

**A Comparative Study of Port Environmental Management in
Canada and China**

by

Yue Gao

A thesis

presented to University of Waterloo

in fulfilment of the

thesis requirement for the degree of

Master of Arts

in

Planning

Waterloo, Ontario, Canada, 2008

© Yue Gao 2008

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

Signature

I understand that my thesis may be made electronically available to the public.

Signature

Abstract

Ports are the foreign gateway for countries and regions, and it is playing an increasingly important role in the world economy. While embracing the economic benefits brought by port development, Chinese ports are also faced with an unprecedented number of environmental problems. The overall goal of this thesis is to explore the similarities and differences between Canadian and Chinese ports in terms of their environmental protection policies, environmental management, and environmental protection measures. The thesis also aims to sum up valuable environmental protection experiences from both countries, in an effort to provide a reference guide for environmental protection activities in China.

In this paper, many research methods have been used, including a review of the literature, site inspection, expert advice and case analysis in order to explore the similarities and differences in policies, concepts and measurements of port environmental protection in Canada and China. This information will be used to define the advanced concepts, managerial methods and measurements of environmental protection in Canada that Chinese government departments and port authorities could learn from.

Through this study, suggestions will be made regarding what China's port sectors can learn from Canada in the following areas: (1) connecting port authorities with relevant environmental protection experts to carry out environmental protection research; (2) expanding the scope of port environmental protection, paying attention to co-operation with other agencies to protect the environment; (3) enhancing the protection of the ecological environment of the port, (4) paying attention to public participation in the process of port environmental protection; and (5) upgrading the environmental protection management concept on the part of port managers.

It will be suggested that from Canada, relevant Chinese government departments should learn to (1) promulgate operational laws and regulations related to port environmental protection; (2) set up port management institutions to improve the port environmental management; (3) clarify the role of government departments, ports and environmental regulatory authorities in the course of the environmental protection; and (4) strengthen enforcement and regulations. In addition, it will be suggested that the enhancement of public awareness regarding environmental protection be continued and that relevant laws be passed to expand the scope of public participation.

Acknowledgements

This research has been made possible by the assistance of several people and organizations. First of all, I would like to thank my supervisor, Dr. Murray Haight, for his intellectual support, encouragement and guidance during the past two years of my master's program; and for providing me with the opportunity to conduct my research. His tolerance, humour, and friendship towards Chinese people have been appreciated. It took me one year to finish the work and I was very guilty for the delay. When I got frustrated and even tried to give it up, Murray encouraged me and helped me out. He also helped to me to make a habit it to review my finished work every evening because I would bear in mind in my life what he told me to do some work every day. As well, I would like to thank my committee member Dr David Wood for their valuable comments and critiques, especially on the corrections of my statistical methods.

I thank all the people, Dr Wu, Dr Kong and a number of master's students in Dalian University of Technology and all my interviewees for their assistance and help during my field study in China. Without their help, it would have been impossible for me to get the sufficient data for my research.

A special thank you to my brother and my parents of their continued support and encouragement throughout my studies. Finally, many thanks to my friends, who have always been ready to give me a helping-hand.

Yue Gao (Chris)

Table of Contents

Abstract	iii
Acknowledgements	v
Table of Contents	vi
List of Figures	x
List of Tables	xi
Chapter 1 Introduction.....	1
1.1 Introduction.....	1
1.1.1 The Functions of Ports.....	1
1.1.2 Environmental Problems Facing Ports.....	3
1.2 The Need for a Comparative Study of Port Environment Protection in China and Canada.....	4
1.3 Research Goal and Objectives.....	6
1.4 Organizational Structure of the Thesis.....	8
Chapter 2 Literature Review.....	9
2.1 Introduction.....	9
2.2 Definition of Port.....	9
2.3 Port Management.....	10
2.3.1 Definition of Port Management.....	10
2.3.2 Port Management Models.....	10
2.4 Environmental Management of Ports.....	12
2.4.1 Planning at Ports.....	12
2.4.2 New Environmental Legislation Affecting Ports.....	16
2.5 Port Pollution.....	17
2.5.1 Environmental Issues of Ports.....	17
2.5.2 Identification of Pollution Problems Caused by Port Activities.....	18

2.6 Case Studies of Foreign Ports.....	25
2.6.1 United Kingdom (UK).....	25
2.6.2 United States (US) Strategy.....	27
2.7 Comparative Studies of Foreign Ports.....	29
2.8 Summary.....	30
Chapter 3 Research Methodology.....	32
3.1 Introduction.....	32
3.2 Qualitative Research Methodology and the Case Study.....	32
3.3 Research Design.....	33
3.3.1 Developing a Thick Description.....	34
3.3.2 Triangulation.....	34
3.4 Research Procedures.....	35
3.4.1 Conceptual Framework.....	35
3.4.2 Research Approach.....	36
3.5 Data Collection.....	37
3.5.1 Open-ended Interviews with Participants.....	38
3.5.2 Data Analysis.....	39
3.5.3 Publications.....	40
3.5.4 Field Research.....	40
3.5.5 Direct Observation	41
3.6 Research Limitations.....	41
Chapter 4 Case Studies in Canada.....	43
4.1 Canadian Port Environmental Protection Policies.....	43
4.2 The Port of Vancouver.....	46
4.2.1 Overview.....	46
4.2.2 Status of Environmental Management.....	48
4.2.3 Environmental Management Organization.....	51
4.2.4 Issues and Solutions Related to the Current Situation of the Port's Environment.....	53

4.3 The Port of Hamilton.....	55
4.3.1 Overview.....	55
4.3.2 Status of Environmental Management.....	56
4.3.3 Situations Concerned with Port Environment Management.....	58
4.3.4 Issues and Solutions Related to the Current Situation of the Port's Environment.....	58
4.4 The Port of Montreal.....	61
4.4.1 Overview.....	61
4.4.2 Status of Environmental Management.....	63
4.4.3 Environmental Management Organization.....	64
4.5 Summary.....	66
Chapter 5 Port Environmental Management in China.....	68
5.1 China's Ports Environmental Protection Policies.....	68
5.2 The Development of Ports Environmental Protection in China.....	71
5.3 Current Situation of Management of Chinese Ports Environment.....	73
5.3.1 Environmental Protection Features.....	73
5.3.2 Existing Patterns of Ports Environmental Management.....	74
5.4 Environmental Problems Faced by Chinese Ports.....	75
Chapter 6 Case Studies in China.....	77
6.1 Introduction.....	77
6.2 The Port of Qingdao.....	78
6.2.1 Introduction.....	78
6.2.2 Status of Environmental Management.....	79
6.2.3 Environmental Management Organization.....	81
6.2.4 Issues and Solutions Related to the Current Situation of the Port's Environment.....	83
6.2.5 Summary.....	85
6.3 The Port of Tianjin.....	85
6.3.1 Introduction.....	85

6.3.2 Status of Environmental Management.....	87
6.3.3 Situations Concerned with Port Environment Management.....	89
6.3.4 Issues and Solutions Related to the Current Situation of the Port's Environment.....	90
6.3.5 Summary.....	91
6.4 The Port of Yingkou.....	92
6.4.1 Introduction.....	92
6.4.2 Status of Environmental Management.....	93
6.4.3 Environmental Management Organization.....	94
6.4.4 Summary.....	96
6.5 Summary.....	97
Chapter 7 Discussion, Recommendation & Conclusions.....	99
7.1 Situating Study Findings within the Context of Ports Impact.....	99
7.2 Key Findings and Recommendations form the Comparison of Sino-Canadian Ports Environmental Management.....	102
7.2.1 Port Environmental Protection Policies.....	102
7.2.2 Environmental Management.....	105
7.2.3 Protection Measures.....	108
7.3 Future Research.....	111
Appendix A Interview Consent Forms.....	113
Appendix B Consent Form.....	116
Appendix C Consent Form for Audio Taping Interview.....	118
Appendix D Interview Questions.....	119
Appendix E Catalogue of Interviews Conducted During Case Studies Investigation.....	121
Bibliography.....	124

List of Figures

Figure 1-1: Indication of Future Population Distribution at Coastal Regions (1995).....	2
Figure 1-2: Maritime Trade among Various Countries (1996).....	3
Figure 2-1: Evolution of Environmental Planning at Ports.....	14
Figure 2-2: Largest Emission Sources within Ports	21
Figure 2-3: Pollution from Ports Compared to Refineries, Power Plants and Cars.....	28
Figure 3-1: Triangulation: Multiple Data Source & Data Collection Methods in the Case Study.....	35
Figure 4-1: Current Situation of the Port of Vancouver (2005).....	47
Figure 4-2: Current Situation of the Port of Vancouver (2005).....	48
Figure 4-3: Environmental Management of Port of Vancouver.....	49
Figure 4-4: Current Situation of the Hamilton Port (2000).....	55
Figure 4-5: Current Situation of the Hamilton Port (2000).....	56
Figure 4-6: Current Situation of the Port of Montreal (2001).....	62
Figure 4-7: Current Situation of the Port of Montreal (2001).....	62
Figure 6-1: Geographical Location of Three Ports (1999).....	77
Figure 6-2: Present Situation of the Port of Qingdao (1999).....	79
Figure 6-3: Present Situation of the Port of Qingdao (2000).....	79
Figure 6-4: Environmental Management of Port of Qingdao.....	83
Figure 6-5: Current Situation of the Port of Tianjin (2002).....	86
Figure 6-6: Current Situation of the Port of Tianjin (2002).....	87
Figure 6-7: Current Situation of the Port of Yingkou (2005).....	93
Figure 6-8: Current Situation of the Port of Yingkou (2005).....	93
Figure 6-9: Environmental Management of Port of Yingkou.....	95

List of Tables

Table 2-1 Ranking of environmental issues in 1996 and 2003.....	18
Table 2-2: A Survey of Noise Pollution in Container Terminals.....	22
Table 3-1: People to be Interviewed.....	39
Table 4-1: Summary Legislation on the Marine Environment.....	44
Table 4-2: Environmental Management Framework of Hamilton.....	60
Table 4-3: Environmental Management Framework of Montreal.....	65

Chapter 1

Introduction

1.1 Introduction

1.1.1 The Functions of Ports

The world's population is approximately 6 billion (See Figure 1-1): by 2050 it may reach or exceed 12 billion (Preparatory Committee for United Nations Conference on Environment and Development (UNCED), 1999); and it is in the coastal zones that the population will increase the fastest in the future (Chua and Ross, 1998). At the same time, there is a significant increase in maritime trade occurring among various countries. Ports are the international trade gateways and windows of countries and regions (See Figure 1-2). Over 80% of all of the world's trade goods are carried by ships. From computers to clothes, food to oil, shipping is vital to the global economy (The World Bank Group, 2003). At the end of 2005, world seaborne trade (goods loaded) had reached a record high of 7.11 billion tons, and total maritime activities measured in ton-miles increased to 29,045 billion ton-miles (United Nations Conference on Trade and Development(UNCTAD), 2006).

Ports have become active participants in the international transport chain and in the international trading system. In particular, with the development of economic globalization, the functions of ports have developed from those of an initial simple port cargo handling and distribution centre to complex functions that include the port industry function, a modern logistics services function, an information services function, and a passenger travel advisory function. Ports have been playing an increasingly important role in regional economic development and the world economy as a whole.

Along with the acceleration of global integration, many countries around the world have a growing dependency on water transportation. Compared to highway and air transportation,

water transportation is a relatively energy-saving and environment friendly way of transporting many goods. It has advantages such as requiring little operational land area, causing little pollution, and handling large-volumes The European Union plans to vigorously develop water as a strategy for achieving sustainable development (Zhuan Xiao and Genfa Lu, 2002). The Chinese government is also aware that the “vigorous development of water transportation is the key to achieve sustainable development of transportation. Also, it is a positive step to reach resource-saving and environment-friendly society” (Ministry of Transportation, 2006, 28(4):22-25). However, coastal zones are particularly sensitive regions, and coastal ecosystems often are very fragile. The vigorous development of waterways in promoting sustainable development of transportation could potentially lead to negative environmental impacts on ports and the waters surrounding around ports.

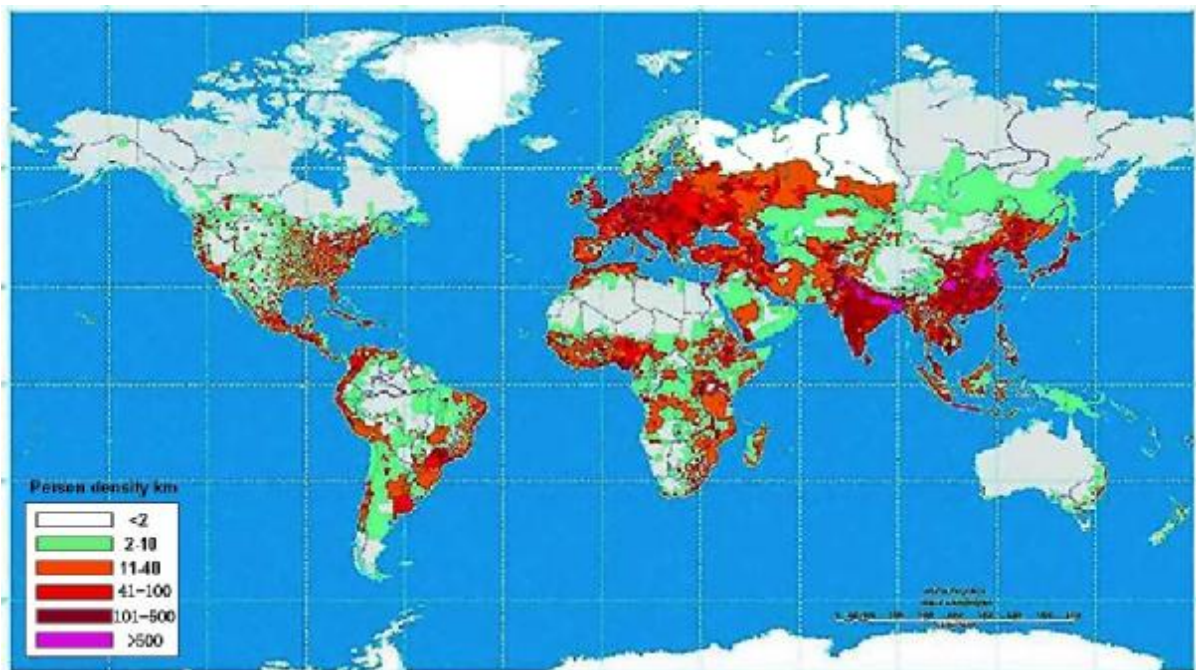


Figure 1-1: Indication of Future Population Distribution at Coastal Regions(1995)

Source:

<http://images.qianlong.com/mmsource/images/2005/04/14/bjdy20050414003.jpg>, retried on March 3, 2006.

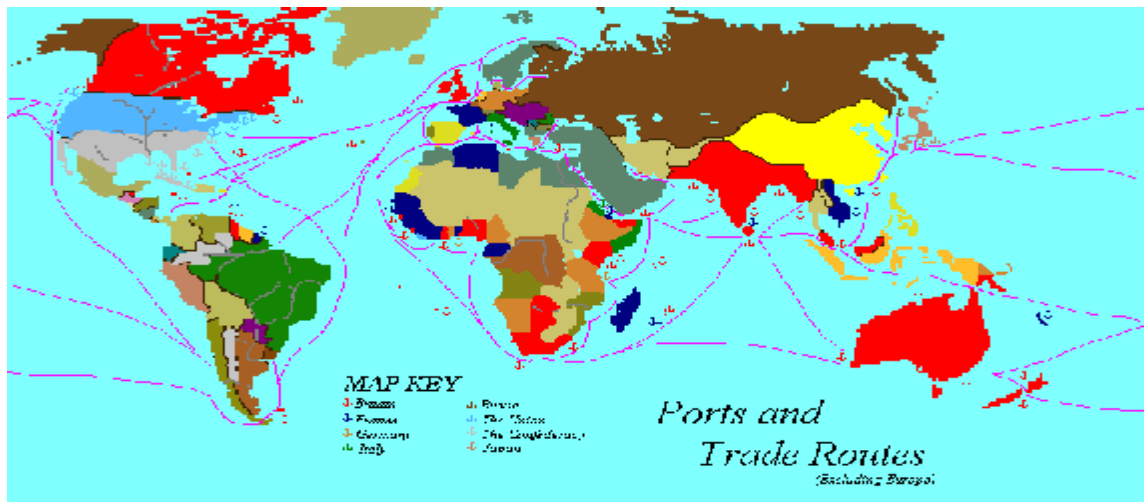


Figure 1-2 : Maritime Trade Among Various Countries (1996)

Source: <http://images.qianlong.com/mmsource/images/2005/04/14/bjdy20050414003.jpg>,
retrieved on March.3, 2006.

1.1.2 Environmental Problems Facing Ports

Ports are major hubs of economic activity and potential sources of pollution (National Research and Development Centre (NRDC), 2005). Pollution from sewage, garbage, oil, agricultural run-off and various chemicals such as sulphur are specific examples. For example, an increase in emissions of air pollutants can affect the local as well as regional air quality (Galloway, 1989; Gupta et al., 2002; Rodhe, 1989; Streets et al., 2000). With the increase in the volume of shipping traffic into and within port regions, sea-based pollution is also a source of concern, especially along heavily congested shipping routes (Chua, 1995a, b). Oil and chemical spills from ships, either from operational activities or catastrophic accidents (i.e. grounding or collision), also pose health issues alongside environmental complaints. On February 15, 1996, the “Queen of the Sea” Oil Tanker hit rocks near the West Wales of the United Kingdom and caused a total of 6.5 million tons of crude oil leakage. Experts estimated that the total number of seabird deaths would reach 50,000 and that it would take 10 years to eliminate the pollution. This accident has caused a great loss to the local ecological environment and to people's lives (Yanqiao Jiang, 2002). In brief, the damages caused by port pollution may be from increased risk of illness, such as respiratory disease or cancer, to

increases in regional smog, degradation of water quality, and the blight of local communities and public lands (NRDC, 2005).

One aspect that may be of considerable importance is the fact that many future scenarios related to environmental accidents usually occur near urban areas; for obvious reasons port areas have historically been situated very close to towns. Any incident with environmental consequences can influence or affect nearby populations to a greater or lesser degree. All of these circumstances mean that environmental considerations are essential for sea ports and will be even more important in the near future (Darbra, et al., 2004). How to coordinate the relationship between port development and environmental protection is one of the important challenges of sustainable social and economic development for every country in the world.

1.2 The Need for a Comparative Study of Port Environment Protection in China and Canada

There is a long history of port development in China. The Port of Guangzhou was established in the Han Dynasty 112 B.C., when China did business with Southeast Asian countries along the Indian River (China Encyclopedia [Transportation], 1986). In 2005, the Port of Shanghai handled 443 million tons, which made it the world's largest and busiest port. The Port of Shanghai and the Port of Shenzhen handled 18 million and 16.18 million standard containers respectively. They ranked third and fourth largest in the world (Ministry of Transportation, 2006). In China, Mr Wang from the Water Transportation Department of the Ministry of Communication indicated recently that port organizational reform will be the key for China as she changes from a big port nation to a powerful port nation (Interview N 30-1).

Over time ports have become organized into one four categories, Holocher and Dr.Klaus Harald (1990) listed and explained the following terms:

- I **The Public Service Port:** Land and the coastline belong to the state, and port management is carried out directly by superintendents assigned by two levels of authorities: the central government and the local government;

- I **The Landlord Port:** Landlord Ports are characterized by private ownership of land, but the land resource of the coastline still belongs to the federal government. The provincial government takes over the responsibility of port management and development from the federal government, and establishes a Port Bureau to unify port management and development, or the management task may be handed to the local government;

- I **The Tool Port:** In the tool port model, the port authority owns, develops, and maintains the port infrastructure as well as the superstructure, including cargo handling equipment such as quay cranes and forklift trucks;

- I **The Fully Privatized Port or Private Service Port:** In fully privatized ports, port land is privately owned, unlike the situation in other port management models.

Canada is a country which leads in the practice of private ownership of land, but the land resource of the coastline still belongs to the federal government. The provincial government takes over responsibility for port management and development from the federal government, and establishes Port Bureaus to oversee the unifying of port management and development. Marine transportation systems make a vital contribution to the Canadian economy and society; and public service port systems are an important part of the marine transportation system. Ports contribute to the safe and efficient movement of vessels and cargo and serve as focal points for regional economic growth and prosperity. Canada attaches great importance to port environmental protection and management. Laws have been passed to promote port environmental protection, and environmental protection has become a concept that is integrated into day-to-day activities. To a certain extent, Canada has formed a management system that is suitable for the development of each port (Williams, Mark Lloyd, Bill Jamieson, 1999).

China at present is a socialist country; the land and the coastline belong to the state, and port management is carried out directly by superintendents assigned by two levels of government authorities: the central government and the local government. Chinese ports are public service ports, and are subject to significant government intervention. The port CEO, assigned by the government, has tremendous power in carrying on port activities. Today the Chinese government attaches great importance to environmental protection in port development and has promulgated relevant laws and regulations to protect the port environment (Interview N30-1; D 1-1). However, China should not be optimistic about the quality of its coastal environment. Port development is still faced with severe resource constraints. Furthermore, during the “11th Five-Year Plan” period, China's waterways transport infrastructure construction will experience a new upsurge. There will be 639 additional deepwater berths, and 101 additional intermediate berths in coastal ports. The total additional capacity will reach 21.2 million tons (Department of Transportation, 2005).

Ports, therefore, play a significant role in the social and economic systems of both China and Canada. Both attach great importance to port environmental protection and have achieved some experience of practicing protection strategies. At this time it is useful to summarize and evaluate the work done by the two countries in terms of port environmental protection in order to provide a reference for the future work in this area. Learning from Canadian ports' successful experience with port environmental management, the researcher is determined to discover ways to improve environmental management of Chinese ports. Once this research is completed, it will not only apply to Yingkou, Qingdao and Tianjin, but also to other coastal regions and other parts of China which are experiencing similar problems. It will help to improve environmental management in China.

1.3 Research Goal and Objectives

The overall goal of this thesis is to explore the similarities and differences between Canada and China in terms of port environmental protection policies, port environmental management, and environmental protection measures. The thesis also aims to sum up

valuable environmental protection experience of both countries, in an effort to provide a reference guide for port environmental protection activities in China. To achieve these objectives, research was undertaken on the following areas:

Firstly, interviews were conducted to gain an insight into the management of port environmental protection both in Canada and China. The following interview questions serve to guide the exploration of a total of six case studies – three each in both countries.

- I What organization body is in charge of port pollution control and prevention at ports? What is the structure of the organization body? What are its objectives, and how are they achieved?
- I Is there any government regulation or policy applied for pollution control and prevention at ports?
- I Are there any training programs for the employees at ports that are aimed at protecting the environment? What types of equipment are being used for pollution control and prevention?
- I What is the port top authority's attitude towards port environmental management? Is port environmental management integrated into port developing and future planning?

Secondly, by undertaking comparative analyses regarding the similarity and difference between Canadian and Chinese ports, in terms of port environmental management were highlighted.

Finally, in comparing the similarities and differences between Canadian and Chinese ports, and with reference to Canadian ports' successful experience in environmental management, recommendations are made for Chinese ports to make visible improvements in environmental protection.

1.4 Organizational Structure of the Thesis

The thesis is divided into seven chapters. **Chapter One** introduces the background of this research, the need for research, and the research objectives. **Chapter Two** is a Review of the Literature, which was conducted along two main lines inquiry: First, a comprehensive summary of the basic features of ports are described including definitions, and models, with the emphasis on the importance of port environmental protection, planning and management; Second, a thorough analysis of the environmental issues related to ports, was conducted to gain a more comprehensive understanding of the researcher produced by former researchers in the field of port environmental protection in China and other countries, including both achievements and outstanding existing problems. **Chapter Three** outlines the case study and the matrix methods, as well as the triangulation research methods which were the main approaches employed in this thesis. **Chapter Four** introduces the concept of environmental management and environmental protection measures of Canadian ports. This chapter is divided into two parts: the first part outlines the environmental management policies of Canadian ports and public participation; the second examines specific case studies: Hamilton, Vancouver, and Montreal. **Chapter Five** discusses the issues of China's port environmental protection policies and public participation, China's port environmental protection development, China's port environmental management situation, and the challenges faced by China's port environmental protection. **Chapter Six** is taking Qingdao, Tianjin, and Yingkou as examples, this chapter uses case analyses to introduce the management concepts and measures of these ports in environmental management. **Chapter Seven** analyzes results obtained from the six selected Canadian and Chinese ports, and compares the similarities and differences of Canadian and Chinese: ports in terms of policy, environmental management and environmental protection measures, and makes specific recommendations to enhance environmental management at Chinese ports.

