fecund way of identifying solutions to problems of planning and managing sustainable development confronted by port administrations and shipping lines. This type of methodological approach needs to be extended.

9.9. International survey of sustainable fluvial-maritime transport

9.9.1. Salient facts

Market globalisation and increases in international commerce will bring about further growth in the volume of interior and coastal maritime traffic. The competitiveness of the maritime industry will depend upon the modernization of major fluvial axes, the adoption of sustainable development practices, and their integration into global maritime networks. The development of fluvial-maritime axes and the studies that have been undertaken to promote their development have lacked a comparative focus. Studies of individual river gateways seriously limit the possibilities of exchanges of information, restrict understanding of the internal and external forces shaping the development of coastal and interior maritime transport, and prevent the elaboration of solutions that are integrated with global supply chains and green logistics.

9.9.2. Recommendation

Support further research – The maritime community of the Saint Lawrence system (industry, Québec Transport Ministry, etc.) should support a second phase of research on sustainable maritime transport with the goal of maintaining the competitiveness of the Saint Lawrence system.

9.9.3. New research axes

Our research team combines Québec expertise in the field of maritime transport, drawn from the universities of Montréal, Laval, du Québec à Rimouski, and Concordia. It has already defined a comparative international research project.

This program covers four themes:

To understand the environmental conditions of inland maritime transport axes – The objective is to identify the environmental challenges confronting several

of the major watersheds in the world, and to assess the contributions made by the different transport modes to environmental pollution.

To measure the traffic flows – The objective is to measure changes in traffic flows; to measure the independence and integration between interior, coastal and international traffic; and, to evaluate the capacity of the ports to cope with anticipated changes.

To analyse the institutional structure – The objective is to understand the institutional character of fluvial systems along three dimensions: 1) ownership; 2) planning and, 3) organization of services.

To analyse choice criteria of shippers – The objective is to measure the potential for the logistics development of fluvial-maritime axes under three considerations: political, commercial and environmental.

10. CONCLUSION

This research has enabled us: 1) to identify the operating conditions of the maritime industry; 2) to understand the trends underlying sustainable transport policies; 3) to see how sustainable development strategies and best practices are used by port authorities and shipping lines; 4) to compare various principles and promotion policies for short sea shipping; 5) to conceive a sustainable development program applied to ports and marine transport; 6) to evaluate the commercial impacts linked to the adoption of sustainable development practices; and 7) to integrate the research results in the context of the Great Lakes–Saint-Lawrence system.

The results contained in the report bring to light several key features.

First, our study reveals the complexity of the relationship, and also that the process of pollution prevention and control is well underway. We believe that governments will continue to play a major role in the elaboration of the policy orientations, strategies and measures needed to achieve the economic, social and environmental objectives of sustainable development. Our surveys underline the importance of government actions in promotion and coordination activities. The best practices are those that rest on a small number of individuals assuming responsibility for the development of “green” ports and short sea shipping.

Second, growth in marine traffic increases the need for the adoption of environmental management programs, since marine environment quality is fundamental to traffic growth . This however, underlines the importance of data collection and risk evaluation processes. There are numerous positive examples where industry contributes to sustainable development. Leadership by businesses thus plays a crucial role in the sustainable development practices.

Third, our analysis suggests that tactics driven by liberalisation and globalization have an unpredictable impact on sustainability, and that the success of policies geared towards sustainability will largely depend on the privately-owned activities of commercial carriers and terminal operators that are also concerned with financial sustainability. As our study demonstrates, the increasingly strong link between environmental performance and competition within the industry suggests that a policy framework should be designed to give operators assessing rights.

Fourth, as the share of maritime traffic increases, the shipping line-hub issue will become more acute. Without green certification, the development of international hub port status will be limited as the ports with the best environmental performance stand to benefit. This could have a profound effect on the Great Lakes–Saint Lawrence system. Despite efficient policies, promotion activities and best practices within the industry, external factors such

as local community groups or demands from shippers remain critical in implementing sustainable development strategies and practices. Everywhere the marine industry acknowledges these forces as favourable opportunities for the adoption of green strategies or the development of short sea shipping.