Chapter 2

Literature Review

2.1 Introduction

The literature review was conducted along two main lines inquiry: First, a comprehensive summary of the basic features of ports are described including definitions, and models, with the emphasis on the importance of port environmental protection, planning and management; Second, a thorough analysis of the environmental issues related to ports, was conducted to gain a more comprehensive understanding of port environmental protection in China and other countries, including both achievements and outstanding existing problems.

2.2 Definition of Port

The Oxford Dictionary defines a Port: As a town or city with a harbour, especially one where ships load and unload goods; a place where ships load and unload goods or shelter from storms (Oxford Dictionary, 2006). This definition does not precisely define today's port. For example, the Port of Yingkou has a land area of 6.94 million square meters, and a water area of 309 million square meters. It engages primarily in containers, coal, crude oil, iron ore, grain and other import and export cargo handling services as well as domestic and international passenger services. By the end of 2005; The Port of Yingkou had a total of 32 production berths, including 22 deep-water berths above the 10,000 ton level.

A more comprehensive and detailed definition is: A port is a harbour town or city where ships may take on or discharge cargo. A port may include one or more port areas, and should satisfy the following three requirements (Qing Xiao, 1998):

- I **Functional Elements:** Ports should have safe access routes for ships, and areas for ships to be safely anchored and berthed. Facilities should exist for the embarking and

disembarking of passengers, for goods to be loaded and unloaded, for transportation and storage functions;

- I **Facility Elements:** To constitute a port, the land area must have hydraulic structures so that ships can anchor, passengers can go aboard and get off, and goods can be loaded and unloaded. Dock facilities that are compatible with the functions of the ports (including buoys), such as storage and loading unloading equipment, must be available;

- I **Port Area Elements:** The port area is comprised of a range of specific regions of waters and lands. Waters include the port channel, port basin, and anchorage area. Land includes the loading and unloading operation zone, storage yard and so on.

2.3 Port Management

2.3.1 Definition of Port Management

The concept of port administration generally covers all activities of the state and local authorities at a port, while narrowly speaking; port administration contains only activities within the port, such as port construction, port facility maintenance, and port operations (Jinrui, Zhang, 2002).

2.3.2 Port Management Models

Ports of different countries or areas have rather different management patterns. While differences in management systems exist with many foreign ports, an independent management relationship between government and enterprises is fairly consistent. The following are some examples of management modes:

2.3.2.1 The U.S. Port Administration Management System

While land privatization is practiced in the United States, land resources along the coast belong to the federal government. The task of port development is handed over by the federal government to the state government. The state governments can either form a port bureau to carry on port management, or assign the management job to the local government. U.S ports generally follow one of three types of business models: landlord seaport, operator seaport, a combination of landlord and operator seaport, respectively. There are 34 landlord seaports, including the Port of Long Beach and Port of Los Angeles (IAPH). As for operations, the port bureau directly operates the port and is responsible for obtaining port operation equipment and hiring port staff. There are 11 ports practicing operator seaports model, including the Port of Boston, and another 11 ports implementing the combination (of landlord and operator) seaport model, including the Port of Houston, and the Port of Portland [IAPH (International Association of Ports and Harbors), 1999].

2.3.2.2 Hong Kong Port Administration Management System

Around the world, a numbers of ports are operated and managed entirely by private enterprises. The Port of Hong Kong serves as a representative example. All Hong Kong Port facilities are made possible and operated by the private company. The container terminals closely follow policies for free ports. For example, Kuyong Port's 19 container berths are operated by four private companies, which are Hutchison Whampoa, American Sealand, Korea Hyunda, and China COSCO (in cooperation with Hutchison Whampoa) (Shuhua Li.1995).

The Port's private enterprises are subject to very little government intervention. Such private enterprises are entitled to make their own pricing decisions. With its high efficiency and reliability, the Port of Hong Kong has gained many long-term contracts with a great number of shipping companies. In fact, the Port nowadays has become one of the busiest container terminals around the world (World Bank Group, 2003).

2.3.2.3 Japan's Port Administration Management Models

The Japanese consider ports as part of the country's national infrastructure. Together the government and private sectors carry out port management. Japanese ports are managed and operated exclusively based on Port Law throughout the country. The Japanese government delegates authority to the port, and encourages the enterprise's independent operations. The port authority is not allowed to interfere with the private enterprise's usual business activities or to undertake competitive business activities with private enterprise (Xinling Wang, 2000).

2.4 Environmental Management of Ports

The management and control of the environment and natural resources systems in the port surrounding area to ensure the sustainability of development efforts over a long-term basis is a critical objective (Environmental Impact Assessment of Irrigation and Drainage Projects, 1995).

2.4.1 Planning at Ports

There has been little attention paid to the major environmental aspects of port planning as a whole. Planning at ports has been greatly influenced by civil engineers and surveyors (Anon, 1997). The emphasis therefore has been on technical standards and land values. Port environmental policies have generally been the by-products of related legislation, such as Health and Safety Regulations, dangerous goods area spacing, waste reception and disposal, and traffic planning for ship safety (Couper, 1999).

Couper (1999, p. 168) outlined the evolution of environmental planning within ports (see Figure 2-1).

Figure 2-1(A) shows a planning process typical of the 1970s

I A goal has been set;

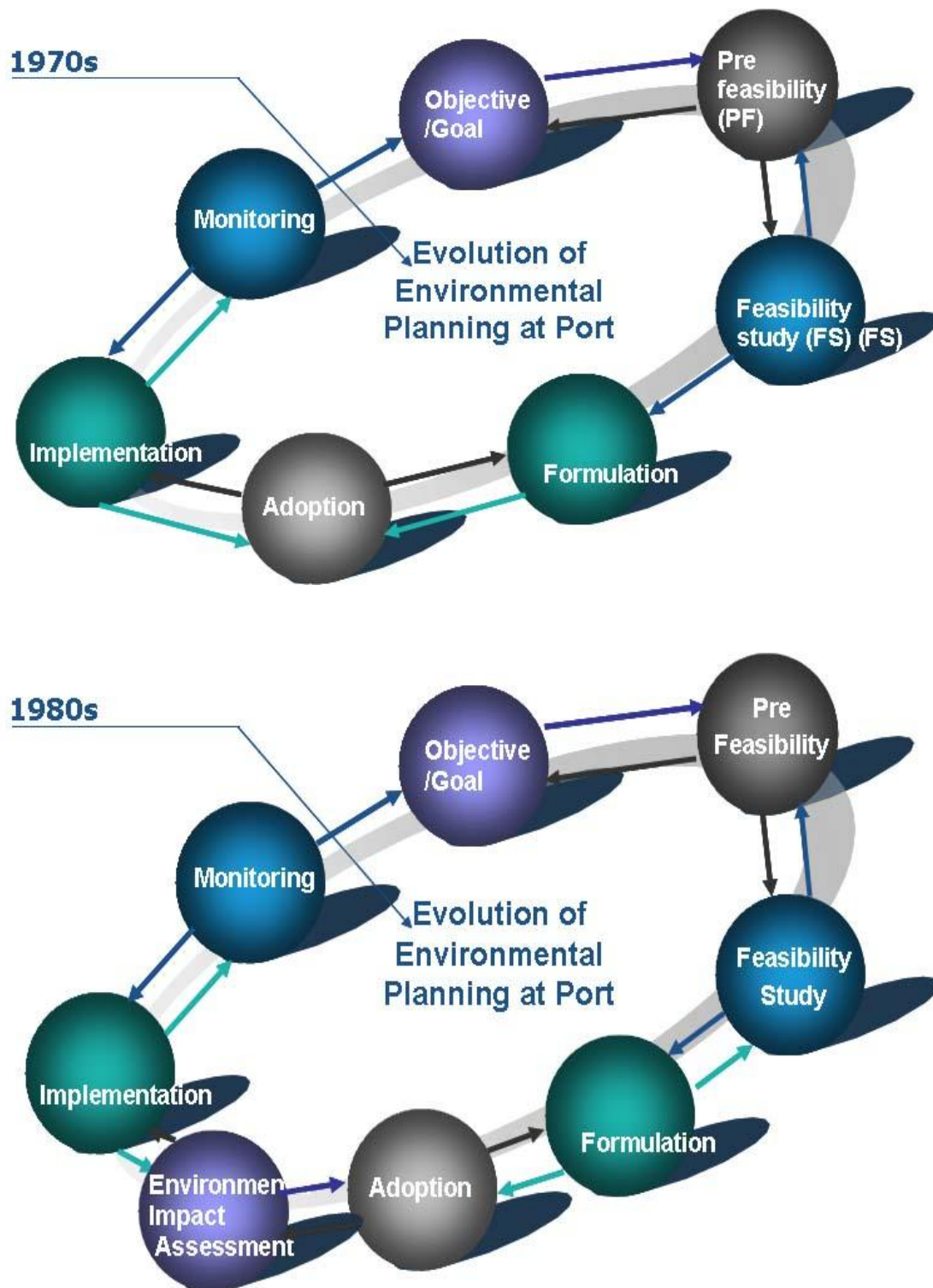
- I A pre-feasibility (PF) study is carried out: this may result in feedback to the decision-makers; perhaps altering the goal or changing the objectives of reaching it;
- I A feasibility study (FS) is then conducted;
- I The plan is formulated;
- I The plan is adopted;
- I The plan is implemented;
- I There is continuous monitoring until the goal is reached.

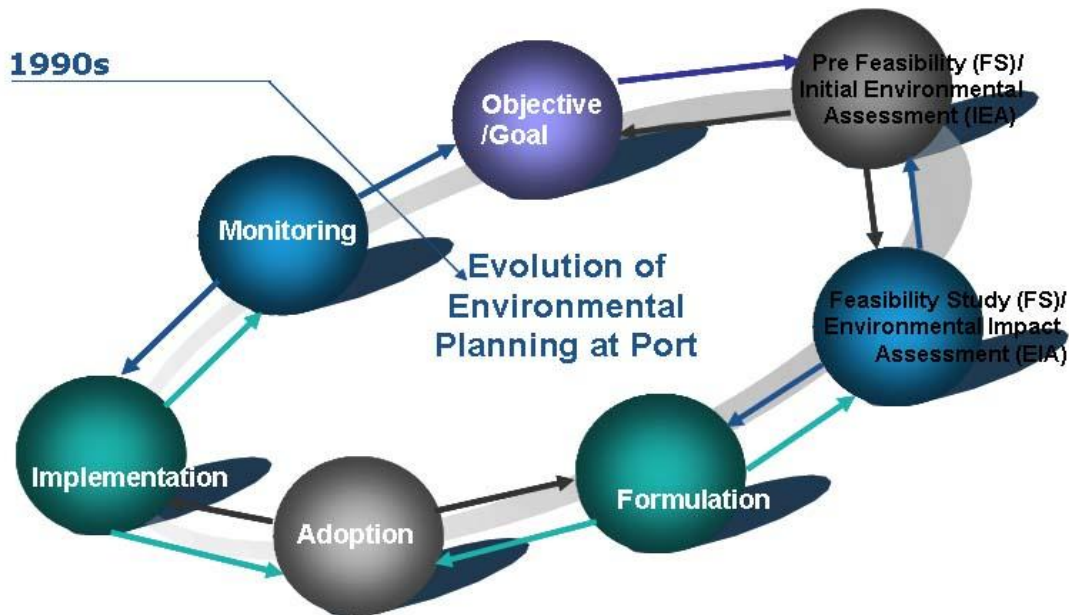
At each stage in this cycle it will be seen from the figure that there is feedback so that the plan can be returned to each previous stage for amendment.

Figure 2-1(B) is typical of the process in the 1980s. It follows the same process: however, after the decision is made to adopt the plan an environmental impact assessment (EIA) is made before implementation (Couper, 1999, p. 169).

Figure 2-1(C) outlines a more recent planning framework. It shows the environmental element appearing earlier and at more critical points in the planning cycle. At the pre-feasibility (PF) stage an initial environmental assessment (IEA) is carried out and the results are fed back to the initiators. At stage three the Feasibility Study (FS) is accompanied by a full EIA. The environmental input is thus part of the decision-making process before the formulation of a plan, not a subsequent procedure after the decision to adopt a project has been taken (Couper, 1999, p. 169).

Figure 2-1 Evolution of Environmental Planning at Ports





Source: Couper, 1999.

Through interview and document research, the researcher learnt that an environmental plan always comes before a specific port economic development project. And each environmental plan is based on Couper's theories. The first step is to verify Pre Feasibility (PF) / Initial Environmental Assessment (IEA) by having experts or environment related institutions assess the environmental aspects of the project. The next step is to submit the project to the corresponding government department for official verification. Only can the project be carried upon it is officially verified by the government department. The entire project implementing process is to be supervised by the national environmental protection department. Each step in the environmental planning process is important. The environmental supervision process at Chinese port is, however, rather insufficient; such shortcoming is one of the main causes for the backward environmental protection condition at Chinese port.

Along with the passage of time and the advancement of society, people have gradually realized that the port's environmental protection should not rely on dealing with environmental problems after pollution has occurred. Instead, the focus should be on managing the sources of pollution and the prevention of problems. By planning for pollution prevention, the port is better equipped to reduce the possible impact of pollution.

2.4.2 New Environmental Legislation Affecting Ports

With the development of modern transportation, those who plan and develop ports should pay more attention to environmental protection, to the harmonious development between humans and nature. While promoting port environmental protection awareness, and facilitating the port environmental protection process, a comprehensive national legal system plays an essential role in healthy and orderly port development (Weiqun Yang, 2000).

In response to international political and public awareness, some governments are already intervening quite strongly in port development and management (United Nations Educational Scientific and Cultural Organization (UNESCO), 1991). For example, in the European Community (EC) environmental matters are dealt with through Directives. These are binding on member States with respect to the goals of the Directives (UNESCO, 1991). However, States may adopt various objectives towards the goals. The EC Directive 85/337 advocates, amongst other things, that all major industries carry out an environmental audit. This applies also to every port, (including those on inland waterways) which accepts vessels of over 1350t (Couper, 1999).

In the United Kingdom, the 1990 Environmental Protection Act is considered to be in line with the goal of the EC Directive. It gives effect to Prescribed Processes and Substances for which there are environmental rules (Environmental Protection Act, 1990). In the UK there is as yet no proper body for coordinating environmental matters in government and no mandatory requirement for an environmental audit. Managers may nevertheless be personally liable for environmental damage, and penalties on ports run into the millions of pounds (Couper, 1999).

A country's policies and laws are crucial to the port's environmental protection. Such national policies and laws are extremely important in terms of their regulating and restraining roles. This is precisely why this article makes comparison with environmental protection related regulations between Canadian and Chinese ports.

2.5 Port Pollution

2.5.1 Environmental Issues of Ports

From the point of view of the environment, sea ports are very complex systems. In fact, the very existence of ports, as well as any expansion of its installations, implies a certain loss of habitat (Darbra et al., 2004). Furthermore, in ports most of the elements which, in one way or another, can be associated with environmental impact can be found: waste water, emissions of gas or particles into the atmosphere, noise, soil contamination, dredging, waste production into water or air, etc. Therefore, pollution can occur either under normal conditions or accidentally (Darbra et al., 2004). The continuous movement of ships in a confined and reduced area—the port—inevitably gives rise to collisions between ships or between ships and the coast at frequent intervals, with the consequent risk of the release of hazardous materials (Trozzi and Vaccaro, 2000).

The importance of the different environmental issues clearly depends on the characteristics of each port, although some issues are frequently more important than others (Casal, et al., 1999). Table 2-1 (A) summarizes the ranking of the major environmental issues in sea ports, according to the results obtained from the Europe Sea Ports Organization (ESPO) Environmental Questionnaire 1996 that was directed at 281 European ports from 15 countries (ECO-information, 1999), and to the analogous ESPO Environmental Survey 2003, to which more than 100 ports replied within the framework of the ECOPORTS project in 2003 (ECO-information, 1999). In 1996, port development (water related) came out as being the most important issue according to the ports, followed by water quality and dredging disposal. In contrast, in 2003 the leading concerns were port waste, dredging disposal and dredging, respectively. The main changes that have occurred over the last 7 years are the presence at the top of the list of port waste (not even present in the 1996 top 10 ranking), the decreasing importance of water quality, and the rising position of noise and hazardous cargoes. Such changes reflect increased environmental awareness in ports and the actions carried out as a

result of increasing pressure from environmental legislation, the need to maintain a good public image, and taking third parties and stakeholders into consideration.

Table2-1 Ranking of Environmental Issues in 1996 and 2003

1996	2003
1 Port development (water)	1 Garbage/port waste
2 Water quality	2 Dredging Disposal
3 Dredging disposal	3 Dredging
4 Dredging	4 Dust
5 Dust	5 Port development (land)
6 Port development (land)	6 Noise
7 Contaminated land	7 Hazardous cargo
8 Habitat loss/degradation	8 Air quality
9 Traffic volume	9 Water quality
10 Industrial effluent	10 Ship discharge (bilge)

Adapted from Darbra et al., 2004.

2.5.2 Identification of Pollution Problems Caused by Port Activities

Ports and harbours are located either in marine zones or on rivers at inland sites. Various port and harbour activities including dredging operations, materials disposal, shore zone development, increased maritime traffic and vehicular traffic in the port can result in the release of anthropogenic contaminants to the environment (Trozzi and Vaccaro, 2000).

Gupta et al. (2002, p. 199) suggested that pollution problems caused by port activities can be categorized as follows:

- I Coastal habitats may be destroyed and navigational channels silted due to causeway construction and land reclamation;

- I Unregulated mariculture activities in the port and harbour areas may threaten navigation safety;
- I Deterioration of surface water quality may occur during both the construction and operation phases;
- I Harbour operations may produce sewage, bilge wastes, solid waste and leakage of harmful materials both from shore and ships;
- I Human and fish health may be affected by contamination of coastal water due to urban effluent discharge;
- I Oil pollution is one of the major environmental hazards resulting from port/harbour and shipping operations. This includes bilge oil released from commercial ships handling non-oil cargo as well as the more common threat from oil tankers; and,
- I Air pollutant emissions due to ship emissions, loading and unloading activities, construction emission and emissions due to vehicular movement.

2.5.2.1 Water Pollution

Pollutants in the waters come from the port development process. These include direct pollutants a way from the port construction and the operation phases, and indirect pollutants from the port under development. A specific analysis of the produced links is as follows (International Association of Ports and Harbors (IAPH), 1999):

- I Cofferdam construction of ports, land reclamation, waterway dredging and lead to cause sea water turbidity; and the possible release of hazardous substances in sediments at the surface of water cause secondary pollution;

- I Ballast water, and wash water of oil tankers, cabin water, gas stations on shore, repair machinery and moving machinery wash water are example of wastewater which then contain oil by products;
- I Runoff water from storm sewers and coal storage iron ore, non-metallic ore, the terminal yard, the wash water of the terminal surface, the belt corridor and other places, and the leaked sewage water from coal and or mines;
- I Toxic, hazardous materials and bulk liquid from containers and transport ships can be present in the cleaning sewage;
- I Port region and ship sewage, mainly from local canteens, bathrooms, toilets, office buildings and other ships anchored in port; and,
- I Industrial wastewaters produced from the nearby port industrial zone.

2.5.2.2 Air Pollution

The main sources of air pollution include construction and vapours, gas oil produced during oil product transport, emissions of transport vehicles. Specific analysis is as follows (Bailey, 2004):

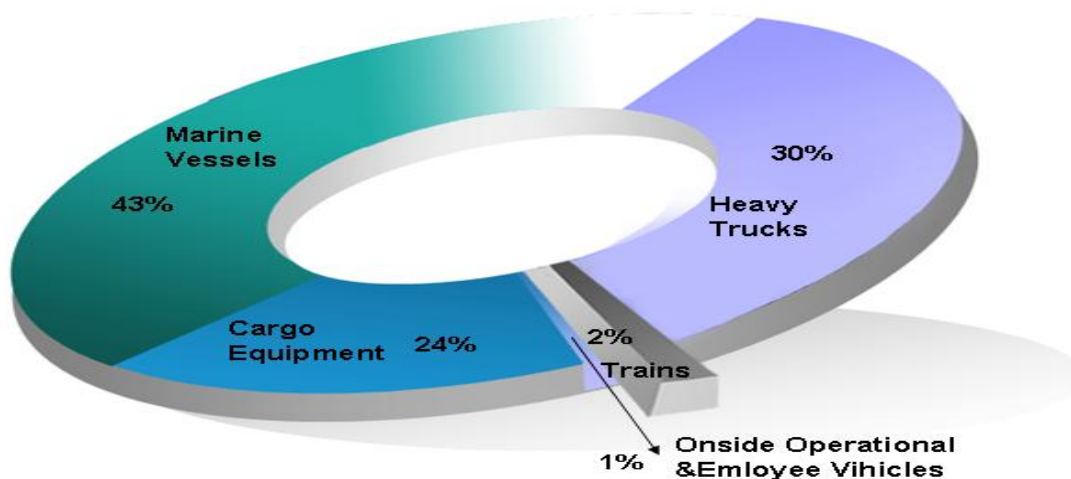
- I Construction dust has a defined impact and is generally limited during the port construction period. Sources include mainly land piling, excavation, road resurfacing, materials transport, and cement casting, and then resulting in a mixture of lime dust in the course of operations;
- I Loading dust refers to the dust released during the process of handling and transporting of coal, ore, grain and other substances that easily produce a certain amount of dust. The secondary stirring of dust may also occur whenever natural wind blow are produced with

storage of similar merchandises bulk yards. Atmospheric dust pollution may result from the fuel used in assisted lifting facilities;

- I Oil gas refers to the exhaust gas that is evaporated during the loading, transporting and storing of oil products and liquids at oil ports and container zones in some port areas; and,
- I Exhaust gas emitted from freight trucks and transportation vehicles.

The largest emission sources within ports are from marine vessels, trucks and cargo handling equipment. Together they account for over 90% of emissions at ports. Figure 2-2 shows the PM emissions and NOx emissions (Bailey, 2004).

Figure 2-2: Largest Emission Sources within Ports (PM Emissions and NOx Emissions



Source: Bailey, 2004.

2.5.2.3 Noise Pollution

During the construction of a port and during its operation, the main sources of noise pollution include the noise of construction machinery, the mechanical noise of loading and unloading,

and traffic noise. Taking container terminals as an example, field investigation shows all the key issues involved the high noise of heavy machinery in container terminals (Table 2-2).

Table 2-2: A Survey of Noise Pollution in Container Terminals

No.	Technique Process		Equipment Used	Source of Noises	
				Distance (m)	Noise Value (dB)
1	Loading ship		Container Cranes	10	84
2	Horizontal Transport Level	dock ↔ yard	Front Carrier	5	74
		yard ↔ hand-over Center	Trailer	5	84
		yard ↔ Washing & repair box	Trailer	5	84
3	Yard	Loading Car	Front Carrier	5	74
		Pier Buttress	Front Carrier	5	74
4	Hand-over	CFS	Forklifts	5	81
	Center	LCL handling car	Forklifts	5	81

Source: “Report of Overall Plan for the Environmental Impact of Yingkou port”, Planning Institute Ministry of Transportation, 2006.

2.5.2.4 The Impact of Port Development on Natural Resources

The impact of port development on natural resources includes mainly the following (Manual for Environmental Impact Assessment of Port and Harbours, 2000):

- I Coastline Resources:** Port development occupies a certain amount of coastline resources. It can permanently change the natural state of coastline resources and limit the function of the port because of a limited amount of flexible adjustment space; unexpected oil spills and insoluble chemical leak incidents will cause shoreline pollution;

- I **Tourism Resources:** Port and harbour area development is likely to reduce room for the development of a tourism shoreline; the noise and waste gas generated by some of the ports and harbour industries may undermine the quality of tourist scenic spots;

- I **Fishery Resources:** The area required for ports and anchorage, fairways, and water basin may occupy part of the sea product breeding areas and fishing areas, thus reducing the quantity of regional fisheries resources; ports and related industries indirectly affect the yield and quality of aquatic products through their regional impact on the water quality. Port accident risk will have an adverse impact on fishery resources;

- I **Land Resources:** The construction of water and land areas of ports will result in a direct occupation of land resources in the region; similarly, the development of the near-harbour region occupies land resources; and,

- I **Water Resource:** The development of the port and near-harbour industry will lead to an increase in water consumption and thus increase pressure on the regional water supply.

2.5.2.5 The Impacts of Port Development on Environment and Ecology

The impact of port development on environment and ecology mainly includes the following (Manual for Environmental Impact Assessment of Port and Harbours, 1999):

- I **Coastal Reclamation:** Port development has a multifaceted impact on the marine environment, the most important of which involves the reclamation of the region's waters into land. In this process, the benthic organisms will be totally destroyed. Some zooplankton will be destroyed, possibly changing completely the nature of the original ecosystem; port development will directly change the structure and the trend movement of tides, currents and waves; it will reduce the size of coastal wetland and result in the loss of the capability of the wetland to purify the environment.

- I Land Region Project: The land region project will change the ecosystem of the land by razing vegetation and destroying the habiting environment of animals within the occupied area. During the construction of the port, the stripping of vegetation and earth excavation and landfill could easily lead to much soil erosion if strict management measures are not implemented during the course of the projects. Also, inadequate protection will indirectly cause land desertification, soil degradation and other conglomerates, thus aggravating soil ecosystem vulnerability.

- I Mismanagement in the process of stockpiling and transport of bulk cargo, containers, oil products and chemical fertilizers may cause a certain degree of ocean water pollution. The living environment of marine organisms may experience some changes. Some types of biological species that are tolerant to pollution will increase and become the dominant species. Other types of biological species will be reduced, having an adverse impact on the marine ecosystem.

- I Invasions of Alien Species: Ships need ballast when navigating with low-load or no-load. This is a necessary condition for the safe navigation of the ship. Nowadays seawater is widely used as ballast material, and it is the usual practice to get the seawater near the ship and the port of discharge. Local water, however, contains aquatic organisms and bacteria. When the aquatic organisms and bacteria in the seawater as ballast are transported to a new place, foreign organisms will be introduced to that new place after the blast seawater is discharged. Once these foreign invading aquatic organisms and bacteria survive in the water region, they will become the new leading marine organisms, and an "avalanche" of extensive breeding of harmful parasites and pathogens in the area may rapidly spread. This may cause the extinction of the local species.

2.6 Case Studies of Foreign Ports

2.6.1 United Kingdom (UK)

There are over 600 ports and harbours within the UK, handling a total of over half a billion tons of cargo every year, representing around 95% of UK trade by volume, 80% by value and employing some 30000 people (Walker, 1997).

New legislation (Donaldson, 2003) recently introduced by the UK Government requires operators of ports, harbours, marinas or other docking facilities to provide adequate waste reception facilities for vessel-generated waste and to prepare a waste management plan with respect to the provision and use of waste reception facilities. This obligation for port and harbour authorities forms part of a major initiative to cut pollution from all commercial and leisure crafts of all sizes using UK ports (Walker, 1997).

The UK Government initiated a comprehensive consultation exercise which was conducted throughout 1995. The outcome of the consultation exercise was the announcement of 18 measures designed to combat the effects of pollution from this source. It was acknowledged that there was no single solution, as waste is not only discharged by commercial shipping activities, but arises from all types of maritime activities, each with its own operational needs and economic circumstances (Wren, 1997). The UK Government, therefore, adopted an approach consisting of three major elements (Ball, 1999, p. 315):

- I Making controls more effective through improving regulations and their enforcement (Wren, 1997);

- I Improving the facilities for the legal disposal of waste in ports; and,

- I Increasing the penalties for illegal discharge (Development of Port Waste Management Plans (MSA), 1996). Fundamental to the concept of port waste management planning is the premise that the facilities should meet the needs of their users *and* of the environment, thus removing as far as practicable any disincentives towards their use.

Thus, Ball (1999) suggests that in the UK's view, adequacy should not be assumed simply because there is spare capacity in the reception facility already provided, or due to the lack of complaints from port users regarding individual facilities. Adequate facilities are those which have been carefully tailored to local needs and meet the operational requirements of the vessels using the port. Port and harbour authorities should therefore attempt to remove as far as practicable any disincentives towards their use by providing facilities that (Ball, 1999, p. 325):

- I Cater for all types of waste which are landed at the port;
- I Are conveniently located and easy to find;
- I Are easy to use;
- I Do not present a cost disincentive; and,
- I Are periodically reviewed to ensure that they remain adequate.

The UK concluded that there was no simple solution which would ensure both better provision and use of port waste reception facilities. Pollution at sea arises from all types of maritime activity, not only commercial shipping (Walker, 1997). The UK has therefore developed an integrated approach to tackling this problem, based on a package of measures aimed at all types of port and harbour authorities and all types of vessels (Ball, 1999).

2.6.2 United States (US) Strategy

In March 2004, the Natural Resource Defense Council (NRDC) issued report cards for the 10 largest U.S. ports on their efforts to control pollution. This report discusses solutions to port pollution problems and provides recommendations for ports and policymakers. Figure 2-7 uses the Port of Los Angeles and the Port of New York and New Jersey as examples because they are the largest ports on the West Coast and East Coast, respectively, to show pollution from ports compared to refineries, power plants, and cars. It also highlights emissions of NO_x and PM, because these pollutants are associated with very severe health impacts (NRDC, 2005, p. 4).

Recommendations for Ports

Ports must commit to protect local communities and the environment, not only during expansions but also during regular operations. Ports should consider the negotiation of new or modified leases as an important opportunity to require a combination of the mitigation measures, such as the use of cleaner fuels and equipment (American Association of Port Authorities, 2001).

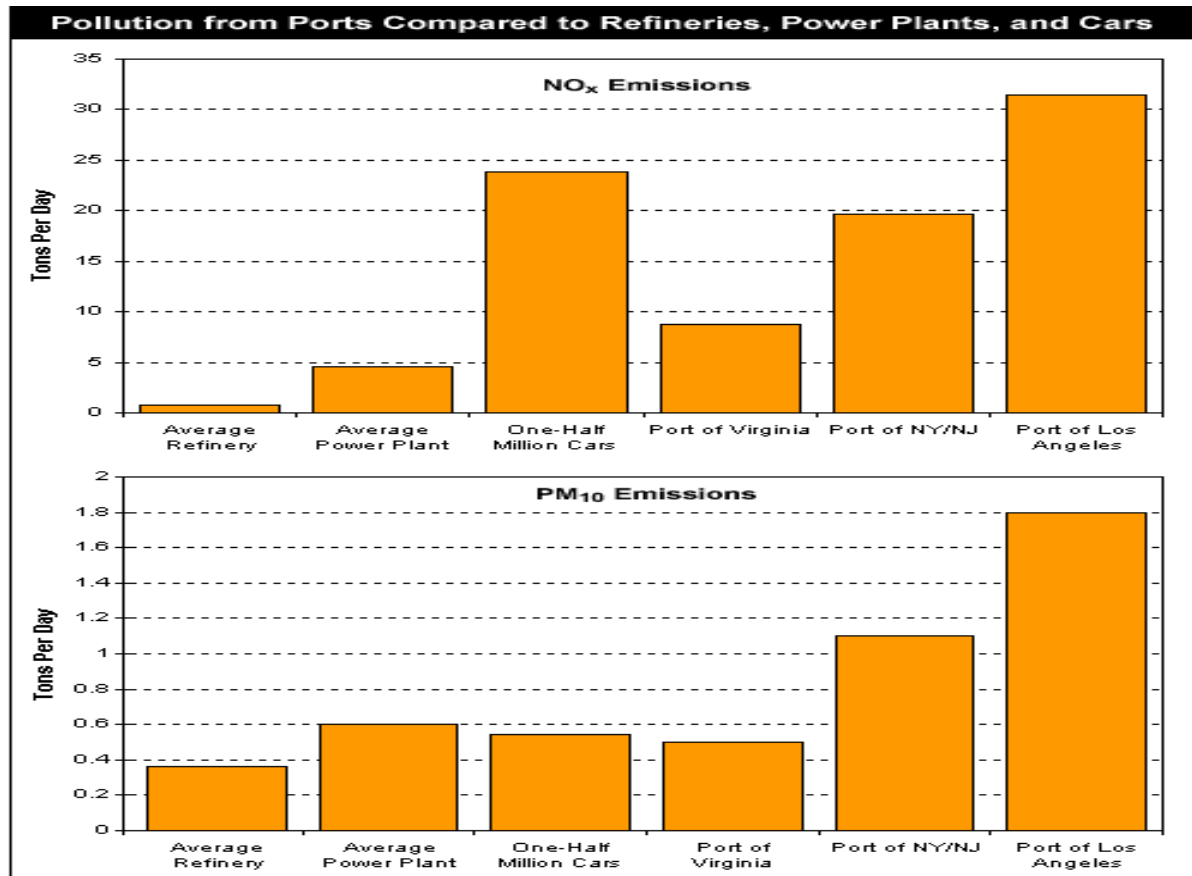
Recommendations for Policymakers

In addition to the mitigation measures, ports should implement on their own, a number of policy and regulatory actions to protect human health and the environment from the large, industrial, and high-polluting operations at marine ports. While a patchwork of international, federal, state, and local rules applies to various pollution sources at ports, most are weak and poorly enforced (U.S. Public Port Facts, 2001).

In summary, based on the survey of 10 of the largest container ports in the United States, not nearly enough is being done to alleviate the severe impacts of the highly polluting shipping industry despite real and significant environmental and health impacts associated with marine port operations. Ports should take internal measures to reduce pollution caused by port activities (American Association of Port Authorities, 2001) Likewise, regulatory agencies at

the federal, state, and local level must provide long overdue safeguards. Further, if port expansions are to continue, all projects must be mitigated to the maximum extent possible, efficiency must be improved, and current operations should be cleaned up (NRDC, 2005).

Figure 2-3: Pollution from Ports Compared to Refineries, Power Plants and Cars



Resource: Defence Council (NRDC), 2005.

This case shows that the U.S government is serious with both port environmental management and policies while dealing with port environmental pollutions. Therefore, solving port environmental problems firstly requires the Government to design a comprehensive system of environmental protection laws and regulations. And secondly, the port needs to develop a well-designed environmental management system equipped with effective and efficient environmental protection facilities. Government environmental laws

and port environmental management are equally important in working on environmental protection.

2.7 Comparative Studies of Foreign Ports

In view of the fact that China's port industry is in the early stages of modern development, it is advisable for China to learn from many advanced foreign theories and methods. For this reason, many Chinese scholars have undertaken comparative studies on issues of port development in China and foreign lands with a view to accelerating the domestic port development process.

Presently, related scholars have done comparative studies on port environmental issues in China and other countries. Man-hua Xue (1999) made a comparison of port environmental protection in China, Japan and South Korea. The cities included Osaka, God Lu, Hiroshima, Kitakyushu, and Fukuoka in Japan; Inchon, Seoul, Kwangyang, and Busan in South Korea; and Tianjin and Dalian in China. After a comparative study of the present condition of the ports in these three countries, Xue concluded that the port builders of China should learn from those of Japan and South Korea. (1) When the port construction projects are being prepared, port environmental planning should also be made; (2) When port planning is made, more attention should be paid to improving people's living environment, and to creating a better space environment of in addition to preventing environmental pollution.

Jun-hai Ding (1998) analyzed the environmental protection management agencies of British ports, public environmental awareness, and prevention and control measurements, and made a comparison with those of China. He pointed out the deficiencies of the current Chinese pattern of domestic port environmental protection management. The study indicated that the environmental protection measures, equipment, and technology of the major ports in China's coastal area had reached a considerably high level. The large-scale environmental equipment is close to the level of that of developed countries. As coastal ports, the difference of the environmental protection hardware between China and the United Kingdom is not great. The

main gap was in the fact that China had spent a huge amount of money to build environmental protection facilities and equipment but they were not used effectively. The study also indicated that the difference between China and the United Kingdom is mainly in the management level of port environmental protection awareness and environmental management.

Comparative studies in the field of port environmental protection have a very important significance for guiding port sustainable development in China. However, little research has been done in this field. Up to now, there have been a few comparative studies of port environmental management in Canada and China. Canada is considered one of the more advanced countries in the world regarding environmental protection. Its environmental protection industry is among the world's best, and ranks as the fifth largest industry in the country. When it comes to the difference in environmental field between China and Canada, Dr. Tang (an expert on environmental protection, and the inspector general from Jacques Whitford Environment Company in Ontario) has made such comments: "Canada truly has its own magic in the field of environmental protection. Its well-done environment and ecology speak for themselves" (Report from the 9th Science Conference, 2006).

Differences in approaches to environmental management between Canada and China are reflected in many aspects such as view points and management. Therefore it is reasonable to undertake a comparative study of port environmental management in these two countries in order to facilitate the transfer of advanced concepts and measurements from Canada that can assist in achieving sustainable port development in China.

2.8 Summary

In order to give reader an Omni-directional understanding of port, this chapter firstly defines port and port management, and states port function and types of port management. Secondly, to make people aware of the importance and significance of port environmental protection, the chapter provides a deep analysis on environmental problems caused by port development.

Also, by doing research on environmental related documents, the chapter summarizes environmental solutions adopted by some countries. Finally, this chapter compares former environmental work that has been done between China and other countries.

Chapter 3

Research Methodology

3.1 Introduction

The research design employed to investigate the environmental management of ports in China and Canada, is centred on a case study approach. Although broadly accepted as a strategy of inquiry primarily associated with qualitative research (Creswell 2003:15; Holliday 2002:18), the ‘case study’ has many different meanings. The following section will outline the case study and the matrix methods, as well as the triangulation research methods which were the main approaches employed in this thesis.

3.2 Qualitative Research Methodology and the Case Study

In contrast to quantitative research which seeks to explain certain phenomena or processes by controlling for variables, qualitative research attempts to understand the complexity of interrelationships and perceptions within a setting by examining an array of variables (Stake 1995:37, Holiday 2002:4). As the aim of this study is to develop an understanding of the political, economic, historical and social contexts in which the environmental management of ports takes place, a qualitative approach was deemed most appropriate. Earlier studies on the ports have used the case study approach (Li, 1999) which provides precedence for the use of this method in this research setting.

Stake (1995:101) asserts that many researchers today assume a ‘rationalist-constructivist’ approach to qualitative research, which assumes that an independent objective reality exists but that it is superimposed by people’s perceptions and interpretations of this reality. According to Stake (1995:101) the goal of the researcher is to assemble multiple interpretations into a version of ‘collective’ reality which can withstand disciplined scepticism. This approach complements an interpretative research strategy in which “research is located within the meanings people give to their worlds, and of allowing this meaning to

emerge”(Holliday 2002:17).The methodological approach adopted in this study most closely resembles these qualitative research approaches.

A case study can be described as “the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances” (Stake 1995: xi). Yin (2003) defines the case study as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context”. The ‘case’ is understood to mean a program, activity, process, or an individual, that is bounded by time and activity (Creswell 2003:15). An essential feature of case study investigation is that sufficient data is collected in the natural context for the researcher to then explore significant aspects of the case and put forward interpretations for what was studied (Bassegy 1999:47).

3.3 Research Design

In this study, a multiple case study design was employed to both explore and describe the ‘case’ investigated. The study was framed by ‘how’ and ‘why’ questions with a focus on contemporary phenomena which, Yin (2003) states, renders the research particularly well suited to case study inquiry. Furthermore, the case study is exploratory in that it strives to develop questions and hypotheses for further study (Yin 2003:3) by providing a thick description of a phenomenon within its context. By seeking to better understand a broader concern or question, the case study strategy correlates with Stake’s (1995:3) notion of an ‘instrumental case study’. The broader issue that this study attempts to address is how Chinese notions of sustainable development and top-down, blue-print planning approaches shape the mainstreaming of a port development program.

In comparison with single-case study design, Yin (2003:3) suggests multiple case studies, although more time consuming, can produce more robust research. Time and resource constraints coupled with the intention of developing thick descriptions of each case, led to the selection of six cases for investigation.

3.3.1 Developing a Thick Description

Rather than simply ‘fact’ reporting, the study attempts to develop a ‘thick description’ of the context, meanings and intentions of port environmental management. When developing a thick description, the purpose of data collection is to probe the many aspects and perceptions of the case so that its full complexity begins to emerge. According to Holliday (2002:80), thick description does not entail an exhaustive coverage of the case, but rather a scan of “the different facets of the social matrix or culture with which it is found and comes up with good analysis”. Through thick description, the ‘verisimilitude’ (Holliday 2002:80) or ‘trustworthiness’ (Bassegy 1999:74) of the study is satisfied. In the case study research, thick description has emerged as an important alternative to sample based research (Holliday 2002; Stake 1995; Bassegy 1999).

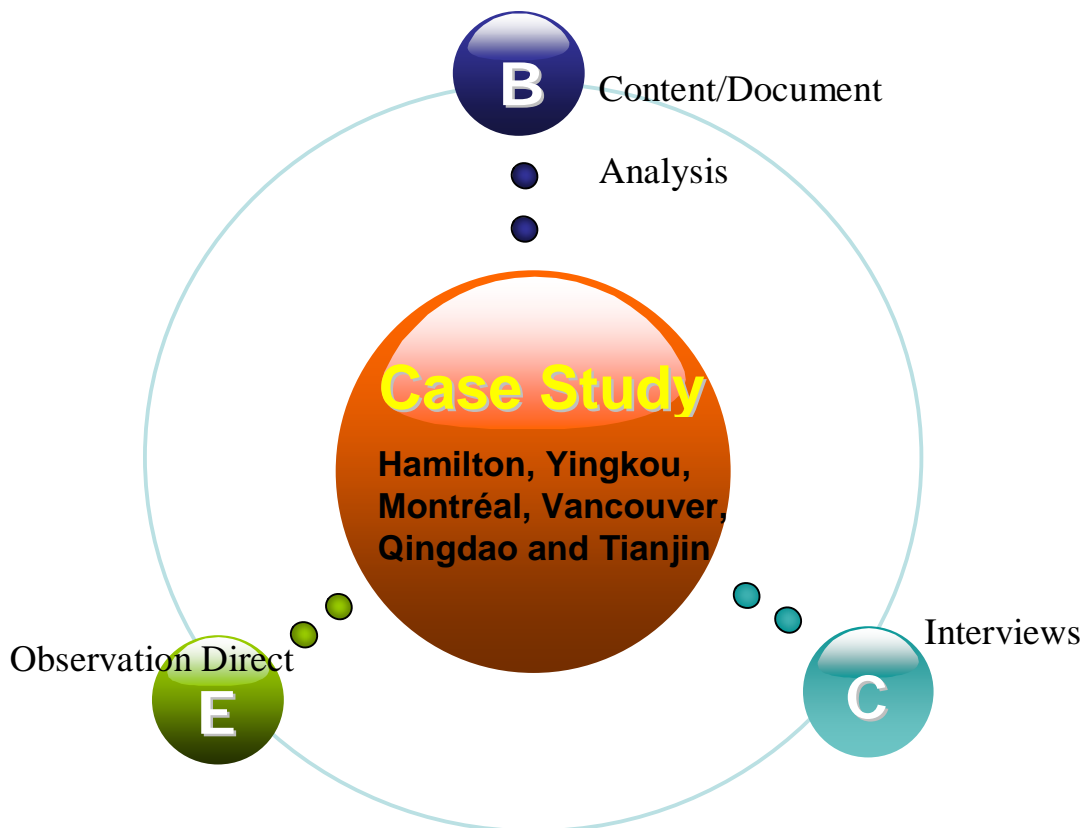
3.3.2 Triangulation

An important method of verify qualitative research is known as triangulation-the use of differing methods, data sources, theories and researchers. Triangulations strengthen research objectivity and maximize validity (Flick, 1992). There is an ongoing debate about the use of triangulation. Some researchers believe that it takes a narrow positive approach to interpreting the subject matter, while others believe it increases the depth and range of data (Flick, 1992).

There are four recognized types of triangulation (Yin 2003:98; Stake 1995:112) and this study primarily focuses on two: data source triangulation and methodological triangulation. Yin (2003:99) suggests that data triangulation involves collecting information from multiple sources with the intent of corroborating the same fact or phenomenon. Methodological triangulation entails combining various researcher methods in order to increase the confidence of interpretations (Stake 1995:114).In this study, semi-structured interviews were coupled with transect walks, observations, and document reviews. Although not formally structured into the study, theory triangulation, seeking interpretations of co-observers with alternative theoretical viewpoints (Stake 1995:113), was included. When parallel

interpretations were reached between the researcher and research assistant the interpretation could be said to be partially triangulated. A summary of the triangulation method applied in the thesis is found in Figure 3-1.

Figure 3-1: Triangulation: Multiple Data Source & Data Collection Methods in the Case Study



3.4 Research Procedures

3.4.1 Conceptual Framework

Research preparation was initiated beginning with a search of the library and internet to locate subject-related articles both in China and Canada which then helped with the design of specific questions which would form the thesis interviews. Three representative ports from each of the two countries were identified.

In order to be well prepared for the field research in China, a number of articles related to port environment management were read, prior to departure to China in October 2006. In order to obtain an overview on current port environment management in China, a visit with Professor Tao Jianhua from the Department of Environment Science and Engineering of the University of Tianjin was arranged. Professor Tao is a well known expert in the field of environmental management. After combining opinions from interviews and several of articles, a conceptual framework was constructed for the research. This study compares and contrasts the level of knowledge of port environmental protection measures between Canada and China. It also identifies the advantages and disadvantages of port environmental management and protection from each country.

3.4.2 Research Approach

A case study is a type of research in which a researcher examines, in great detail, features on many people or units of a particular type or in a specific place, or both. It is an approach that can be adopted in both cross-sectional and longitudinal research (Neuman, 2002:32,505). In a case study, as many data as possible regarding the subject of interest are collected and examined in a given social situation. In Babbie's (1990:32-33) opinion, the case study initially "aims at the comprehensive understanding of a single, idiosyncratic case." A study of one community would be an example of the case study approach. The aim is to understand the specific community of concern, rather than a generalized understanding of all communities. However, a well-designed study may have implications that extend beyond the confines of the specific case.

As mentioned in the previous chapters, this study analyzes the important role environmental management plays in each port. Several research methods were adopted to collect data in the case study: doing on-site observations, having face-to-face interviews, and collecting secondary information from publications and other documents. The primary data analysis is based on the principle of maximizing both data quantity and quality. The data from the 10

interviews were considered a small sample size, and used only to supplement and reinforce the data from questionnaire survey.

3.4.2.1 Selecting the Study Areas

In this research, the Port of Vancouver, the Port of Hamilton, the Port of Montreal, the Port of Qingdao, the Port of Tianjin and the Port of Yingkou were selected for the case study. These six ports have similar types of goods and large handling capacities. They all play important roles in the socio-economic development of China and Canada. The Port of Vancouver is Canada's largest port, the Port of Hamilton is among the top 10 of cargo ports in Canada, and the Port of Montreal is the largest transportation hub in eastern Canada. The cargo ports of the Port of Qingdao, the Port of Tianjin, and the Port of Yingkou are all within the top 10 in China (Department of Transportation, 2005). The Port of Qingdao ranks first in the world's iron ore imports. The Port of Tianjin is China's largest grain import port and the second largest port of foreign trade grocery and container handling in China.

3.4.2.2 Research Ethics

This research project received ethics clearance through the University of Waterloo's Office of Research Ethics. This study meets the guidelines for human research. A letter outlining the study was presented to all key informants and they were asked to sign a consent form to confirm their understanding of the research. Appendix A contains copies of the introductory letter and consent form.

3.5 Data Collection

Research methods most often associated with case studies such as observation, interviews and document review (Stake 1995:114; Bassey 1999, Yin 2003) were used to collect data. The following provides an overview of the methods used during each stage of the field work.

3.5.1 Open-ended Interviews with Participants

In order to gather the detailed descriptive information required for this research, the open-ended interview was adopted as the method of primary data collection.