Sustainable development of the Great Lakes–Saint Lawrence system cannot be considered in an isolated way. But it can easily become the spearhead for the development of Québec's transport system. More importantly, the integration of sustainable development issues with shipping policy provides a research agenda abounding in opportunities for comprehensive development in Québec.

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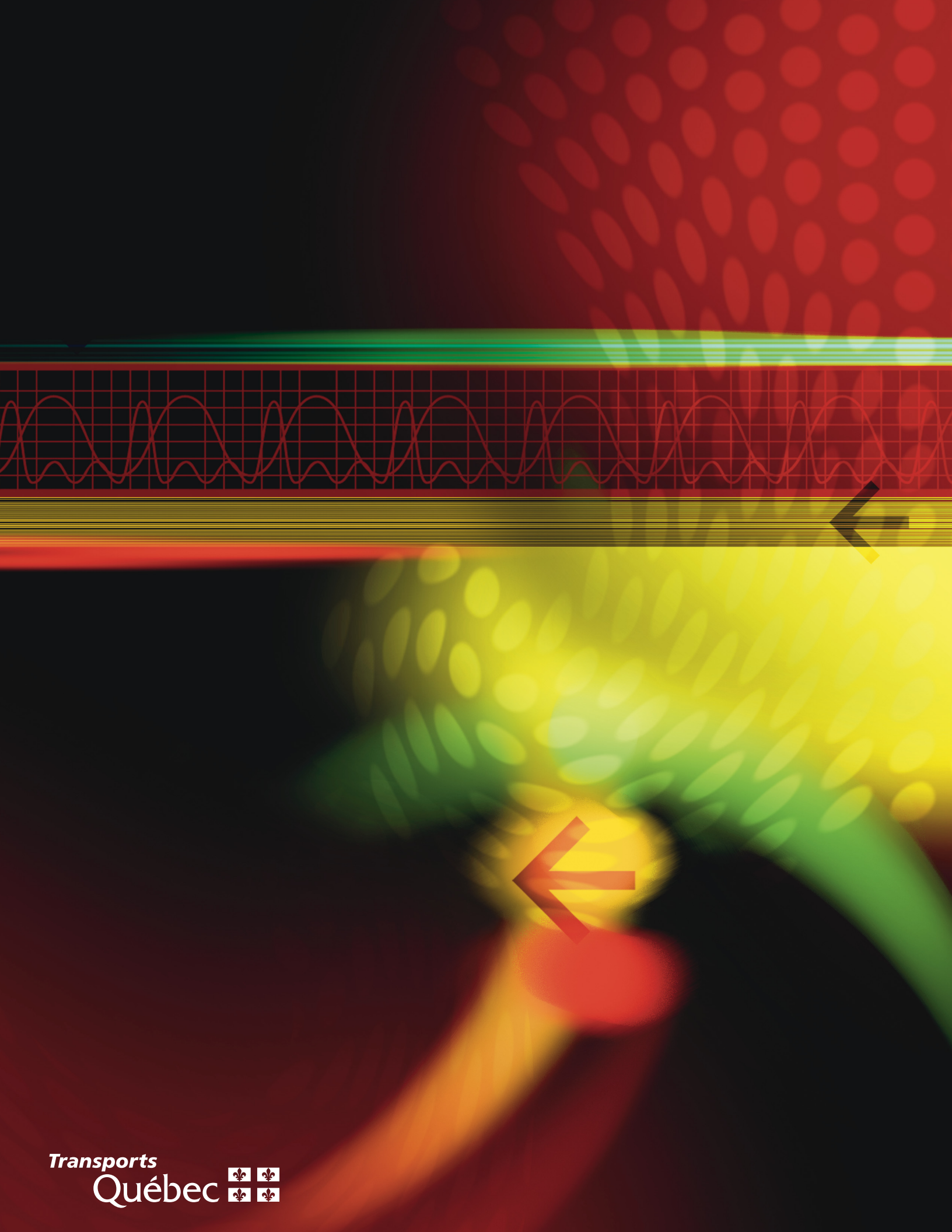
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