Open-ended interviews were conducted in order to understand the perceptions and concerns of planners, port executives and staff towards port environmental management. There are two reasons for this approach: **First**, interviewing is an important method for gaining in-depth understanding and insight about the opinions and feelings of interviewees, as well as their organizational and personal goals; **Second**, open-ended questions allow interviewees to compose their answers in their own words and diverge from the subject, possibly offering additional facts that may be important for the study in the future. Considering the different economic and socio-cultural contexts between the two countries, port executives and staff may have different preferences and priorities on environmental management. Open-ended interviews allow in more spontaneity and flexibility, and thus enrich the research findings. And all the questions were open-ended and followed the general structure of the sample in the questions outlined in Appendix D.

Seventeen staff from the six ports¹ was interviewed (See Table 3-1). All respondents had lived at these locations for more than ten years and as such were familiar with information pertaining to the topics of concern as raised in the questions and each was in a position to provide informed insights. However, the interview data collected is only a small sample, and therefore not used as a major data source for the research.

¹ Five from ports of Canada and Twelve from ports of China.

Table 3-1: People to be Interviewed

Port	Person Number	People Position	Department
Port of Vancouver	1	Director	Planning and Development.
Port of Hamilton	3	Director, Vice-president Personnel	Planning and Development.
Port of Montreal	1	Director	Planning and Development.
Port of Qingdao	3	Director, Vice-president Personnel	Planning and Development.
Port of Tianjing	4	Personnel, Director, Vice-Director Vice-president	Planning and Development.
Port of Yingkou	5	Personnel, Vice-Director, Director, Vice-President, President	Planning and Development.

3.5.2 Data Analysis

Thematic analysis is a commonly used qualitative analysis procedure in which emergent themes are abstracted from raw data (Holiday 2002; Luborsky 1994; Auerbach & Silverstein 2003), was used in this research study.

With permission from the respondents, all semi-structured interviews were tape recorded and transcribed to a word processor. The audiotapes were to be used for later correction on potential typographic errors. While the interview was conducted, notes were taken in detail for back up purposes.

The interview field notes were reviewed several times. The first review included a relevant text selecting and a filtering process where pertinent raw data was unidentified for analysis (Auerbach & Silverstein, 2003). The interviews had three components: port general information, port general environmental policy, and port environmental management information.

More focus was given to the second reading, which focused on repeated and important idea identification (Luborsky, 1994; Auerbach & Silverstein, 2003). Labels or “codes” were given to the repeated ideas, and then entered into an Excel spreadsheet with their relevant text. Bits of text or passages that had more than one idea were coded in different ways. Such repeated ideas were separated into two major sections. One section included ideas related to process, involving the sequence of events, planning approaches, and so go, which the other section captured ideas that reflected people’s perceptions, concerns, and ideas.

3.5.3 Publications

Publications used included the academic literature, official publications, journal articles, local newspapers, magazines and published government documents. The sources came from different countries: most of them were written and published in Australia, Britain, Canada, and the United States, because these countries or regions hold leading positions in theoretical and empirical research both on ports and on environmental management.

3.5.4 Field Research

The research study was taken a during four month period. Case Study covered six ports in total and interviews with ten ports executives (See Appendix E). Through the whole process, update a information on current port environment management between China and Canada was acquired and steps taken to improve and facilitate port environment management by the Chinese and Canada both governments was identified.

3.5.5 Direct Observation

Before each interview appointment the researcher would take a tour around the port area (See Appendix E) in order to have an overall understanding of the port focusing on environment issues. The researcher was also able to look solutions implemented at the port to handle environment impacts, and be better prepared for the interviews with key informants.

3.6 Research Limitations

There are some key limitations to this study that readers should bear in mind. Since the research is exploratory, generalizations made from the case studies do not necessary apply to the whole population. Readers should not infer conclusive theories from the case studies. The case study makes a substantive contribution to our knowledge base and adds to the literature on port environmental management.

Prior to be each interview, specific on-line research was carefully completed to locate people who were most knowledge able about to environmental management issues at each port. However, potential respondents were not always readily available for the interview; they were often occupied with other responsibilities at the time. Interviewees' availability only contributed to some minor problems, and did not affect the completion of the interview plan. Another not worthy limitation was inability to make connections with the local government authorities. A direct approach with the government authorities to ask on environmental questions would contribute to a better understanding of government policies on environmental management.

In regard to cross-cultural research skills and the ethics review requirements, certain limitations apply. A social and cultural understanding gap exists despite ethics clearance. The ethics review was made through the Office of Research at the University of Waterloo. The research was conducted in an area in China where English is not applicable for communication and research. Questionnaires and related forms in English were required for

ethics approval. The equivalence of language was neglected. For example, the square means Guangchang in Chinese, which not only refers to reserved natural land for public use, but also is applicable to a garden or commercial parkland for recreations.

The main objective of the research is to summarize the experience gained in the Port Environmental Management in Canada and China over the years. Such a study is based on a good amount of collected information. However, there are few documents and materials available comparing environment management between Canada and China.

Chapter 4

Case Studies in Canada

To introduce the concept of environmental management and environmental protection measures of Canadian ports, this chapter is divided into two parts: the first part outlines the environmental management policies of Canadian ports and public participation; the second specific case studies: examines Hamilton, Vancouver, and Montreal are examined.

4.1 Canadian Port Environmental Protection Policies

In Canada, major environmental legislation started in the late '60s and early '70s of the last century. The initial legislative progress was largely not based on reasonable considerations of policy, but on public concern for the deteriorating environmental situation, the strong demand for governmental intervention, and the need for the government to deal with urgent catastrophic events (Macdonald, 1995).. The early 1970s was an active period for Canadian environmental legislation. In July 1988, based on the collection of five environmental regulations made in the early 1970s, the Canadian government enacted a comprehensive and integrated Canadian “Environmental Protection Law”. At that time, that law became the most important environmental legislation in Canada, known as the cornerstone of Canadian environmental law (Saundry, Richard and Peter Turnbull, 1997).

There are three levels of laws and regulations applicable to ports in Canada - federal, provincial, and municipal, respectively. In recent years, the Canadian government has mainly enacted the following legislation on the marine environment (See Table 4-1):

Table4-1 Summary Legislation on the Marine Environment

1 Canadian Law of the Sea	2 Canadian Arctic Waters Pollution Prevention Act
3 Canada Ocean Shipping Law	4 Canadian Environmental Assessment Act
5 Law on the Canadian Port	6 Canadian Environmental Protection Act
7 Transport of Dangerous Goods Act	8 Oil and Gas Production and Protection Law
9 Navigable Waters Law	10 Environmental Assessment Act

Canada has chiefly implemented the following specific marine project environmental management systems: common responsibility, the polluter reparation system, environmental assessment, and contingency measures (McDonagh, Stephen. 1999).

Sound laws and regulations play a major role in environmental protection in Canadian ports, but some problems exist in Canadian port environmental management. For example, in the “Canada Ocean Shipping Law” promulgated in 1998, restrictions on the financial activities of the ports, which to some extent constrained the rapid development of Canadian ports and the economy of sea transportation. Meanwhile, Canadian ports may face inadequate funding from government, thus they may experience a corresponding lack of investment for environmental protection (Williams, Mark Loyd, Bill Jamieson, and Noerton Rose, 1999). For example, the Port of Fraser River in BC of Canada, which needs to be cleared of 120 cubic meters sediment per year, would be completed in ten years time at the expense of 1,090,000 US dollars. However, until now, the project has raised only 676,000 US dollars which means it could not even supply the funds required for completing the one year's task. Due to the restriction of Canadian Marine Law, the Fraser Port Authority found difficulty in raising sufficient funds. ‘If Fraser Port fails to raise sufficient funds for clearing the channel, then the loading rate of Fraser Port will decrease by 1/4, resulting in an unexpected financial loss’ said Allan Thomas the president of Fraser Port (Jianyong Yang, 2001). The Canadian Federal Government once discussed in 2003, about the proposal from the Canadian port authorities to reform the Canada Shipping Act, no result yet has ever been reached (Interview J 23-1).

Public Participation

Public concern for the deteriorating environmental situation and the strong requirement for governmental intervention in environmental protection have played a very important promoting role in the making of Canadian environmental protection laws. Canada attaches great importance to public participation in environmental protection actions. The 1999 version of the "Environmental Protection Law" formulates specific rules for public participation, for example, in making links of environmental laws and regulations, in stipulating the establishment of online environment registry, in providing environmental information, data, and the state of affairs, so as to make it convenient for the public to supervise the entire process of making legal documents from proposal draft to the final approval. Besides, the public can express their views, thus ensuring the public's right to know and participate in the environment protection. In addition, the "Canadian Environmental Impact Assessment Law" states that "The government should encourage and facilitate public participation in environmental impact assessment of the projects approved by the government or assisted in the implementation" and "to ensure public participation in environmental impact assessment." (Weiqun Yang, 2000). For example, the issue of permission for the sea disposal of waste must have a 30-day waiting period after public notice to allow time for the public to raise objections, in accordance with the administrative rules set by "Environmental Protection Law." After the minister makes the announcement, there should be a 60-day appraisal period for public discussion, written evaluation, objection notice, and calling for the establishment of a commission to hear reasons for objection. As for environmental litigation, the process for public participation has been improved. The public or individual both have the right to put forward a request for an investigation of environmental violations. And if no appropriate action is taken after the ministerial investigation, environmental protection litigation can be started against the violator, requesting the court to rule that damage must be stopped and those who suffer from personal and property damage can claim compensation through civil litigation. For the protection of perennial 'whistle-blowers' with in violating organizations, provisions in the act prohibit the disclosure of the 'whistle-blower's' identity, dismissal; harassment and punishment of informants are offences set by the regulations.

Canadians have been increasingly aware that environment and economy are two aspects of one issue. At present, public opinion surveys show that Canadians are very concerned about the environment. Most people believe that strong economic growth and a clean environment are inseparable. The first survey in 1993 showed that in Canada, the majority of the public has started to think that most of the responsibility for environmental protection lies in individuals; changes of personal lifestyle are now increasingly considered to be the key to solving environmental problems (IRCHA, M. C., 1997).

The analysis above shows that Canada has enacted specific procedural regulations to support public participation and has ensured the extensive implementation of public participation and the effective collection of public ideas through the legal system. Canadians have a strong sense of environmental protection and think that changing their individual lifestyles are keys to solving environmental problems.

4.2 The Port of Vancouver

4.2.1 Overview

The Port of Vancouver is located in south-western British Columbia. The Port of Vancouver is Canada's largest port and also one of the world's major wheat export ports. Compared with other ports in North America, the distance between the Port of Vancouver and Asia is the shortest, so it has a special advantage in shortening journey time and lowering shipping costs. Therefore, the Port of Vancouver plays an important part in developing trade between Canada and the Asia-Pacific region, especially trade with China (The Port of Vancouver, 2005).

The Port of Vancouver currently has 27 wharfs, among which are 17 bulk cargo wharfs, 5 grocery wharfs and 3 container wharfs. The Port of Vancouver has become the busiest hub and the third largest port in North America with more than 70,000,000 tons of annual cargo throughput. The main exporting goods are wheat, machinery, paper and pulp, copper, cereal, flour, wood products, coal, fertilizer, coke, fish, fruits, and Importing goods are mainly salt,

tea, cement, steel, sugar, iron and phosphate stone. The existence of the Port of Vancouver promotes the development of neighbouring industries, which specialize mainly in shipbuilding, wood processing, paper-making, automobiles, fish processing, textiles, aircraft manufacturing and petroleum processing (The Port of Vancouver, 2005).

The mission of the Port of Vancouver is to facilitate and expand the movement of cargo and passengers through the port in the best interest of Canadians. The values of the Port of Vancouver are shown as following:

The Port of Vancouver said: “Our Commercial Customers: We strive to be our customers' strategic advantage by providing facilities, technologies and services that are competitive, innovative and commercially viable. Our Environment: We operate in a manner that respects and sustains our natural, social and community environments. Our Financial Health: We manage our business to ensure financial self-sufficiency. Our People: We provide a challenging and rewarding working environment for committed and effective people. Our Reputation: We conduct ourselves in a manner that earns trust and respect” (The Port of Vancouver, 2005).



Figure 4-1: Current Situation of the Port of Vancouver (2005)

Source: [http:// www.noms2006.org/content/venue.html](http://www.noms2006.org/content/venue.html), retrieved on March 5, 2007.



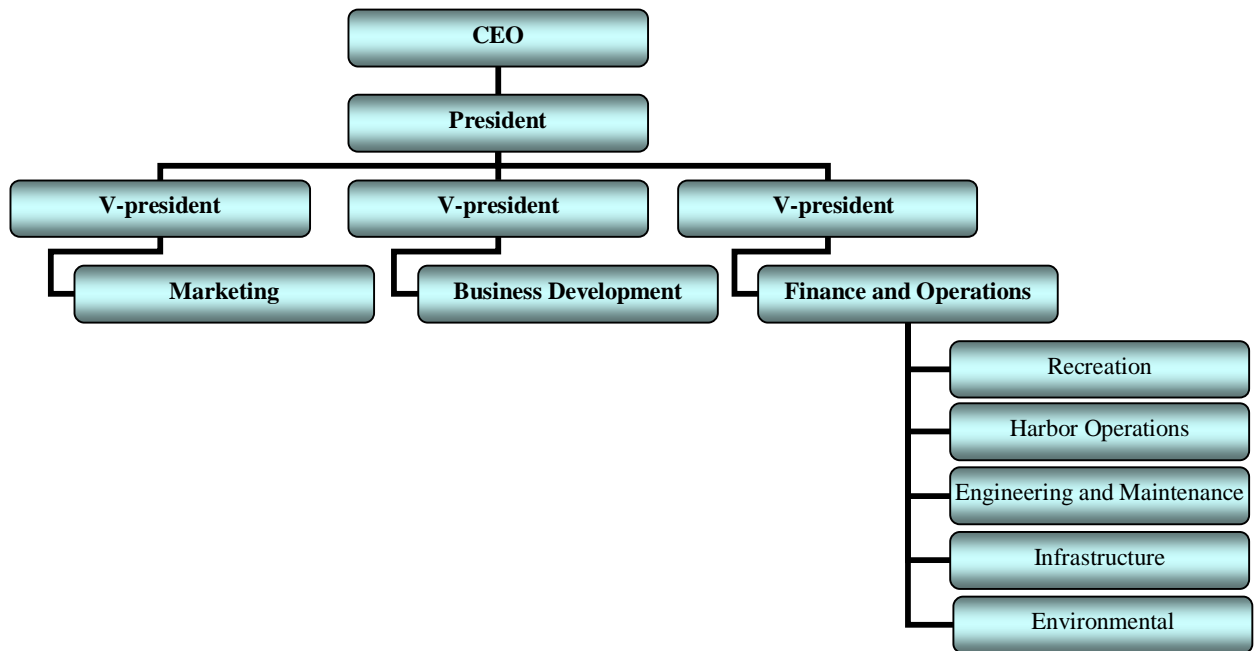
Figure 4-2: Current Situation of the Port of Vancouver (2005)

Source: http://w01.international.gc.ca/canadexport/Get_PubImage.asp?id=1609, retrieved on March 5, 2007.

4.2.2 Status of Environmental Management

The Vancouver Port Authority (VPA) is subject to the Canada Port Authority Environmental Assessment Act (EA Regulations). The Vancouver Port Authority is supportive of initiatives by the Federal Government to improve air quality, including Transport Canada's work with the International Maritime Organization to establish regulations on emissions. In addition, VPA supports Environment Canada's work with Washington State through the Georgia Basin International Airshed Steering Committee to implement a strategy to reduce emissions.

Figure4-3: Environmental Management of Port of Vancouver



Source: Interview J 18-1, 2006.

4.2.2.1 Work undertaken on port environmental protection

Prevention of Water Pollution

The VPA began a program of replacing all old underground storage tanks on VPA property with modern above or underground tanks with environmental containment and leak detection systems; new storm water collection and discharge systems to Burrard Inlet are now routinely fitted with oil and sediment interceptors to prevent pollution discharges (The Port of Vancouver, 2005).

Ecological Environment Protection

The port became the first in North America to require mid-ocean ballast water exchanges to limit the potential for the introduction of exotic species into Burrard Inlet. Since 1983, the VPA has conducted a regular ballast water-monitoring program to ensure clean ballast discharge and is a key participant in the non-indigenous species working group, made up of representatives from the regulatory agencies and academia in British Columbia and

Washington; To assist in protecting key natural habitats within the port setting, the VPA initiated and participated in the inter 'tidal and shallow sub' tidal habitat (to -20 m) mapping of the entire shoreline of Burrard Inlet (more than 200 kilometers); The VPA set aside 24 hectares of uplands at Maplewood South in North Vancouver to serve as the Port Vancouver Conservation Area. Located on the Pacific Flyway, the conservation area is a great place for local birdwatchers and seeing nature up close (The Port of Vancouver, 2005).

Air Pollution Control

- I The Port of Vancouver is working to reduce air emissions through improving operational efficiency, technological innovation, supporting regulatory change and development of a data baseline (The Port of Vancouver, 2005) ;

- I A number of air emission reduction projects are already underway and planned for the future; there is collaboration with other ports, the Marine Industry and with government agencies to promote efficiency and the implementation of technologies to reduce air emissions (The Port of Vancouver, 2005);

- I Emissions from ports have the potential to increase due to growth in response to the increasing demand for import and export of goods. This means more cargo, ships, trucks and trains will go through ports each year to meet that demand(The Port of Vancouver, 2005);

- I A key component of making the Port of Vancouver sustainable is reducing emissions from port-related activities including ships, trucks, trains and cargo handling equipment as well as industrial processes (The Port of Vancouver, 2005);

- I Emission estimates are used to forecast future emission levels, these estimates are arrived at by using information available, looking at projections from a variety of sources, and making further assumptions about how port growth will be accommodated (The Port of Vancouver, 2005).

The Port of Vancouver has established links with its local study institutions, including the University of British Columbia and Simon Fraser University, supporting research opportunities for their graduate students, to their mutual benefit (Interview J 18-1).

4.2.2.2 A Look to the Future

According to respondents, key objectives for Vancouver Port are:

- I To reduce air emissions through improving operational efficiency, technological innovation, supporting regulatory change and development of a data baseline(Interview J 17-1; J18-1) ;
- I To implement a number of air emission reduction projects and to collaborate with other Ports, the Marine Industry and with government agencies to promote efficiency and the implementation of technologies to reduce air emissions (Interview J 17-1; J18-1) ;
- I To address the expected increase in emission due to growth and increasing demand for import and export of goods. This means more cargo, ships, trucks and trains will go through Ports each year to meet that demand (Interview J 18-1);
- I To reduce emissions from port-related activities including ships, trucks, trains and cargo handling equipment, as well as industrial processes(Interview J17-1); and,
- I To both maintain and improve the environment, port in order to represent a true “green port” (Interview J 18-1).

4.2.3 Environmental Management Organization

The Port of Vancouver is more than cranes, cargo, terminals, ships and international trade; it is successful in another way. It is recognized globally as a naturally beautiful and clean port complemented by sound and innovative environmental leadership. The Vancouver Port

Authority's Environmental Programs provide a close-up of the port from an environmental angle (The Port of Vancouver, 2005). Environmental protection is a core value of the Port of Vancouver Authority and is a very serious responsibility. The Vancouver Port Environmental Management Agency has several duties:

- I As the first port in Canada having environmental services (since 1990), the first action of Vancouver was to implement an extensive environmental policy with a rigorous appraisal procedure for all new projects. Further, to identify any potential risk to the natural environment, the agency conducted a full environmental audit of all marine facilities(Interview J 17-1);
- I It has working associations with other governments to share information and coordinate environmental projects and plans. The agency is a founding member of the Burrard Inlet Environmental Action Program (BIEAP), a partnership agreement between Environment Canada, the Department of Fisheries and Oceans, B.C.(Interview J 18-1);
- I The participation of all of these partners begins with initial planning. They identify environmental problems in the preliminary designs and begin timely investigative programs to gather environmental data. They also help to design procedures and features into the development plan to mitigate environmental impacts that might result from the construction and/or operation of new facilities(Interview J 17-1; J 18-1);
- I The Environmental Programs Department administers the port's internal environmental review process and plays an important role in guiding the development proposal through external environmental reviews. Also, it provides information and interprets complex technical issues for concerned members of the public and affected municipalities (Interview J 17-1); and,
- I The Environmental Programs Department also is responsible for monitoring the effectiveness of any mitigator or compensatory features built into the new facility, and

finally, are responsible for ensuring that the on-going operation of the new facility does not result in the development of environmental liabilities (Interview J18-1).

The Vancouver Port Authority is the governmental port management agency responsible for port construction, development and protection. To develop and make rational use of the port coastline is the basic objective of its port environmental protection strategy. The Environmental Programs Department, established 15 years ago, is responsible for environmental programs and services, and it is equipped with dynamic personnel including engineers, biologists, and scientists. As the first North American port to employ a dedicated team of specialists to address issues concerning the environment, the Vancouver Port Authority shares this responsibility with Transportation Canada, Environment Canada and the GVRD. Environment is one of the core values of the VPA (Interview J17-1).

4.2.4 Issues and Solutions Related to the Current Situation of the Port's Environment

The Vancouver Port Authority is supportive of initiatives by the Federal Government to improve air quality, including Transport Canada's work with the International Maritime Organization to establish regulations on emissions. Maintaining and improving air quality as a key priority (Interview J 18-1).

- I **Dust:** First of all, by using bio-diesel (better quality fuel) and shore power, air emissions are largely reduced. Secondly, Spray Towers are used to mitigate the effect of spray down dusts and particulate matters in the air. Spray Tower technology is a computer based monitoring system; it automatically sprays when there is wind. The water used to spray down air pollutions, is recycled to be used again, so no further fresh water is wasted (Interview J17-1);

- I **Mid-Ocean Exchange to Deal with Ballasted Water:** The Port became the first in North America to require mid-ocean ballast water exchanges to limit the potential for the

introduction of exotic species into Burrard Inlet. Since 1983, the VPA has conducted a regular ballast water-monitoring program to ensure clean ballast discharge and is a key participant in the non-indigenous species working group, made up of representatives from the regulatory agencies and academia in British Columbia and Washington (Interview J 18-1);

I **Air Pollution:** The Port of Vancouver ("the Port") is working hard to reduce emissions of criteria air contaminants and greenhouse gases, not only from the marine sector but all related activities including railways, trucks, construction equipment and industry. The Port is working with other Ports such as Seattle, Los Angeles and Long Beach, exploring options to determine the most effective alternatives for emissions reductions. The Port is also leading the way with additional emission reduction strategies, the results of which will in turn be shared with other Ports (Interview J 18-1); and,

I There are **'Historical Pollutions'**, and it takes time to clean them up at the port. There are factors affecting the Port's environmental condition, and yet it's not under the Port's control. For example, cruise ships are potential port pollution sources, and even though port has total control at terminals, cruise ship regulation requires international negotiation. The good news is new cruise ships are built with environmental protection in mind, so that will help reduce further pollution from ships (Interview J 17-1).

Environmental protection is considered very important at the Port of Vancouver. Environment concerns all human lives and economic development. Therefore, Chinese ports should learn from such foreign ports with innovative environment thinking, contributing to a better global environment.

4.3 The Port of Hamilton

4.3.1 Overview

The Port of Hamilton is a naturally protected body of water created during the last glaciation period. Its watershed comprises an area of 500 square kilometres that is encompassed by a shoreline measuring 45 kilometres in length. The harbour is accessible from Lake Ontario through a short channel known as the Burlington Shipping Canal (The Port of Hamilton, 2005).

The Port of Hamilton ranks in the top ten in cargo throughput among all the ports of Canada. The Port of Hamilton connects the major transportation routes of two large lakes. The Welland Canal entrance is situated about 26 miles from the Burlington Canal, and the St. Lawrence River is about 151 miles from the entrance to the Port of Hamilton. Both the Port of Hamilton and the industries it spurs make an important contribution to the vitality of the regional economy. Goods transported at the port include coal, iron ore, salt and sand, grains and beans, fertilizer, and jet fuel. Business development in recent years has become a major focus of the port authority (The Port of Hamilton, 2005).



Figure4-4: Current Situation of the Hamilton Port (2000)

Source: [http:// www.greatlakes-seaway.com/fr/img/hamilton.jpg](http://www.greatlakes-seaway.com/fr/img/hamilton.jpg), retrieved on March 8, 2007.



Figure4-5: Current Situation of the Hamilton Port (2000)

Source: [http:// www.billwrigley.com/s_08.html](http://www.billwrigley.com/s_08.html), retrieved on March 8, 2007.

4.3.2 Status of Environmental Management

The Hamilton Port Authority was created on May 1, 2001 as a result of the issuance of letters patent pursuant to the Canada Marine Act. The Hamilton Port Authority (HPA) is the successor corporation to The Hamilton Harbour Commissioners, an organization established by The Hamilton Harbour Commissioners Act of 1912. The HPA is governed by a seven-member Board charged with administering, operating and developing the harbour in a financially self-sufficient manner consistent with the national ports policy objectives. The Board is responsible to the Federal Minister of Transport (The Port of Hamilton, 2005).

In the 1970s, the Hamilton Port Authority set up the Port of Hamilton Spill Control Group (POHSCG), comprising 12 subsidiary companies responsible for rapid clean up of oil pollution and for providing service to the entire port region. Although the Port of Hamilton does not have a specific department dealing with emergent pollution accidents, these 12 companies are exclusively responsible for decontamination (Interview J 24-1).

It is clear that environmental protection awareness began quite early at the Port of Hamilton. The Port also established a specific company to be responsible for the port environmental management task.

- I The officers in charge of port environment in the Hamilton Port Authority join with local environment sectors to actively carry out environmental restoration. They also work with other environmental groups and governmental agencies. The port is working on garden creating projects to improve the local environment and continues to take the lead in protecting fish and wildlife habitats (Interview J 23-1);
- I Currently, there is a special sewage treatment plant in the Port of Hamilton. Meanwhile, the staff and local neighbourhood residents are cautioned to decrease the dumping of toxic material directly into the sewer system in order to reduce the pollution of the local water environment as far as possible(Interview J 23-1; J 24-1);
- I The government provides funds through tax collection to support port development and designates the annual budget for environmental planning(Interview J 24-1);
- I The Port of Hamilton is also a member of the Clean Marine Program. The program puts forward more than 200 environmental initiatives, including fuel, waste oil and paper recycling, Canada Environmental Protection Bureau and Ontario Branch has cooperated to work out the EPA manual and have requested that members perform a comprehensive environmental audit. Terra Choice Environmental Services conducted this audit for the Port of Hamilton and turned the results into the five-point ecological hierarchy(Interview J 23-1; J 24-1); and,
- I The Port of Hamilton always pays great attention to environmental protection on the gulf and the coast. It also plays a major role in pollution control projects, such as on Randle Reef, which was co-sponsored by the local Environmental Protection Bureau and Canada Environmental Protection Bureau in 2002. The project not only aims to deal with

contaminated areas but also takes into account the local landscape and the future economic development (Interview J 24-1).

4.3.3 Situations Concerned with Port Environment Management

The Port of Hamilton has put forward an environmental management concept: “What is good for the environment is just good for the port.” At the port of Hamilton, there are President and CEO, 3 VPs (in marketing and business development, in finance, and in operations) Under the VP of operation, there are 5 managers – of recreation, harbour operations, engineering and maintenance, infrastructure, and environmental (Interview J 23-1).

There are some educational and technological institutions with which the Port of Hamilton works to enhance with port environmental planning. As well as companies sharing their new technologies and information with the port (Interview J 24-1), for example, Marilyn Baxter, Environmental Manager, is a member of the Bay Area Implementation Team (BAIT). The Hamilton Port Authority is a strong supporter of both the Bay Area Restoration Council (BARC) and the Hamilton Harbour Remedial Action Plan.

4.3.4 Issues and Solutions Related to the Current Situation of the Port’s Environment

The HPA has already carried out extensive work on port environmental protection and will do more in the near future (The Port of Hamilton, 2005).

4.3.4.1 Work Undertaken on Port Environmental Protection

The Hamilton Port Authority has made the environmental health of Hamilton Harbour and its shoreline a priority. Most significantly, the HPA has committed to taking a lead in the remediation of Randle Reef, a toxic hot spot on the Great Lakes. In 2002, this included partnering with Environment Canada and the provincial Ministry of the Environment to develop the preferred option of containing and capping the contaminated area to deal with

this problem. It also includes making the site aesthetically appealing and preparing it for future economic development.

4.3.4.2 A Look to the Future

The HPA continues to be a leader in the environmental restoration of the harbour and has undertaken environmentally friendly practices in its operations; Port lands are being landscaped to make them more visually attractive and environmentally friendly; In cooperation with other environmental groups and government agencies, initiatives to protect and restore fish and wildlife habitat are continuing, in cooperation with other environmental groups and government agencies (Interview J 24-1).

4.3.4.3 Environmental Management Formwork

At the Port of Hamilton, the researcher was able to have interviews with the Port Director of Planning and Development, and the Port Director of Environmental Programs (note: the individual department of environment has only recently been established.)

Information on the port's main pollution concerns as well as the corresponding solutions, and the implementing agencies was obtained. See the following chart (Table 4-2):

Table 4-2: Environmental Management Framework of Hamilton

Issues	Solutions	Executors
Oil pollution	Building a barrier to prevent oil spill from getting into ocean	Port of Hamilton Spill Control Group(POHSCG)
Air pollution	Using high quality fuel or automobile, and do road pavement to avoid trucks getting dusks to the air, which contribute half of Hamilton harbor air pollution, and use water spray to deal with dust in the air already	VP of operation,
Ballasted water pollution form ships	Ballasted water pollution form ships are international problem; it's taken seriously at Port Hamilton, especially with its new assigned manager of environmental.	VP of operation,
Coal pole	keep it from spreading into the air, using water spray; keep it from spreading all over when it's raining, using plastic or rubber cover	VP of operation,

Source: Interview J 23-1; J 24-1, 2006.

The Port of Hamilton had an early start in environmental protection, and has established an effective environmental management system. The port also vigorously participates in various environmental protection groups, as well as inviting organizations specialized in environmental protection to collaborate with the port to address pollution issues.

4.4 The Port of Montreal

4.4.1 Overview

As a business port in eastern Canada, the Port of Montreal is located near the junction of the Ottawa River and the middle reaches of the St. Lawrence River at north latitude 45 ° 30' and west longitude 73 ° 33'. It reaches the sea via the Bell Island Straits over 838 miles and with the Cabot Straits over 690 miles. The St. Lawrence River links the Five Great Lakes at the upper and with the Gulf of St. Lawrence at the lower end, a distance of 960 km. Through comprehensive control in the 1950s, the river runs 8.2 meters deep and 10,000-ton sea craft can reach the Great Lakes. Ships, handling more than annual 40 million tons, can easily keep steady in the fairways due to the ability to water leads in the Great Lakes. The channel below the Port of Montreal averages 10.9 meters in depth, which allows access to ocean liners with a draught of 10 meters. However, influenced by the Labrador cold flow, the river is not open for navigation during the winter (from the middle of December to early the following April) (The Port of Montreal, 2005).

The Port of Montreal is the largest transport hub in eastern Canada. It is 139 nautical miles away from Quebec, 1,033 nautical miles to the Port of St. Johns via the Cabot Straits, 986 miles to Halifax, and 3,286 nautical miles to Cologne City of Panama. Five railways intermingle at the Port of Montreal, eastbound to St. John and Halifax, northbound to Three-Rivers and Quebec, southbound to New York, and westbound to Vancouver. The Port of Montreal has broad highway connections and an international airport. The harbour area is from upper Victoria Bridge to the West Bank along the river about 17 km from southwest to northeast, with more than 50 jetties (The Port of Montreal, 2005).

Container transports at The Port of Montreal carry a wide variety of goods, including food (fruit, dried fruit, vegetables, alcohol, forest products, metals, chemicals, iron and steel products, construction materials, food grains, vehicles and accessories, non-metallic minerals and textile products, reflecting the diversity of industries in the North American market. The

Port of Montreal is a leading port in North America along the North Atlantic route and connects the industrial heart of North America (Central Canada, North eastern, Central and Western United States), the Nordic region and the Mediterranean region. Ninety-five percent of the containerized cargo of the Port of Montreal is transported via this route. The Port of Montreal is also considered a multifunctional port, handling various pieces of groceries, dry bulk and liquid bulk with an annual throughput of 20 million tons, creating an annual value of US\$1.7 billion and providing 17,000 jobs (The Port of Montreal, 2005).



Figure4-6: Current Situation of the Port of Montreal (2001)

Source: <http://www.transport-canada.org/quebec/tp13298/05-06/images/Port-de-Montreal.jpg> retrieved on March 10, 2007.



Figure4-7: Current Situation of the Port of Montreal (2001)

Source: http://www.boatnerd.com/news/newpictures03b/Port_2003_D-024.jpg, retrieved on March 10, 2007.

4.4.2 Status of Environmental Management

The Port of Montreal is administrated by the Montreal Port Authority (MPA). The Board of Directors consists of seven members, three of them appointed by one federal, one provincial and one municipal, and another four by the Federal Transport Minister. Under the Board of Directors, the Chief Executive Officer (CEO) is responsible for three sectors: the Market Development Division (in charge of business and economic research and analysis),the Operations Division (responsible for measures support, security and fire control),and the Human Resources Management Division (responsible for the financial services, human resources and environmental management) (The Port of Montreal,2005).

- I The Montreal Port Authority has its own environmental regulatory division that can monitor environmental changes at any time (Interview J 30-1);

- I The Montreal Port Authority has its own contingency plans to deal with accidents that can cause damage to the public or the natural environment. It has permanent staff to cope with emergencies. It also has a specialized team performing fire control and natural disaster prevention, inspections and electronic surveillance in the port area (Interview J 30-1);

- I The Montreal Port Authority invites three experts in the environmental field to assess if environmental policies are applied properly, and its staff and port users abide by these policies. These experts, who have advanced knowledge of research and many years of relevant working experience, can provide their professional advice for wildlife management, and both chemical and geological aspects in the port area. Additionally, the port cooperates with some professional organizations that are specialized in environmental management in order to introduce their advanced concepts and measures (Interview J 30-1; J 31-1);

- I As for dust control of port, according to different kinds of goods, the Montreal Port

Authority applies "dry and wet" basic cleaning methods to the wharves, utilizing vacuum, water spraying and the virescence to the roads. Most importantly, in every loading and unloading aspect and position, the commander and the operators take proper responsibility to see that the various environmental protection equipment and measures are implemented(Interview J 30-1);

- I For wastewater treatment, the Port of Montreal builds closed catchments systems of rainwater and living wastewater. All wastewater is processed, recycled mainly for sprinkling or discharged according to standards. The oily wastewater and chemical wastewater are professionally processed by treatment systems. The chemical wastewater treatment is determined through chemical monitoring (Interview J 30-1; J 31-1);

- I Regarding the contingency measures for ocean and river oil spills, the Port of Montreal pollution control center and relevant departments can, promptly and effectively react to set up oil containment, draw spillover oil with special ships, spray oil dispersant, clean up floating objects, and spray dispersant in large areas by plane. The Port Authority has specialized vessels for environmental protection to promptly clean up the oily surface of river, salvage various floating solid objects and collect ship garbage and wastewater. Professional oil tankers can directly separate and recycle oil in the water (Interview J 31-1).

4.4.3 Environmental Management Organization

The Montreal Port Authority attaches great importance to environmental protection because it understands that environmental management is a significant task. The Montreal Port Authority has the obligations to raise environmental management to a high level and seriously implement it. The Montreal Port Authority has the following primary responsibilities in environmental management:

- I To ensure that environmental legislation and discussion procedures are applicable for its

organization(Interview J 30-1; J 31-1) ;

- I To operate the business to recognize the importance of environmental protection and minimize the risk as much as possible(Interview J 30-1; J 31-1) ;
- I To examine use of land to ensure that the port activities are harmonious with the environmental benefits(Interview J 30-1; J 31-1); and,
- I To ensure that employees, customers and the public are aware of environmental requirements (Interview J 30-1; J 31-1).

The main pollution treatment methods of Port of Montreal are as follows (Table 4-3):

Table 4-3: Environmental Management framework of Montreal

Issues	Solutions	Executors
Land Pollution	Vacuum, water spraying and the virescence, Transport vehicles decked.	The Environmental Management Department of MPA
Air Pollution	using high quality fuel or automobile,	The Environmental Management Department of MPA
Coal Pole and Forest Products	keep it from spreading into the air, using water spray; keep it from spreading all over when it's raining, using plastic or rubber cover; Thatch covered (dust coverage) mode	The Environmental Management Department of MPA

Source: Interview J 30-1; J 31-1, 2006.

The Port's performance in environmental protection is closely linked to the governing of the City of Montreal. As a matter of fact, the city of Montreal is considered one of the top cities in Canada in addressing environmental protection (McDonagh, Stephen, 1999).The City of

Montreal has very strict processing procedures and monitoring standards regarding air, water, soil, and garbage. Garbage in the city is sorted before recycling. Its water quality of the St. Lawrence River surrounding Montreal Island, has met accepted drinking standards after a ten-year water treatment plan. This success adds more weight to the fact that the port's environmental protection record, it is also influenced by the environmental protection status and economic development of the local city. Therefore, a good environmental protection performance needs not just an individual or an agency; it requires the collaboration of every agency's efforts.

4.5 Summary

The case studies just cited show that the environmental management of Canadian ports has the following characteristics:

- I In the concept of port management, Canadian ports emphasize environmental amity, respect for nature and sustainable development of the environment; and,
- I With regard to the establishment of port environmental management departments, Canadian port authorities attach great importance to efforts of port environmental protection and have set up dedicated port management departments that are equipped with specialized environmental experts.

As to port environmental management responsibilities, in addition to implementing port environmental management in accordance with the requirements of laws and regulations, Canadian port management departments conduct research on environmental protection and actively participate in various environmental protection groups.

Port Management Measures

The case studies just cited show that the environmental measure of Canadian ports has the following characteristics:

- I Aiming at the pollution problems, the use of effective environmental protection measures;
- I Paying attention to updating port equipment and adopting advanced measures to reduce the emission of pollutants in Canadian ports;
- I Valuing the prevention of environmental pollution problems arising from the source;
- I Focusing on the prevention of sudden environmental risk accidents; and,
- I Cooperating with other agencies to protect the environment.

These points will be compared to Chinese Ports in Chapter Five and Chapter Six.

Chapter 5

Port Environment Management in China

This chapter discusses the issues of China's port environmental protection policies and public participation, China's port environmental protection development, China's port environmental management situation, and the challenges faced by China's ports in effectively addressing environmental issues.

5.1 China's Ports Environmental Protection Policies

In China, the history of environmental protection law can be traced back to the Yin Shang 1562 B.C. period. In world history, China might be the earliest country with environmental protection laws and regulations. However, the emergence of modern environmental law in China occurred later than in Western countries by at least one century (Peiyang Han, 2002). In 1972, China took part in the United Nations Conference on the Human Environment. Under the influence of the Conference, China held the first national environmental protection conference in August 1973 and issued the "Several Provisions on the Protection and Improvement of the Environment" presented by the State Council. In 1978, China revised the "Constitution of the People's Republic of China." For the first time, environmental protection was included in the fundamental law of the country. In September 1979, China promulgated the "Environmental Protection Law (draft)" and in 1989 it enacted the current "Environmental Protection Law of People's Republic of China" on the basis of a revision of the draft law (hereinafter referred to the current "Environmental Protection Law") (Ruilin Jin, 1998). From 1989 to the present, China's political and economic situation has undergone major changes, in particular, it has drawn up (or modified) more than 20 individual protection laws on the environment and natural resources. It can be said that the legal foundation for the protection of the environment and natural resources has been established (Wang Yi Dai, 1998; Peiyang Han, 2002; Ming-De Cao, Xisheng Huang, 2003; Shouqiu Cai, 2003; Penggao Zhao, 2005).

Two years after the United Nations Stockholm Conference adopted the “Declaration on Human Environment” in 1972, the Ministry of Transportation in China established a leading group to establish an environmental protection program. In 1974, the State promulgated the “Provisional Regulations to Prevent the Pollution of Coastal Waters,” which initiated China’s water environment legislation. In 1979, the Country initiated the “People's Republic of China Environmental Protection Law (Trial Implementation)” and put forward the requirements on the assessment of a port construction project's environmental impact. In August 1982, China promulgated the “Marine Environmental Protection Law”, China’s the first comprehensive marine protection basic law (Penggao Zhao, 2005). In December 1983, the state enacted the “Regulations on the Prevention of Water Pollution from Ships,” which gives more detailed provisions on the prevention of marine pollution from ships. For instance, if ships cause pollution incidents, immediate action should be taken to control and eliminate the pollution by the nearest Ports Superintendent. In June 1990, the Ministry of Transportation passed the “Environmental Protection Managements of Transportation Construction Projects,” and successively enacted the “Port Environmental Protection Design Standard” and “Port Environmental Protection Management Standard” as the comprehensive requirements for environmental protection. In 2002, the “Environmental Impact Assessment Law of the People's Republic of China” was implemented. It put forward requirements for the environmental impact assessments of port layout, including strategic environmental impact assessment at the planning level. In 2003, the state issued the “Port Law of the People's Republic of China,” in which Article 15 provides that port construction projects must include an environmental impact assessment. Port facilities for safety and environmental protection must be designed, and implemented the same time as the main construction project.

In addition, China also promulgated the “People's Republic of China Maritime Safety Act,” “Regulations for controlling marine pollution damage caused by coastal construction projects to the marine environment” and many other related regulations. The sound laws and regulations provide strong support to the prevention of port environmental pollution.

China has a relatively complete set of laws and regulations regarding port environmental protection. However, China still has certain problems with implementing these laws and regulations (Zhongyan Zhang, 2003; Ming Yu, 2003).

Specific analysis is as follows: Traditionally, since the surveillance role for port environmental protection is played by marine, land, transport, fisheries, and military departments, confusion may be created regarding responsibility for environmental pollution. After the "Port Law" was enacted, many ports established departments in charge of local management. However, these departments are responsible not only for the administration of port security and environmental protection, but also for port operations.

Public Participation

When the United Nations Conference on Human Environment was held in 1972, China sent only a small 20-member official delegation to learn about some of the issues regarding the global environmental situation and problems. Since the country lacked awareness and participation in environmental issues, it was impossible to talk about public participation at this stage. However, in 2002, China sent a senior governmental delegation to attend the United Nations Conference on Sustainable Development in Johannesburg. In total, 13 non-governmental environmental protection organizations in line with western standards took part in this World Summit on Sustainable Development (Zhong-Mei Lu, 2000).

Article 6 of the "PRC Environmental Protection Law" states that all units and individuals have the obligation to protect the environment and have the right to report and accuse units and individuals who pollute and destroy the environment. Correspondingly, the "PRC Law on Controlling Environmental Pollution Caused by Solid Waste," the "PRC Water Pollution Prevention and Control Act," (Shouqiu Cai, 2003) the "PRC Noise Control Law," the "PRC Marine Environmental Protection Law," the "PRC Air Pollution Control," the "PRC Law on Desertification Control" and other regulations explicitly provide any units and individuals with the right to expose and report any other units and individuals who produce solid waste pollution, water pollution, sound pollution and marine pollution. The mission of "Several

regulations by the State Council on environmental protection issues” (August 3, 1996) reads: “to establish a mechanism for public participation in environmental protection, to exert the functions of social organizations, to encourage the public to play a role in the environmental protection, to welcome any report, and to expose any violations of environmental protection laws and regulations.”

On October 28, 2002 the State promulgated the “Environmental Impact Assessment Law,” which gave more specific provisions for public participation in the process of Environmental Impact Assessment; Article 5 provides that “the state shall encourage the appropriate public participation in environmental impact assessment.” In addition, the “21st Century Agenda of China” specifically includes this chapter: “Organizations and the Public Participate in Sustainable Development” discussing in detail the significance of public participation and outlining a specific program of action.

An existing domestic study found that the level of public participation in environmental protection in China is still relatively low (Liyang Ren, 2001). Although the Chinese government has been creating conditions to encourage public participation in environmental protection and to give the public the privilege of taking part in environment management, this power has not yet been fully utilized. A higher level of political participation in environmental protection is impossible, such as in the form of participation in environmental decision-making and impacting national development policy (Liyang Ren. “Public participation in environmental protection - Environmental issues and environmental awareness” .Beijing: Huaxia Press, 2001: 89-113).

5.2 The Development of Ports Environmental Protection in China

So far, port environmental protection in China has gone through four major stages (Zhiwen Feng, Ruiqing Zhao, 1999; Weiqun Yang, 2000):

- I The 1970s was the initial stage of the port environmental protection in China when the Chinese government formulated three environmental policies: “prevent first and combining control with prevention,” “who pollutes is responsible for clearing” and “strengthen environmental management”;
- I The period from the 1970s to the early 1990s was the stable development phase of port environmental protection in China. At this stage, ports carefully assessed their impact on the environment and strictly enforced the “three-in²” system, gradually establishing a series of environmental regulations and beginning governance over sewage, smoke and noise;
- I From the 1990s to the present, port environment has experienced consolidation and improvement. The ports have gained many valuable lessons from their years of practice, and have established a series of environmental management systems; and,
- I In the 21st century, especially after China joined the WTO, ports will face great opportunities for development as the domestic market opens up, as foreign trade and the international environment improve and international trade shipping capacity increases significantly. Meanwhile the special nature of port operations also brings tremendous challenges to port environmental protection.

While promoting port environmental protection, Chinese ports should seize the opportunity which port-globalization has to offer. That is, learning from environmentally well managed foreign ports in terms of their advanced environmental management experience and technologies, in an effort to present a "better and healthier" Chinese port image on the world stage (Interview N18; D1; D4).

² designed, performed and put into use with the main construction project at the same time

5.3 Current Situation of Management of Chinese Ports Environment

5.3.1 Environmental Protection Features

With the economic reform and development of China, the international community's appeal for more environmental protection is rising. Therefore, in recent years China has developed a new port environmental protection situation, which has the following characteristics (Hongyun Du, Hongxing Shi, 2002):

- I Pay attention to the environmental impact assessment of port layout and in the early stage; Layout and construction, site selection, project feasibility studies and other preparatory works must have environmental impact assessment in accordance with the regulations; change environmental protection mode from passive pollution control to active pollution prevention;
- I Pay more attention to green landscaping of the port; undertake ports work on old harbor reconstruction to eliminate the polluting sources; coordinate these functions with the style of urban construction;
- I Pay much more attention to environmental problems in the process of port construction and development; during the implementation of the environmental protection "three-in" system, ensure that pollution prevention and control are included in the port construction; seek to systematically solve the problems of pollution damage that may arise during this process;
- I Prevent and control oil pollution: Handling the dry bulk dust pollution and petrochemical products fringe wastewater during the transportation process is the main target in the pollution prevention; According to different handling production functions, ports take corresponding measures to process the pollution sources of dust emissions, waste gas, waste water and noise during loading, unloading and transportation; Areas that are prone

to recurring pollution accidents, ports should develop contingency plans to strengthen on-the-spot supervision management and environmental monitoring, and establish a pollution accident reporting system; and,

- I Emphasizes cooperation with other countries and ports in the field of environmental protection; make port environmental protection service a part of the operating activities of the port; ports establish a professional team for environmental protection, conducting sea area surface cleaning, recycling garbage from vessels, fencing oil containment for the operating tankers and professionally dealing with other pollutants treatment.

5.3.2 Existing Patterns of Ports Environmental Management

Currently, China's ports have no uniform environmental management system. The available modes are summed up roughly as follows (Fajun Yin, 2001; Ping Wang, Yuhong Sun, 2005):

First, the port environmental management department has partial authority over environmental protection administration. It can collect charges on sewage on behalf of the local environmental protection department and perform the day-to-day supervision and management.

Second, as administrative sectors, port environmental management departments can only perform monitoring, management, analysis and prediction on port environment quality. Some units are qualified to carry on environmental impact assessment.

Third, ports put environmental protection, safety, greening and public health foundations all into one functional department. All the works can be carried out in a relatively independent manner.

5.4 Environmental Problems Faced by Chinese Ports

After more than 20 years of exploration and practice, the infrastructure construction of port environments in China has been strengthened. It has initially formed a comparatively complete infrastructure system, which can satisfy the basic needs of dealing with dust and storm sewage, oily shipping wastewater and waste disposal. Meanwhile, port environmental management is also being developed in depth. On the basis of good infrastructure construction on environmental protection and ensuring the environmental protection facilities do normal operations and environmental monitoring and assessing, these ports encourage the public to actively participate in environmental protection.

Although there have some achievements, most of China's ports were built before the economic reform; some of them were established in the early 1990s; and, only a few ports were built after the 90s. Since the concept of port construction and management fell far behind at that time and the ports lacked environmental protection facilities and funds, they did not even take into account environmental protection issues when building ports (Interview D 1-1). Similarly, the unique nature of port operations has brought many new environmental protection problems, including (Yufang Zhang, Yanli Lu, 2005):

- I Due to the increasing demand for imported oil and mineral ore, ports will have more challenging environmental pollution prevention tasks in the large-scale oil and ore piers, and thus face greater environmental pollution risks;
- I Most port waters have become the accepted body destination of urban sewage and are heavily affected by urban sewage discharges and the level of urban environmental protection management;
- I Because of the state transportation constraints, port operations are mainly enterprise activities. It is difficult for a port solely to alone bear the capital input on environmental

pollution prevention facilities and the maintenance of operation cost, which in fact impacts port environmental protection development;

- I The available port development investing system is rather insufficient. The system management insufficiency has resulted in a severe lack of environmental fund during port development. Due to inadequate environmental fund, port facilities for environmental protection are significantly compromised both in quality and in quantity (Interview N15; N22; D6) ; and,

- I In the current management pattern and market economy conditions, some ports have been weakening environmental protection services whenever they are face insufficient operating funds and low rates of service. They are not able to either update environmental protection equipment or increase the quality of service. Since the monitoring data from port environment monitoring stations built years ago is not recognized by the community and local departments in charge of environmental protection, many port-related environment monitoring projects have lost their significance and the port environment monitoring business is in a state of atrophy.

Through comparisons and researches, Chinese ports will constantly study internationally advanced experiences to further standardize port environmental management. Port-globalization provides a fortune of such study opportunities. The Chinese ports can gain many valuable lessons from other international ports, and have established a series of environmental management system for Chinese ports, and thus helps create a "better and healthier" Chinese port image on the world stage.

Chapter 6

Case Studies in China

6.1 Introduction

By taking Qingdao, Tianjin, and Yingkou as case examples, this chapter introduces the management concepts and measures these ports employ in environmental management.

Figure 6.1 shows the geographical location of the three ports.



Figure 6-1: Geographical Location of Three Ports (1997)

Source: www.maps.com, retrieved on March 15, 2007

6.2 The Port of Qingdao

6.2.1 Introduction

The Port of Qingdao, built in 1892, is a large national port with a 114-year history in the country; it is one of the 512 key state-owned enterprises. The Port of Qingdao consists of three parts: the Old Port of Qingdao area, Huangdao Oil Harbour, and the New Port of Qianwan Area. The Port of Qingdao is well-known as a good harbour with deep water, no silt, and no period of time during which it is frozen. It engages primarily in containers, coal, crude oil, iron ore, grain and other import and export cargo handling services as well as domestic and international passenger services. It has trade connections with more than 130 ports in the world. The Port of Qingdao is an important international trading port and maritime transport hinge on the west Pacific Coast (The Port of Qingdao, 2005).

There are 12,000 staff and workers at The Port of Qingdao. It has 15 port terminals and 73 berths, including 13 operating port terminals and 49 operating berths. 32 of the berths are more than the ten thousand tons level, 6 berths are more than the fifty thousand tons level, 6 berths are more than the one hundred thousand tons level, and 3 berths are more than the three hundred thousand tons level. The port throughput increased from twenty million tons in the 1980s to 187 million tons in 2005. During the “Eleven Five-year Plan” the net increase of throughput has been twenty million tons each year. The port completes 142 million tons of foreign trade throughputs and continues to maintain the country's second rank position. It also completes 630.7 million TEU container throughputs, and joins with the regional international shipping centers. The port is the largest iron ore import port in the world. It has the country's largest container port, an oil terminal, a world-class coal and iron ore port terminal, a bulk grain handling terminal, and the largest EDI Information Center in China (The Port of Qingdao, 2005).



Figure 6-2: Present Situation of the Port of Qingdao (1999)

Source: <http://www.zishizhongxue.com.cn/dangwei1/xuzhen.htm>, retrieved on March 15, 2007.



Figure 6-3: Present Situation of the Port of Qingdao (2000)

Source: <http://www.book-hotel.cn/date/art/655.html>, retrieved on March 15, 2007.

6.2.2 Status of Environmental Management

The Port of Qingdao has a long history, and its management has its own distinct characteristics, which motivate the initiative of employees. Also, it has sound supervision and control mechanisms. Supervision, congress, petition and other methods are used to enhance the idea of ownership among employees. There are 12,000 full-time staff and workers at The

Port of Qingdao, which has the most simplified system in the country. Its advantage is that it keeps stable working teams, which helps train and retain capable personnel. The disadvantage is the increase of production cost to the company. The Port of Qingdao attracts a large number of contract farmers. After the implementation of a positive performance evaluation system, contract farmers can become permanent workers. This system reflects the “people-oriented” ideology of the Port of Qingdao. The Port of Qingdao management mode has more prominent features of state-owned enterprises (The Port of Qingdao, 2005).

In order to make fundamental changes in the port environment and achieve the goals of purity and beautification, the Port of Qingdao takes measures from “rational distribution, upgrading equipment, improving technology, optimizing the environment” to solve problems of “mess, dust, noise, and smudginess” (Interview N13-1). Detailed measures include the following:

- I Changing separated and disordered handling. Many river ports (and a few sea ports) are still using the traditional habits of building terminal ports along the waterfront. They make for a decentralized and fragmented port area, lacking a sense of tidiness. According to the requirements of modern cities, industrial areas, commercial areas, and living areas must be separated. Working areas should also be separated from non-working areas. An overall plan should be made to include a long-term plan, mid-term plan, and short-term plan. Port renovation and construction should follow these plans to change an unorganized situation to form a concentrated loading port region. Meanwhile, the region's ancillary facilities must also be setup, with clean-washing equipment, storage, ventilation facilities, shelter from the sun and rain facilities, recreational facilities, maintaining the cleanliness of the port region, and the virescence and beautification of the environment of the port region. (Interview N 13-1; N 14-1);
- I Fully implement cleaner production: The Port of Qingdao comprehensively promotes clean production, uses advanced production technology, and stresses the importance of secondary energy recovery in order to radically reduce the pollutants produced. In

addition, the Port of Qingdao has increased capital investment and constantly improves treatment facilities to minimize the emission of pollutants (Interview N15-1);

- I Construct an emergency response and rescue system. In recent years, the Port of Qingdao has implemented a large scale transformation of measures innovation and measures reform. More than five million Yuan has been invested in safety automation control, industrial television monitoring, electronic inspection, smoke alarms, security guards, hurricane lamps and more than 70 other safety device transforms. Coal, oil, ore, containers, and grain are in automation central control. A modernized port of dangerous goods storage has been built and a modern unified security command center has been established to improve the safety monitoring and emergency handling capability as well as production capacity and the overall security management. The Port of Qingdao has also strengthened management control and prevented major incidents (Interview N 13-1; 14-1);

- I The ISO14000 environment system certification of the Port of Qingdao was launched in March 2001. After a long period of practice, each company's responsibility has been clarified and the division has become rationalized; the application of high technology in the environmental protection process has been enhanced; workers have improved their ecological concepts through the certification process; and they have set up their own emergency response teams. The benefits of meeting ISO14000 environmental management certification include the systematization of environmental management and the responsibility division of the department; any huge environmental sector alone can not effectively handle the overall work of environmental management. (Interview N13-1; N14-1; N15-1)

6.2.3 Environmental Management Organization

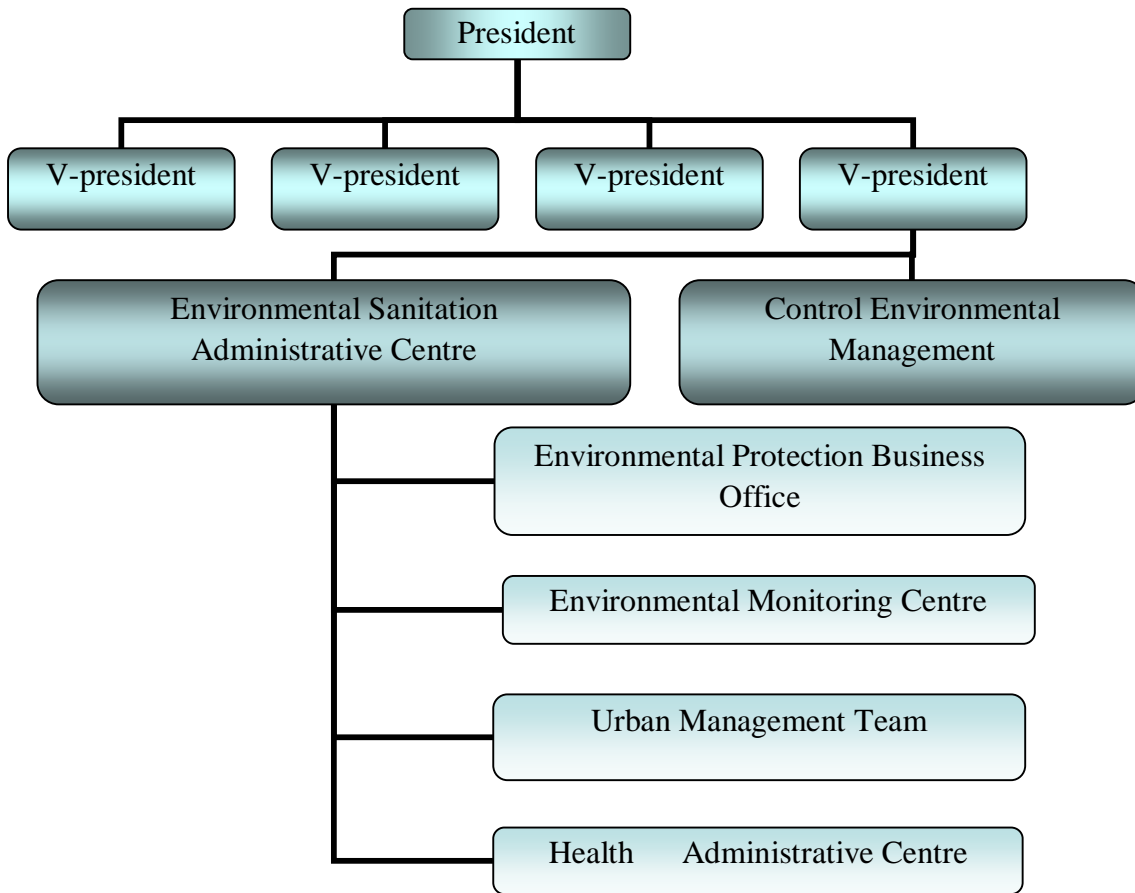
With the shift of economic development in Qingdao, the Port of Qingdao has met unprecedented opportunities. During its development, port put the economic development of

the port and environmental protection in priority positions. The Port of Qingdao is the first port to build eco-enterprises, as well as actively promote green culture, implementing the advanced strategy of sustainable development. In concrete work, the port management integrates environmental management in all directions, including starting from multiple channels, strengthening environmental management, promoting pollution prevention, and handling multiple tasks (Interview N 13-1; N14-1; N15-1).

In addition, the Port of Qingdao comprehensively promotes management innovation by establishing a four-layer model of operation: using the bureau as a policy-making level, using the company as the operations level, using a team as the management level, and using groups as the working level. It is the first port to use the integration of a new safety and quality environmental management systems, which provides a solid foundation for rapid development (The Port of Qingdao, 2005).

There are only nine personnel in the Port of Qingdao environmental management department. Everyone has more than one responsibility, making for a condensed and efficient team. The Port of Qingdao has a well-established and strict management system. The long-term education and training greatly enhance the quality of the workers. The port environmental management department conducts environmental monitoring and evaluation, pollution control, environmental virescence, and environmental protection supervision and management in accordance with the national laws and regulations (Interview N 15-1).

Figure6-4: Environmental Management of Port of Qingdao



Source: Interview N 15-1, 2006.

6.2.4 Issues and Solutions Related to the Current Situation of the Port’s Environment

According to respondents, the port's main pollution concerns as well as the corresponding solutions were as follows:

- I The major environmental concern comes mainly from the ore-terminal, since Qingdao Port has the world number one throughput ore-terminal. Ore fines are known for their troublesome clean-up. In dealing with ore fines, the Port has employed a number of cleaning methods, including developing its own dust vacuum equipment, routinely assigning cleaning staff at fixed hours, and applying automatic spray washers at random

times. All water used comes from the Port's own Wastewater Treatment Plant, and all spray water makes use of reclaimed water(Interview N15-1);

- I **Noise Pollution:** Using advanced equipment, improve effectiveness and reduce noise pollution. Except for a small number of ports, the general loading machines that most ports use are obsolete. Many of the machines, designed in late 1950s and early 1960s, are ineffective, have high energy consumption, and make loud noise. Using these loading machines results in slow speed, but also pollutes the surrounding environment. Aiming to solve these problems, related departments of the Port of Qingdao actively use both domestic and foreign advanced equipment to reduce noise pollution(Interview N14-1);

- I **Dust:** Improve technology; especially solve the problems of handling dust and toxic materials. Currently the most serious environmental pollution is caused by dust and toxic materials, such as bulk coal, sand, power, soil, and cement and to solve this problem, the Port of Qingdao uses closed mechanical loading and improves packaging. For toxic materials, the Port of Qingdao has an exclusive terminal port and special machinery to prevent the dissemination of pollution. For the problem of sludge materials handling carriers, in particular transport vehicles in port, washing is done vigorously and often to keep them clean; often these materials are even put into a closed carriage to prevent leakage in transit(Interview N13-1; N15-1);

- I **Dust Cleaning Methods for Ore Fines and Coals Disposal Sites:** Spray, Cover agent, Thatch covered (dust coverage) mode (Interview N14-1);

- I **Air Pollution:** Making alterations to instruments and equipments at terminals, replacing oil with electricity, can reduce air pollution (Interview N15-1).

6.2.5 Summary

Qingdao port put aside a significant amount of funds for environmental management, and has implemented a comprehensive environmental management system. Moreover, long-term worker training helps to promote the environmental management capability of staff. The Qingdao Port established an environmental management system in accordance with ISO 14000. However, the Qingdao Port's areas are still using manpower to keep it clean, which inevitably adds to the total cost. The Port of Qingdao has adopted an administrative means to settle controversies caused by port pollution between the local residents and the port. The underproduction in fishery and fruits, for example, caused by pollution from the Port of Qingdao has only been symbolically compensated. (Interview N 13-1).

6.3 The Port of Tianjin

6.3.1 Introduction

The Port of Tianjin is in Tanggu District, at the Haihe River mouth on the west coast of the Bohai Bay. It is the largest artificial harbour in China and the gateway to the capital city of Beijing. The earliest history of the Port of Tianjin can be traced back to the Han Dynasty 114 B.C. It was formally opened in 1860. It is one of China's earliest foreign ports. Tianjin currently has transport business contacts with more than 300 ports in more than 160 countries and regions in the world. Kobe and Tokyo in Japan, Philadelphia in the United States, Deliyasite in Italy and Melbourne in Australia have become its sister ports (The Port of Tianjian, 2005).

The Port of Tianjin has an existing water and land area of nearly 200 square kilometres, a land area of 47 square kilometres. It will have a total land area of about 100 square kilometres by 2010. The Port of Tianjin is one of the most complete quays among the coastal ports in China. The Port of Tianjin is mainly divided into four areas: northern, southern, and eastern and the Haihe River. There is 20,000 full-time staff. Major goods are coal, ore, and containers.

During “the 10th Five-Year Plan” period, the Port of Tianjin had a rapid growth in throughput: In 2001 it became the first billion-ton port in north China; in 2004 it became the only 2-billion-ton international port in north China; in 2005 it ranked No. 406 of the country's top 500 enterprises and No. 2 the port industries. In 2005, Tianjin completed the cargo throughput of 240 million tons, ranking No. 6 in the world. Annual cargo throughput is expected to be reach 265 million tons in 2007 (The Port of Tianjian, 2005).

After a long period of construction and development, Tianjin Port has become an integrated multi-functional international trade port in China. It is responsible for import and export cargo transport in North China and the vast economic hinterland of northwest China, becoming one of China's most important hubs. It is the largest grain import port, its foreign trade, chandlery and container throughput are ranked second in China. The establishment of commercial bonded warehouses and bonded areas in the port and the implementation of Sino-foreign joint venture projects of building piers create favourable conditions for developing an export-oriented economy and expanding the port functions (The Port of Tianjian, 2005).



Figure6-5: Current Situation of the Port of Tianjin (2002)

Source: <http://www.zjqhr.com/MemberSite/Example3/aboutus/index.asp?Username=tjport>, retrieved on March 16, 2007.



Figure6-6: Current Situation of the Port of Tianjin (2002)

Source: <http://www.ttqz.com/News/2006/200609/6233.html>, retrieved on March 16, 2007.

6.3.2 Status of Environmental Management

The Port of Tianjin vigorously promotes productivity and actively constructs an enterprise culture. The Port of Tianjin's three main goals are: to build The Port of Tianjin into a talent training school, a pleasant and harmonious family, and a vigorous military. The four basic elements of The Port of Tianjin corporate culture are: excellence; people-oriented; democratic; and, tolerable. Environmental protection concepts include: building an ecological port; and, sharing clear water and blue sky. Tianjin port attaches great importance to environmental protection in its corporate culture (Interview N 27-1; N 28-1).

The main source of pollution at Tianjin Port comes from coal and ore fines. The Port has paid increased attention to its environmental protection and management, along with its progressive economic development. In dealing with pollution from coal and ore fines, the Port adopted the method of “North-to-South Coal Transporting,” meaning transporting coal from its original north region to the south region. In practicing “North-to-South Coal Transporting,” Tianjin Port was able to reduce port-caused pollution to the city-crowded north region (Interview N 29-1).

Why then does Tianjin Port propose to adjust district functions, to transport coal from north to south, and to construct an ecological port? Tianjin Port is located in the Bohai Sea, an inland sea, which is known to have insufficient ability to self-purify. The Bohai Sea is surrounded by many provinces, having many pollution discharge sites, yet it lacks of a unified management system. All these factors contribute to a worsening environmental condition in the Bohai Sea. The main cause for the situation is the lack of a complete environmental management strategy from the central government, and the ambiguous distribution of responsibility within its environmental department (Interview N 27-1; N 28-1; N 29-1).

The Tianjin port has regulations for all transporting vehicles to remain airtight during transportation. As for ground cleaning work at port area, the Port makes sure that a daily inspection is carried out, and a weekly bulletin covering a number of cleaning conditions printed out (Interview N 28-1).

The port areas have made plans for environmental protection facilities. In the Nanjiang port area (featuring bulk cargo, coal, and oil), sewage treatment has been 100% achieved. It is equipped with rainwater recycling systems (the city of Tianjin is also a water-insufficient city). The Beijiang port area has also basically achieved 100% sewage treatment. After the treated sewage reaches a certain environmental standard, it eventually goes to the sea, and part of it used for environment greening (Interview N 27-1).

The Port of Tianjin began to establish and implement the ISO14000 environmental management system in 1996. It is expected to complete the three certification systems of quality, environment and safety in 2008 (Interview N 29-1).

The Port of Tianjin combines the rapid growth of the oil throughput with actively formulating and implementing contingency plans for oil spills. The port has established the “The Port of Tianjin Oil Spill Contingency Plan,” and invested more than 200 million RMB investments for oil containment booms to absorb the asphalt, degreasing agents, oil trawling, the range

aircraft with emergency equipment and materials. Meanwhile, Tianjin Port has invested 29 million Yuan for dedicated environmental construction of the second ship, which has the ability not only to receive and process oil and sewage, but also advanced functions for oil spill contingency. The ship has the capacity of sewage treatment of 10 tons per hour (Interview N 27-2; N 29-1).

6.3.3 Situations Concerned with Port Environment Management

As for its environmental management system, The Port of Tianjin Group has established a leading team for environmental protection, under which there is an environmental protection center responsible for the management of subsidiary companies and the personnel of departments. The environmental protection center currently has 58 staff covering environmental protection, virescence, hygiene and disease prevention, supervision, urban management, and integrated departments. Port environmental management departments principally conduct port environmental monitoring and evaluation, pollution control, environmental virescence, and environmental protection supervision and management in accordance with national laws and regulations. The Tianjin municipal government gives the port great support, and the port has a strong environmental protection input (Interview N 27-1; N28-1; N29-1).

The Port of Tianjin attaches great importance to environmental protection, mainly because of its special location. The Port of Tianjin, located in the Binhai New District, is a state key development zone. The image of the Port of Tianjin is extremely important. A major port environmental management philosophy of the Port of Tianjin is: “Taking the port's economic construction as the central task, taking the state environmental protection laws and regulations, criteria as the basis, taking the world's advanced ports as examples, to establish a modern and science-oriented international environmental management system that is compliant with international conventions and ISO14000 environmental management system and is based on a modernized computer information system” (The Port of Tianjian, 2005).

6.3.4 Issues and Solutions Related to the Current Situation of the Port's Environment

According to interviews, the main pollution concerns potential solutions were:

6.3.4.1 Solid Waste Management

Solid waste is managed by the Center of Planning and Sanitation. By implementing the “The Port of Tianjin solid waste control procedures,” residential waste is managed by local governments. In addition, the Port of Tianjin has its own hazardous solid waste treatment plant. (Interview N 28-1).

6.3.4.2 Dust Pollution

The Port of Tianjin has the following main measures to deal with dust pollution control:

- I Spray and Artificial Snow:** The main source of these two kinds of water is from the wastewater treatment plant and most of them are from water faucets because the wastewater treatment plant in the southern part of the Port of Tianjin is too small and insufficient and the city's sewage treatment plant is too far away from the port (Interview N 27-1);
- I Wind-proof and dust-proof network:** The Port of Tianjin applies foreign advanced scientific measures. Cargo is covered by net-like sheets to prevent particles spreading into the air. (Interview N 28-1);
- I Cover Agent:** Forming a protective layer by a high-pressure water gun to put dust suppressants at 17-19 meters high on the pile. This could effectively control dust in an economical way (Interview 29-1);

- I **Thatch Covered (dust coverage) Mode:** All thatch covers yard, it is the only one in China. Yard and slag heap are implemented covered thatch. Thus it becomes a "green view," because the dust-proof net is green (Interview N 27-1);

- I **Transport Vehicles Decked:** The goods of transport vehicles are covered in the port area. Such practice has better environmental results than thatch covered, in terms of its prevention from dust stirring. Tianjin government supports this practice. (Interview N28-1);

- I **Formulation of the Regulations:** The thatch over the goods can be taken away only within an hour before leaving the yard. Goods entering the yard within half an hour must be thatched. Three cars are for daily supervision and monitoring. If they do not do it well, there is a consequential punishment. Moreover, it may be written in a special briefing (the management will punish them once they know that). They check everyday and report to supervisors every month (Interview N 29-1); and,

- I **Yard and Road are separated:** Sweeping clean is done by sprinklers (Interview N 27-1).

6.3.4.3 Ballasted Water Pollution form Ships

Ships mainly make use of the sewage treatment plant to discharge ballasted water. However, releasing without permission is becoming more serious, and has become a challenge for the port (Interview N 29-1).

6.3.5 Summary

While the Port of Tianjin has made a visible effort to promote environmental protection, problems remain. Stagnation in environmental protection has to do with local government lack of awareness in environmental protection. The researcher, in part, also found that local

governments' environmental protection practices are rather backward in terms of employing environmental equipment (Interview N17-1; N29-1; N 30-1; D 6-1).

6.4 The Port of Yingkou

6.4.1 Introduction

The Port of Yingkou is located at the Liaodong Bay in the Bohai Sea, at the west of Liaodong Peninsula. It is the second largest port in northeast China and one of China's 20 coastal hub ports. It has more than 130 years of history (the old harbor). It has two port areas: The Old Port of Yingkou and The New Port of Bayuquan. There are 70 kilometres between the two ports. The Port of Yingkou has 11 greater than ten-thousand ton specialized terminals for containers, ores, assembly cars, grain, coal, bulk, refined oil, and liquid chemicals and others. Cargo includes steel, iron ore, fertilizer, stone, vegetables, and fruit. The Port of Yingkou has a total of 32 production berths, including 22 deep-water berths above the 10,000 ton level. With the rapid economic development of northeast China, the annual throughput of the Port of Yingkou has gradually increased as has the marine navigation density (The Port of Yingkou, 2005).

The basic development principle of the Port of Yingkou in the 21st century is to optimize its port management system, improve port operation, management and service, improve the quality of personnel, and turn the Port of Yingkou into a multi-functional, regional, and international modern port (The Port of Yingkou, 2005).



Figure6-7: Current Situation of the Port of Yingkou (2005)

Source: http://202.123.110.5/jrzg/2007-01/06/content_488788.htm, retrieved on March 18, 2007.



Figure6-8: Current Situation of the Port of Yingkou 2

Source: http://202.123.110.5/jrzg/2007-01/06/content_488788.htm, retrieved on March 18, 2007.

6.4.2 Status of Environmental Management

Yingkou Port is emphasising improved environmental protection. In the newly built Xianrendao port area, the Port was able to maintain the protective forest, the wind power

plant, the wetland, and the fishing village. The port was also able to obtain a port environmental design from an environmental protection expert (Interview D 14-1).

The Port area's daily household garbage is managed by the local environment protection department, and the Port's production garbage is the responsibility of each production company. All companies under the Port are equipped with environmental protection departments responsible for environment supervision. The Port's Safety and Environment Department is mainly in charge of the overall port environment supervision. Moreover, the Port makes an effort to make sure waste from ships in-and-out are properly recycled and processed (Interview D 15-1).

Since 2000, the Port of Yingkou has put port environmental protection as one of its top priorities. A total of 320,000,000 Yuan has been invested into equipment maintenance and environmental facility updates. For instance, up to 4,000,000 Yuan has been invested for port greening. The greened area amounts to 950,000 square meters, occupying 95% of potential greening areas. At the same time, energy saving is carried out throughout the entire port. Specific energy saving work is assigned to each individual to specify responsibilities for each port staff. The port also attempted to increase public awareness and involvement in energy saving activities, thus incorporating the concept of energy-saving into everyday life. The port also tries to make the most of annual energy-saving propaganda week, by means of providing the public environmental policies and regulations, and illustrating energy saving cases and general knowledge. Each year, the port organizes some topic activities, such as "one individual saves one thousand Yuan" (Interview D 15-1; D14-1).

6.4.3 Environmental Management Organization

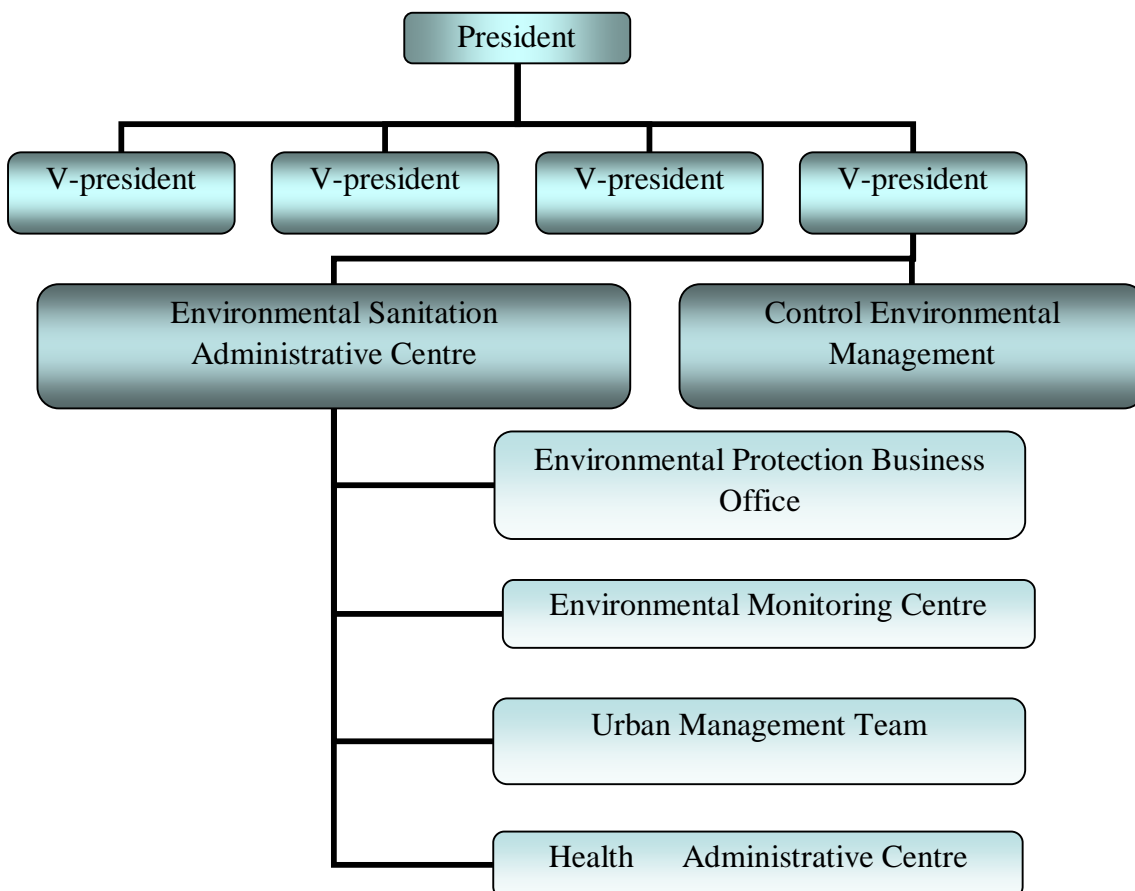
6.4.3.1 Situations Concerned with Port Environment Management

The Port of Yingkou embraces the idea of a green port and takes ecology as one of the competitive advantages. Environmental indicators have been incorporated into the performance appraisal standard system. From government to port management departments,

the concepts of environmental protection are enhanced. The Port of Yingkou has established a special environmental protection and sanitation center in environmental management department settings (See Figure6-8), which is mainly responsible for the environmental evanescence, supervision and management of environmental protection, pollution prevention and control, environmental monitoring and assessment, supervision management and health vaccination. It actively conducts green GDP accounting and investigation on economic losses of environmental pollution, implements special funds for works, and ensures the duration and quality of investigation (Interview D15-1).

The environmental protection organizational agency: The Environmental Sanitation Administrative Centre is in charge of environmental concerns for the departments in the port.

Figure6-9: Environmental Management of Port of Yingkou



Source: Interview D 15-1; D14-1, 2006.

6.4.3.2 Issues and Solutions Related to the Current Situation of the Port's Environment

- I **Solid Waste:** The Port of Yingkou has about 10,000 tons of household garbage and 30,000 tons of production garbage per year. A community center has been established to carry out port waste recycling. Due to the insufficiency in port environmental management, however, solid waste pollution has remained as one of the port's main environmental problems. For example, an incinerator is built inside the port, but its actual usage is far below its designed capacity. Such insufficiency in employing environmental equipments reflects a serious lack of environmental management at port. (Interview D 14-1; D 15-1);

- I **Air Pollution:** With the rapid development of the port, the staple bulk cargo throughput increased, and air pollution is worsening. There are two main measures: First, intensify bulk storage and handling operations management, control dust pollution. Second, control boiler dust pollution (Interview D 15-1);

- I **Dust Cleaning Methods for Ore Fines and Coals Disposal Sites:** Spray, Cover agent, Thatch covered (dust coverage) mode (Interview D 14-1).

6.4.4 Summary

Interviews were conducted with the port president, the vice president in charge of environmental management, and the director of the environmental department. According to the respondents, the major determinant of the port's transformation from its initial low awareness of environmental protection to its current expansion on port environment management results from:

- I The Port's senior management is focusing more and more on environmental protection. By and large, the amount of attention the port's authority pays to environmental

management essentially determines the performance of port environmental protection; this applies to all Chinese ports; For instance, the port authority's focus on environmental protection has led to the birth of an ecological port, namely the Port of Immortal Island;

- I The Port has been making progressive and impressive development in its economic position. This entails the importance of a good solid economy in making environmental management the port's key priority. The Port of Yingkou knows the story just as well: In recent years, Chinese ports have experienced an unprecedently rapid increase in port development. While there has been an increase in port development fund, the corresponding percentage spent on port environmental protection is nearly enough to cover all the environmental protection expense. As a result, a large number of environmental protection projects have not been realized

Environmental protection is a topic concerning both human survival and economic development. To ensure environmental protection is not compromised by the economic development, careful environmental supervision is to be made at each port developing stage. After ISO 9000 standard, ISO 14000 has brought new international standard to environmental management.

6.5 Summary

Based on the investigation and studies of the Port of Tianjin, the Port of Yingkou, and the Port of Qingdao, Chinese port environmental management can be characterized as follows:

- I **Port Environmental Management Philosophy:** The concepts of corporate culture and environmental protection in China's major ports have gradually taken ecological port and green port as development concepts;
- I **In the Setting of Port Environmental Management Departments:** Chinese port divisions have environmental management departments for port environmental

protection, showing that the Chinese port authorities attach great importance to environmental protection;

I The Main Responsibilities of Port Environmental Management: The main duty of the port management departments in China is to protect the port environment in accordance with China's laws and regulations at various levels; and,

I Port Management Measures: Chinese ports have used specific pollutant control measures to take care of the port environmental pollution problems; Chinese ports pay attention to updating port facilities, utilizing advanced measures to reduce the emission of pollutants; Emphasize the prevention of environmental pollution arisen from the source; Focus on the prevention of sudden environmental risk accident; Chinese ports attach major importance to their own environmental management; As for the impact on the ecological environment, the form of value-added flow is mainly taken in China to maintain the diversity of species around the port.

This chapter adopts three cases to discuss Chinese port environmental protection status in terms of three aspects: environmental protection policy, port environmental management, and environmental protection measures. The researcher will compare the similarities and differences of environmental policy, environmental management, and environmental protection measures between Canadian and Chinese ports, and hoping to make constructive suggestions for Chinese port environmental protection.

Chapter 7

Discussion, Recommendations & Conclusions

The goal of the research was to explore the similarities and differences between Canada and China in terms of port environmental protection policy, port environmental management and environmental protection measures. Built upon the previous chapters, this chapter analyzes the results obtained from the six selected Canadian and Chinese ports, and compares the similarities and differences of Canadian and Chinese, ports in terms of policy, environmental management and environmental protection measures. Some findings, based primarily on the analysis of six case studies, have been presented in Chapter Four and Six. Further observations and implications will now be presented.

7.1 Situating Study Findings within the Context of Ports Impact

In the first chapter of this thesis, the important roles ports play in each country's economic development were identified. While port development is certainly a key component of the local economy, each port also brings with it environmental problems along with economic opportunities.

In 1992, the United Nation Conference on Environment and Development held in Rio de Janeiro elaborated on the “sustainable development” concept and formulated “Agenda 21” as the basis for achieving sustainable development. Since then, sustainable development has been a key framework for discussion of economic, social environmental issues in including approach to port development. Only by following the path of sustainable development can ports solve the integrated problems of economic development, environmental protection and social progress to achieve a balanced development of economic and social benefits (Xinling Wang, Kongxiu Wang, Xirong Wang, 2000).

Port sustainable development aims to promote good development of a variety of functions in all aspects of the production and operation of the port within the capacity of the natural environment. In order to achieve port sustainable development, planners should pay attention to the following aspects: strengthening port infrastructure construction and rationalizing port structure; recognizing port construction and management as an ongoing process of technical and organizational innovation; improving environmental protection awareness and accelerating the process of port environmental protection; strengthening port legal systems to ensure the healthy and orderly development of the port; promoting port system reform; and, raising the level of port services (Weiqun Yang, 2000).

This study has shown that local environments are affected during the processes of port construction, development, and operation. Ports may affect the environment in several ways: **First**, the port construction period can result in major adverse impacts on the terrestrial environment, marine environment, as well as affect land resources, coastal resources, and fishery resources that often are irreversible. **Second**, development of industries adjacent to the ports may lead to permanent impacts on land, the coastline and other natural resources. In addition, they may have long-term adverse effects on the quality of regional environments. **Third**, oil and chemical spills and other environmental accidents can have serious detrimental impacts on the marine environment, and fisheries resources. Such impacts may be both short-term and long term and some may be irreversible. **Fourth**, as various cargos are being transferred through the port they can become potential pollution sources. Port pollution may occur during loading, transportation, and storage of cargoes. In dealing with coal, ore, and chemical fertilizer for example, the port may suffer from a massive amount of particles released into the air. Automobiles and machinery generate considerable noise, causing everyday inconveniences and troubles for residents living around the port area. Ships that are loading and unloading cargos at the port also bring ballast water and garbage with them, causing a serious burden on local waste disposal facilities.

The question then becomes how to reduce the port's negative impact on its surrounding areas. (ECO-information, 1999; Darbar et al., 2004; Casal, et al., 1999) Such a question must be solved by each country's port industry in their process of port development. Based on an assessment of selected ports in the UK, US and Nigeria, it was determined that port environmental problems generally focus on three key aspects: port policy; port environmental management; and, port environmental protection measures.

Port Policies: Environmental laws related to ports within a country can demonstrate how much the country takes port environmental protection into serious consideration. A coherent system of policies and regulations can increase the effectiveness of port environmental protection practices (Walker, 1997; Weiqun Yang, 2000).

Port Environmental Management: Environmental protection departments generally carry out daily port environmental supervision including program development, training, and management, such as ISO14000 environment system. Advocating and promoting environmental protection awareness throughout the daily management process may also effectively control pollution sources. Take the Port of Harcourt for example. in adjusting its environmental management system, the port is able to effectively control pollution caused by solid pollutants (Ayotamuno, 2004, p. 397; Federal Office of Statistics, 2003).

Environmental Protection Measures: By updating old equipments, adopting new technologies for port environmental protection, and formulating effective environmental protection policies, the port is in a better position to prevent and control port environmental pollution from the beginning. For example, in March 2004, the Natural Resource Defense Council (NRDC) issued report cards for the 10 largest U.S. ports on their efforts to control pollution. The Port of Los Angeles and Port of New York through updating port loading and unloading machineries to reduce air pollution, and thus reducing port environmental impact on its surrounding areas (NRDC, 2005).

The case studies in Canada and China undertaken during this research have identified significant differences in approaches between the two countries in how issues related to

these aspects are addressed. These differences will be discussed in more detail in the following sections.

7.2 Key Findings and Recommendations from the Comparison of Sino-Canadian Ports Environmental Management

7.2.1 Port Environmental Protection Policies

Canada and China have extensive and comprehensive laws and regulations related to the protection of the port environment, including marine environment protection, port environmental impact assessment, the transport of dangerous chemicals, and traffic and maritime security. These policies represent strong support for environment management of the ports in both countries. However, some problems exist in the enforcement of the Chinese Environmental Protection Laws, which are mainly due to the lack of specificity in laws and regulations, and unclear lines of responsibility. In this respect, China could learn approaches from Canada to enhance the operation of its system of laws and regulations.

Canada

Canadian ports' environmental performance is determined by two key factors:

- I A comprehensive system of laws and regulations supports and protects port environmental protection. Major Canadian environmental legislation started in the late 1960s and early 1970s. A more comprehensive and integrated Canadian “Environmental Protection Law” was enacted in July 1988 (Saundry, Richard and Peter Turnbull, 1997); and,
- I The development of a port is closely linked with the peripheral community as well as city development; as a result, a port’s environmental management system receives a

considerable amount of attention from its peripheral residents. Public participation in port environment protection is an essential factor in its development and operation. Many Canadians have developed a strong environmental protection ethic, which is considered to be a key to solving environmental problems. Canada establishes relevant laws and regulations to ensure public participation in environmental protection and to stipulate the specific details of public participation to ensure the effective collection of public views. For example, the Port of Montreal in its environmental management policies promises to convey its environment policy to its staff, customers and the public (Interview J 31-1).

People's Republic of China (PRC)

Although environmental protection started late in China, numerous environmental protection laws and regulations have been passed. For example, in 1978 for the first time China included environmental protection in its fundamental law, the “Constitution of the People's Republic of China.” In September 1979 the “Environmental Protection Law (draft)” was promulgated. And in 1989 on the basis of the original “Environmental Protection Law (draft),” China established the current “PRC Environmental Protection Law”. However, a situation exists where responsibility in the enforcement of China’s Environmental Protection Law is unclear.

While China’s environmental management system of law and regulation is relatively complete, port environmental protection lacks an adequate supervision and enforcement system. The consequence of the absence of environmental supervision is the failure of many port companies to carry out their initial environment-friendly policies and regulations.

Recommendation:

The PRC should establish a consistent environment management system for all ports, including a complete supervision system and enforcement system to ensure that policies and regulations are carefully carried out.

The Chinese government has not provided a complete set of environmental plans for the national coastline to prevent abuse with random development. As a matter of fact, Chinese ports' constructions and developments are normally under great control of their local governments. Since the port's economic development is the main concern for each local government, the port's environmental protection and control has not been given its deserved attention.

Recommendation:

The PRC should consider developing a management plan that includes a complete set of environmental plans for the national coastline.

When the United Nations held a conference on the Human Environment in 1972, the concept of public environmental participation in China was basically non-existent. But the Chinese government realized the importance of public participation. The "People's Republic of China Environmental Protection Law" promulgated in 1989 stated that: "All units and individuals have an obligation to protect the environment and have the right to report and accuse the units and individuals who pollute and destroy the environment." Since then, a number of laws and regulations were also promulgated to regulate public participation. The introduction of relevant laws and regulations enabled public participation to develop considerably in Chinese environmental protection affairs. The Chinese people, on the other hand, have a weaker sense of participation in environmental protection, but movement toward this concept has been considerable in recent years. For example, many Chinese ports are equipped with special populace hot lines and the President Mailbox (available for public questions and opinions directly to the port

president). While Canadian ports' surrounding residents have a high participation in port environmental protection, Chinese ports received rather low public participation in port environmental protection. Because of such low public participation, the special populace hot lines and the President Mailbox have never been fully utilized.

Recommendation:

Public participation is important in port environmental protection. The PRC should continue to enhance the public awareness in environmental protection, and encourage public participation in port environmental protection and supervision.

7.2.2 Environmental Management

The management and control of the environment and natural resource systems in the port surrounding area in such a way so as to ensure the sustainability of development efforts over a long-term basis is a critical objective (Environmental Impact Assessment of Irrigation and Drainage Projects, 1995).

Ports in Canada and China respect nature and try to have as little impact as possible on the environment; this idea has been embedded as a part of the corporate culture and is conducive to achieving the objective of port development combined with sustainable environmental management in a win-win situation. For example, the Port of Vancouver states that its intention is to “Operate in a Manner that respects and Sustains Our Natural, Social and Community Environments” (The Port of Vancouver, 2005). The Port of Hamilton advocates an “Environmental Friendly” Development Model (The Port of Hamilton). Turning to ports investigated in China, the Port of Tianjin espouses the issue of “Building an Ecological Port, Sharing Clear Water and Blue Sky” as part of the port’s environmental protection plan (The Port of Tianjin, 2005). The Port of Qingdao suggests that it “Build an Ecological Port, Advocate Green Civilization, and Implement the Strategy of Sustainable Development” in its concept of environmental protection (The Port of Qingdao, 2005).

As for the organization of environmental management departments in the port area, both Canada and Chinese ports are provided with environmental management departments responsible for port environmental protection. Canadian port environmental management departments generally are staffed by trained and experts in environmental protection. For example, during field research, it was determined that the Canadian Port of Vancouver, Hamilton, and Montreal have environmental experts in charge at their environmental department (Interview J 18-1; J 31-1). Canadian ports have already integrated port environmental protection work into the port daily management system. Port personnel are aware and conscious of the importance of port environmental protection. In addition to research, Canadian port environmental management departments have actively participated in various environmental protection organizations. For example, the Port of Vancouver is a key participant in the non-indigenous species working group, made up of representatives from the regulatory agencies and academia in British Columbia and Washington. (Interview J 18-1) The Hamilton Port Authority is a member and strong supporter of both Bay Area Restoration Council (BARC) and the Hamilton Harbor Remedial Action Plan. (Interview J 24-1).

Recommendation:

- 1. Ports of China should visit and study foreign ports with successful environmental management experiences.**
- 2. Port authorities in China should employ relevant environmental protection experts to carry out environmental protection research.**

On the other hand, Chinese ports still have much to improve in terms of attention given to port environmental protection. Specifically, the environmental protection awareness of port staff needs to be strengthened with a deeper understanding in the significance of environmental protection. For example, the environmental management departments of China's three major ports conduct environmental management in accordance with the

relevant laws and regulations and see to environment virescence, the supervision and management of environmental protection, pollution control, environmental monitoring and evaluation, health monitoring management, and sanitation and epidemic prevention (Interview N15-1; N 29-1; D 15-1). There are not staffed by trained experts in port environmental management. And the port personnel are not aware and conscious of the importance of port environmental protection. Chinese ports do not have much contact with other professional environmental organizations or groups.

Recommendation:

- 1. The scope of port environmental protection should be expanded by enlisting the co-operation of other agencies in protecting the environment; Adopting plausible environmental protection plans from professional environmental organizations.**
- 2. Port staff's awareness in environmental protection, and environment educational activities should be ensured.**

Based on the research, it can be concluded that Chinese ports' environmental protection has stagnated to some degree. Local governments tend to have a rather ambiguous idea regarding port environmental protection. And their environmental protection practices are well behind international environmental protection standards (Interview N17-1; N29-1; N 30-1; D 6-1). The Port's top management must focus more and more on environmental protection. By and large, the amount of attention the port's senior manager pays to environmental management essentially determines the performance of port environmental protection. This applies to all Chinese ports (Interview N5-1; N29-1; D14-1).

Recommendation:

- 1. Training and environmental awareness are carried out to enhance port enterprise leaders' understanding in the importance of environmental**

protection, and to increase their awareness in port environmental protection; For instance, the Port of Yingkou adopted the idea of the ecological port from visiting and communicating with the Port of Hamilton. While developing the Xianren Island port area, the Port Authority emphasized the port ecological environment, and worked to prevent ecological destruction;

2. Clarify the role of government departments, ports and environmental regulatory authorities in the course of environmental protection.

After all these years of port development, Chinese ports have gradually realized the significance of port environmental protection. For example, Many Chinese ports have given more and more attention to port environmental protection. The concepts of ecological port and green port have been put into port top developing plan. Researches done with the six selected Canadian and Chinese ports, and compares the similarities and differences of Canadian and Chinese port policy, environmental management and environmental protection measures. This is generated in a hope to provide valuable reference for later port environmental protection job.

7.2.3 Protection Measures

Despite the similarities of their methods in managing environmental protection, each port generally has a unique, specialised approach when dealing with specific environmental pollution problems.

Both Canada and China place great importance on environmental protection measures of the port pollution control as evidenced by the following common points:

- I Ports in both countries have adopted measures to control pollutants. For instance, the Port of Montreal has a rainwater production and sewage catchments systems

(Interview J 30-1). In China, the Port of Yingkou operates incinerators to process solid waste produced by the port operations (Interview D 12-1);

- I Both countries have focused on updating port equipment and have introduced advanced measures to reduce pollutant emissions. For example, in the Port of Vancouver, a number of air emission reduction projects such as adopting advanced pollution control measures and establishing databases, are already underway and planned for the future; there is collaboration with other ports, the Marine Industry and with government agencies to promote efficiency and the implementation of technologies to reduce air emissions (The Port of Vancouver, 2005). In China, a total of 320,000,000 Yuan has been invested into equipment maintenance and environmental facility updates. For instance, up to 4,000,000 Yuan has been invested for port greening. The greened area amounts to 950,000 square meters, occupying 95% of potential greening areas (Interview D 15-1; D14-1);

- I Both countries, pay attention to pollution prevention from the source. For example, the Montreal Port Authority strives to combine environmental protection in its development planning. In order to combat air pollution, the port uses high-quality fuel as much as possible to greatly reduce the emissions from the source (Interview J30-1). China's Port of Qingdao reduces noise pollution and pollution caused by toxic supplies by using advanced equipment, improving technology and enhancing the effectiveness of pollution control measures such as making alterations to instruments and equipments at terminals, and replacing oil with electricity. Qingdao Port also developed own dust vacuum equipments for clean-up work (Interview N 13-1; N14-1). The Port of Hamilton strives to combine environmental protection in its development planning. In order to combat air pollution, the port uses high-quality fuel as much as possible to greatly reduce the emissions from the source (Interview J 23-1; J 24-1); and,

- I In both countries, emphasis is placed on the prevention of sudden environmental accidents. For example, The Port of Tianjin combines the rapid growth of the oil throughput with actively formulating and implementing contingency plans for oil spills. The port has established the “The Port of Tianjin oil spill contingency plan,” and invested more than 200 million RMB for oil containment booms to absorb the asphalt, degreasing agents, oil trawling, and aircraft with emergency equipment and materials(Interview N 27-2; N 29-1). The Port of Montreal has a set of emergency plans for random environmental problems. Such plans are carried out by specifically assigned port staffs, which are trained in dealing with emergency situation;

The two countries, however, have different levels of performance related port to environmental protection. Canadian ports pay special attention to ecosystem protection. For instance, research at Port of Hamilton, revealed that many birds inhabited a man-made island in the port area. In order to maintain the original ecological environment for nesting migrating birds, the Port of Hamilton built an artificial island for birds to compensate and maintain the original ecological environment. As for impacts on the ecological environment, the form of value-added flow is mainly taken in China to maintain the diversity of species around the port (Interview J 23-1). However due to the insufficiency in supervision and management, and the lack of understanding of environmental protection, Chinese ports have achieved very limited success. Although some Chinese scholars have recognized the severe destruction to the peripheral environments surrounding ports brought on by port development, ecosystem protection generally has been neglected in pursuit of rapid economic development. Canada's attitude toward port ecological environment is that port environmental protection should come before port economic development, while in China; it's usually the other way around. In fact, environmental concern only comes in sight when certain economic standard is met. Many Chinese ports have encountered the problem of balancing port economic development and environmental protection. This especially requires the port authority's awareness in environmental management, and recognizing the irreplaceable position of environment.

Recommendation:

- 1. China should invest more in port environmental protection, particularly for small ports which may lack environmental protection funds.**
- 2. Clarify the role of government departments, ports and environmental regulatory authorities in the course of the environmental protection.**

Environmental management systems authentication in Chinese ports emphasizes such aspects as achieving ISO certification. Canadian ports, on the other hand, are not as passionate about the environmental management authentication standard; instead, they give more attention to the coordination of a combination of advanced ideas and practical management approaches.

Recommendations:

- 1. Employing advanced environmental protection equipment technologies.**
- 2. Chinese government should have a consistent port planning system to effectively regulate conflicting usage of natural resources between local ports, in order to solve problems caused by improperly resource sharing.**

In doing comparisons and researches, the Ports of China will unceasingly study internationally advanced experiences, and further regularize and standardize port environmental management, in an effort to contribute to a better global environment , and thus creating more human well-fare.

7.3 Future Research

Considering the limitations and the findings of this research, future research should pay more attention to the following points:

First, this comparative study focuses on the port environmental management of the main pivot/hub ports in China and Canada. Comparative studies of other function types of port environmental management should also be carried out.

Second, due to limited research time and scope, this thesis covers only six selected Sino-Canadian ports for a broad-brush comparative study on port environmental management. Further in-depth studies should be conducted on specific pollution problems; for example, ocean pollutions caused by port development.

Third, another similar settlement should select in which to explore the development of port and environmental management and to permit comparison with the current study. This will permit testing and expansion of the model.

Appendix A
Interview Consent Forms
(English Version)

Yue Gao
University of Waterloo
School of Planning
200 University Ave.
Waterloo, ON. Canada

Date (insert)

Dear (Resident,Official,ect.),

This letter is an invitation to consider participating in a study I am conducting as part of my Master's degree in the School of Planning at the University of Waterloo under the supervision of Professor Murray Haight. I would like to provide you with more information about this project and what your involvement would entail if you decide to take part.

Port development is a major priority in China, while port pollution has become a severe environmental problem. There is a real challenge involved in maintaining a balance between the need to maintain the economic viability and competitiveness of ports, shipping and overall trading position, and the desire to protect port environments. Therefore, it is necessary to identify the strategies to control and prevent port pollution in China to maintain the balance of economic growth and environmental protection. It is, however, a field in which few initiatives have been undertaken and there are currently

still many sea ports in China that are not using any specific strategies to control and prevent port pollution to improve their environmental situation.

The purpose of the project is to generate practical and specific plans for Port Waste Management in China, by making comparisons of ports in a western developed country and in an oriental developing country. Specifically, the ports of Montreal, Hamilton and Vancouver in Canada are chosen to represent western ports; the ports of Qingdao, Yingkou and Tianjin in China are to be compare. In particular, solid waste pollution has been a major in issue identified many Chinese ports. On the other hand, Canadian ports apparently have had successful experience with solid waste management. Findings from this study will be used to make recommendations for Port Waste Management in China.

Participation in this study is voluntary. It will involve an interview of approximately forty minutes in length to take place in a mutually agreed upon location. You may decline to answer any of the interview questions if you so wish. Further, you may decide to withdraw from this study at any time by advising the researcher. With your permission, the interview will be taped-recorded to facilitate collection of information, and later transcribed for analysis. Shortly after the interview has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of our conversation and to add or clarify any points that you wish. All information you provide is considered completely confidential. Your name will not appear in any thesis or report resulting from this study, however, with your permission anonymous quotations may be used. Data collected during this study will be retained for 2 years in a locked cabinet in my office at the University of Waterloo main campus. On the other hand, after 2 years all data will be confidentially destroyed. Only researchers associated with this project will have access. There are no known or anticipated risks to you as a participant in this study. With your permission, information provided by you will be identified by your department and port in the thesis. I agree to the reporting of information I provide by my department name and the name of the port, in the thesis

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me at +1-519-888-4567 ext. 37035 or email mehaight@fes.uwaterloo.ca. You can also contact my supervisor, Professor Murray Haight at +1-519-888-4567 ext.37035 or email mehaight@fes.uwaterloo.ca

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes of this office at +1-519-888-4567 Ext. 36005

If you are interested in participating in this study please respond to this email.

Yours sincerely,

Yue Gao

Planning Candidate

University of Waterloo

Phone Number :(Chinese cell phone number); 1-519-888-4567, ext.32789

Email Address: y2gao@fes.uwaterloo.ca

Contact Information of Supervisor:

Professor Murray Haight, Director

School of Planning

University of Waterloo

Phone: 1-519-888-4567 ext.37035

Email: mehaight@fes.uwaterloo.ca

Appendix B

Consent Form

I have read the information presented in the information letter about a study being conducted by Yue Gao of the school of Planning at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted.

I am aware that I have the option of allowing my interview to be tape recorded to ensure an accurate recording of my responses.

I am also aware that excerpts from the interview may be included in the thesis and/ or publications to come from this research, with the understanding that the quotations will be anonymous.

I was informed that I may withdraw my consent at any time by advising the researcher. This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact the Director, Office of Research Ethics at +1-519-888-4567 ext.36005.

If this consent form be completed, please contact me by email.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

Yes No

I agree to have my interview tape recorded.

Yes No

I agree to the use of anonymous quotations in any thesis or publication that comes of this research.

Yes

No

Participant Name: _____ (Please print)

Participant Signature: _____

Witness Name: _____ (Please print)

Whiteness Signature: _____

Date: _____

Appendix C

Consent Form for Audio Taping Interview

I understand that the interview will be audio taped to facilitate the collection of information with the understanding that all the information I provide will be held in confidence and I will not be identified in the thesis, summary report, or publication. I understand that I may withdraw from this consent at any time without penalty by advising the researcher.

Participant Name: _____

Participant Signature: _____

Witness Name: _____

Witness Signature: _____

Date: _____

Appendix D

Interview Questions

1. Could you briefly talk about the structure of your port's authority, especially in environmental management aspect?

2. In the history of port development, has there been any severe incidence of water or land pollution? How did you manage it? And is there a pollution emergency department at port? If yes, can you briefly talk about this particular department?

3. Are there specific government regulations on port environmental protection and control? What role do governments play in port environmental management? What has been achieved in terms of port environmental management at your port? And what is yet to be improved?

4. Which particular department is in charge of environmental protection at the port, and what daily procedures are performed?

5. Can you talk about pollution at your port? What are the major sources? What equipment and technologies are applied to deal with specific pollutants?

6. What is the annual cost to the port for environmental protection and control? What do you see as the specific benefits arising from investing into the environmental condition? Are you considering increasing efforts, and if so what are some examples?

7. Particulate matter pollution has been a major issue of concern at many Chinese ports. I was wondering if you could share your experience with how such air pollution is managed. In particular, what methods have been adopted to prevent and control particulate matter? Are there any specific pieces of equipment or specific technologies

that you have found to be successful?

8. How do you deal with waste arising from ships? Is there a specific department in charge? Are there government regulations or policies addressing ships' coming and going at port?
9. With regard to cargo storing, pollution to port environment may arise leading to environmental problems. What approaches have you taken to deal with such sources? Can you be specific about methods used, including equipments, and appropriate technologies?
10. Regarding environmental monitoring, what is the main focus of the monitoring program? What monitoring programs do you use?
11. Is there an educational or technological institution with which you work to associate with port environmental planning? If so, how did you establish such relationship and how has it been working for you?
12. Can you talk about the long-term plans for port environmental management? What are the specific objectives?
13. What are the main difficulties facing environmental protection and control at port? What are the barriers do you face to sustaining port development?

Appendix E

Catalogue of Interviews Conducted During Case Studies

Investigation

Ports of Canada

Date	Participant's Position/Title	Location	Data Collection Method (Interview, Informal discussion, etc.)	Duration
July 17, 2006	Environmental Technician	Port of Vancouver	Interview & tour of port by car	2.0 hrs
July 18, 2006	Director of Environmental Department	Port of Vancouver	Interview	2.0 hrs
July 23, 2006	Environmental Technician	Port of Hamilton	Interview & tour of port by car	2.0 hrs
July 24, 2006	Vice-president, Director and personnel of Environmental Department	Port of Hamilton	Interview	4 hrs
July 30, 2006	Environmental Technician	Port of Montreal	Interview & tour of port by car	1.5 hrs
July 31, 2006	Director of Environmental Department	Port of Montreal	Interview	1.5hrs

Ports of China

Date	Participant's Position/Title	Location	Data Collection Method (Interview, Informal discussion, etc.)	Duration
November 13 & 14, 2006	Environmental Technician	Port of Qingdao	Interview & tour of port by car	5.5 hrs
November 15, 2006	Vice-president, Director and personnel of Environmental Department	Port of Qingdao	Interview	4 hrs
November 17, 2006	Director of Environmental Department	Port of Shenzhen	Interview & tour of port by car	4 hrs
November 18, 2006	Director of Environmental Department	Port of Yantian	Interview & tour of port by car	1.5 hrs
November 22, 2006	Director of Environmental Department	Port of Shekou	Interview & tour of port by car	1.5 hrs
November 27 & 28, 2006	Environmental Technician	Port of Tianjin	Interview & tour of port by car	6 hrs
November 29, 2006	Vice-president, Director Vice-Director and personnel of Environmental Department	Port of Tianjin	Interview	4 hrs
November 30, 2006	Government Official	Tianjin	Interview	2 hrs
December 1, 2006	Professors	Tianjin Navigation Channel Bureau	Interview	2 hrs
December 4 & 5, 2006	Environmental Technician	Port of Ningbo	Interview & tour of port by car	6 hrs
December 6, 2006	Vice-president, Director Vice-Director and personnel of Environmental Department	Port of Ningbo	Interview	4 hrs
December 12, 2006	Environmental Technician	Port of Yingkou	Interview & tour of port by car	4 hrs
December 14, 2006	President	Port of Yingkou	Interview	1.5 hrs
December 15, 2006	Vice-president, Director Vice-Director and personnel of Environmental Department	Port of Yingkou	Interview	2 hrs

Bibliography

- AAPA, Alliance of ports of Canada, the Caribbean, Latin America and United States, American Association of Port Authorities, 2001.
- Alfredo Ortega-Rubio, César A. Salinas-Zavala, Daniel Lluch-Cota, et al. A New Method to Determine the Level of the Environmental Impact Assessment Studies in Mexico. *Environmental Impact Assessment Review*, 2001, 21:73~81.
- Anon, B. (1997). UK ports produce waste management plans, *CZM News, Newsletter of Euro coast UK*, Vol.7, No 2, pp. 1-2.
- Ayotamuno, C. (2004) Municipal solid waste management in Port Harcourt, Nigeria: Obstacles and Prospects. *Management of Environmental Quality: An International Journal* Vol.15, No. 4, pp. 389-398.
- Auerbach, C.F., and Silverstein, L.B. 2003. *Qualitative data: an introduction to coding and analysis*. New York: New York University Press.
- Bailey, D., DEER Conference (2004). *Harboring pollution air quality impacts of marine ports*. Natural Resources Defense Council.
- Ball, I. (1999). Port waste reception facilities in UK ports. *Marine Policy* Vol.23, No. 4-5. pp. 320-327.
- Bassey, M. 1999. *Case Study Research in Educational Settings*. Philadelphia: Open University Press.

Bateman, S. (1996). Environmental issues with Australian ports. *Ocean & Coastal Management* Vol. 33, No 1-3. pp. 229-247.

Bing-zhong Zhou, Xiao-ling Cao, *The Comparative Study Between Shanghai and International First-Class Harbor Cities on the Level of Modernization and Internationalization*, Tongji University Journal Social Science Section, 2005, 16(6): 44-51.

Boke Mao, *About Port Space*, China Port, 2005, 4: 11-14.

Canadian Environmental Protection Law and related Port Environmental Protection Law, <http://lois.justice.gc.ca>, <http://www.ec.gc.ca>.

Casal, J., Perez-Alavedra, F.X., Tyler-Walters, H., van der Veen, M., Wooldridge, C. (1999). *Assessment of the Environmental Situation in Sea Ports*. 1st International Congress on Maritime Technological Innovations and Research—Proceedings, Barcelona. Universitat Politecnica de Catalunya, Barcelona, 21–23 April 1999, pp. 341–350.

Chief Editing Committee of Chinese Encyclopaedia, *Chinese Encyclopaedia* (Transportation), Beijing, Chinese Encyclopaedia Press, 1986.

China's National Environmental Protection Agency, "*Direction of Evaluation of Planning Environmental Impact (Tentative)*" 2005.

Chua, T.E, Ross, A.R., Pollution prevention and management in the East Asian Seas, a paradigm shift in *Concept, Approach and Methodology*, International maritime organization regional programme for the prevention and management of marine pollution in the East Asian Seas, Quezon City, MPP-EAS Technical Report, 1998.

Claire Wright. *Sea Ports: Can Strategic Environmental Assessment Improve Environmental Assessment in the Port Sector?* The thesis degree of Master, University of East Anglia, 2003.

Cicin-Sain, B., Knecht, R.W. (1998). *Integrated Coastal and Ocean Management Concepts and Practices*, Island Press, Washington DC.

China National Bureau of Statistics (CNBS) (2001). International comparison of social and economic development in China. Research Report, Beijing, China.

Couper, A.D. (1999). Environmental port management, *Martine Pollution Management*, 1999, Vol.19, No 2, pp. 165-170.

Creswell, J.W.2003. *Research Design: Quantitative and Mixed Methods Approaches*. 2nd ed. Thousand Oaks: Sage Publications.

Darbra, R.M., Ronza, A., Casal, J., Stojanovic, T.A., Wooldridge, C. (2004). The self diagnosis method: A new methodology to assess environmental management in sea ports. *Martine Pollution Bulletin*, Vol. 48, pp. 420-428.

David Pearce, Edward Barbler and Anil Markandya, *Sustainable Development: Economics and Environment in the Third World*, 1990, p2.

Donaldson, E. (2003). Safer ships, cleaner seas, Report of port Donaldson 1st inquiry into the prevention of pollution from merchant shipping, Cm2560, HMSO, London.

Doug Macdonald, *Green Taxation and Environmental Policy*, Paper presented to the annual meeting of the Environmental Studies Association of Canada, June 5, 1995.

Environmental Protection Act 1990 (1991) and UK environmental protection No 472 (Prescribed processes and substances) regulations. London: HMSO.

Environmental Impact Assessment of Irrigation and Drainage Projects, 1995.

ECO-information (1999). ECO-information in European port final report. ESPO, Brussels.

EcoPort Foundation and ESPO (2003). *Port environmental review system (PERS)*, Version 2. ECOPORTS Foundation (etc), Amsterdam(etc).

ESPO (2003). Environmental code of practice. ESPO, Brussels. Retrieved November 4, 2005, from [http://www.espo.be/publications/English %20ENVIRONMENTAL%20POLICY%20 code. pdf](http://www.espo.be/publications/English%20ENVIRONMENTAL%20POLICY%20code.pdf)

Fajun Yin, An Initial Exploration of Port Sustainable Development Environmental Protection Management Pattern, *Transportation and Environmental Protection*, 2001, 22 (1):24-25.

Federal Office of Statistics (2003). General demographic and health survey of Nigeria, Federal Office of Statistics Bulletin, Federal Ministry of Information and National Orientation, Abuja.

Flick, U.1992. "*Triangulation Revisited: Strategy of Validation or Alternative?*" *Journal for the Theory of Social Behavior*, No.22, pp.173-197.

Galloway, J.M. (1989). *Atmospheric Acidification: Projections for the Future*. *Ambio* Vol.18, pp. 161–166.

- Gupta, A.K, Patil, R.S, Gupta S.K (2002). Emissions of gaseous and particulate pollutants in a port and harbour region in India. *Environmental Monitoring Assessment* Vol.80, pp. 187–205.
- Guoguang Shi, The Role of Port in Regional Economic Development, *Port Economics*, 2002, 2:36-37.
- Hayter, R, & Han, S.S. (1998). Reflections on China's open policy towards foreign direct investment. *Regular Studies* Vol.32, No. 1, pp. 1-16.
- Holocher, Dr. Klaus Harald. 1990. *Port Management Textbook*, Volume 1. Bremen
- Holliday, A. 2002. *Doing and writing qualitative research*. Thousand Oaks: Sage Publications.
- Hongliang Zhao, The Establishment and Future Perspective of ISO14001 Environmental Management System in Tianjin Port, *Transportation and Environmental Protection*, 2000, 21 (4):5-7.
- Hongli Wang, Xiaoyu Liu, Reti Hai, A Case Study of the Ore Port Environmental Impact—Majishan Transfer Port of Baoshan Iron & Steel Corporation, *Environmental Science and Technology*, 2006,29(S1) :102-104.
- Hongyun Du, Hongxing Shi, Port Development and Environmental Protection, *Comprehensive Transportation*, 2002, 4: 30~33.
- Hunhai Ding, The Port Environmental Protection in the Great Britain, *Transportation & Environmental Protection*, 1998, 5: 36-39.

Hui Zhong, Comparative Analysis of Shanghai Port and Three Other International Large Ports in Management System, *China Port*, 2004, 12: 17-18.

IAPH (International Association of Ports and Harbors). 1999. Institutional Survey.

International Development Research Centre, 1994. Taylor, D.M. Off course : restoring balance between Canadian society and the environment. Ottawa, ON, IDRC, 1994. ix + 139 p. : ill.

IRCHA, M. C., Reforming Canadian ports. *Maritime Policy and Management*, 1997, 16, 28-29.

Jianyong Yang, *Economic Globalization and Port Development*, *China Port*, 2001(2): 22-23.

Jianyuan Huang, Yixin Yan, Definition of Competing Ports in International Port Container Transportation Competition Situation, *Water Transportation Management*, 2004, 26(8): 6-8.

Jie Lin, Zhiqin Liang, A Brief Analysis of How Environmental Protection in Guangzhou Port can Adapt Port Economic Development, *Transportation and Environmental Protection*, 2003, 24(4):44-45.

Jinrui Zhang, Chunli Guo, Environmental Protection and Treatment, Beijing, *Environmental Science Press*, 2002, 149-151.

Jin Yu, A Discussion of Financing Method of Port Basic Establishment, *China Port*, 2004, 11: 13-15.

- Jiu-hui Li, Yan-li Yu, Comparing Analysis on Financing and Investment System of Overseas Ports Based on the Management system, *World Shipping*, 2003, 26(1): 14-16.
- K. Gupta, S. K. Gupta, Rashmi S. Patil. Environmental Management Plan for Port and Harbour Projects. *Clean Techn Environ Policy*, 2005, 7: 133~141.
- Lianggan Sun, Environmental Protection Evaluation of Some Ports in Foreign Countries, *Transportation and Environmental Protection*, 1998, 4: 47-48.
- Liyang Ren, *Public Participation Problem and Environment Consciousness of Environmental Protection*, Beijing, Huaxia Press, 2001: 89-113.
- Luborsky, M.R. 1994. The identification and analysis of themes and patterns. In *Qualitative methods in aging research*, edited by J.F. Gubrium and A. Sankar. Thousand Oaks: Sage.
- Manhua Xue, Comparative Study of Port Environmental Protection in China, Japan and South Korea, *China Port*, 1999, 1: 43-45.
- Manual for Environmental Impact Assessment of Port and Harbours, 1999.
- Manual for Environmental Impact Assessment of Port and Harbours, 2000.
- McDonagh, Stephen. 1999. *Port Development International*.
- Mingde Cao, Xisheng Huang, *Environmental Resource Law*, Beijing, Zhongxin Press, 2003.

Mingqing Zheng, Xiaohong Zhuang, A Thought of Establishing Emergency Plan of Handling Port Hazardous Chemical Products, *Transportation and Environmental Protection*, 2003,24(3):22-25.

Ming Yu, *Comments on "Port Law,"* China Water Transportation, 2003, (11):9-10.

Ministry of Transportation, a speech made by Minister Shenglin Li at National Conference of Transportation Projects in 2006, 28(4):22-25. Standing at the New Historical Starting Point to Promote the Eleventh Five-Year Plan of Transportation Development in a Fast and Efficient Way.

http://www.moc.gov.cn/05buzhang/lishengl/t20060116_29979.htm, 2006.

Ministry of Transportation, a speech made by deputy minister Zhenglin Feng at the National Conference of Highway and Water Transportation Safe Production Projects — “Extensively Creating a New Phrase of Project Safe Production Management by Defining Objectives and Responsibilities.”

http://www.moc.gov.cn/05buzhang/lfengzl/t20051221_28989.htm, 2005.

Min Tu, *Comparative Study of Port Privatization Methods*, Special Zone Economics, 2006, 4: 40-41.

MSA (1995). Survey of UK reception facilities for oil and garbage. Marine Safety Agency, Project No. 352, Southampton, pp. 20-23.

MSA (1996). M16592 Development of Port Waste Management Plans. Notice to ship owners, agents, masters, port and harbour authorities. Marine Safety Agency, Southampton.

National Research and Development Centre (NRDC). (2005). Retrieved October, 29, 2005, from <http://www.nrdc.org/air/pollution/ports/execsum.asp>.

National Institute of Ocean Technology IIT Madras Campus Chennai-600036, *Manual for Environmental Impact Assessment of Ports and Harbours*, October, 2000.

Neuman, W.Lawrence (2000). *Social Research Methods: Qualitative and Quantitative Approaches*. A Pearson Education Company, the U.S.

Patton, Michael Q.1986. *Qualitative Evaluation and Research Methods*. London:Sage.

Penggao Zhao, *The Present Situation and Policy Advice of China's Environmental Protection Industry Policy*, *Macroeconomic Management*, 2005(8):24-26.

Peiyang Han, *Textbook of Environmental Protection*, Beijing: Law Press, 2002:78-99.

Planning Research Institute of Ministry of Transportation, *Report of Overall Plan for the Environmental Impact of Yantai Port*, 2006.

Ping Wang, Yuhong Sun, *Successful Strategies of Port Companies Sustainable Development*, *Water Transportation Management*, 2005,27(1):13-16.

Preparatory Committee for United Nations Conference on Environment and Development (UNCED), 1999 (12 August-4 September 1999).

Qian-wei Zhuang, Jian Wang, *Development and Enlightenment of Foreign Port Logistics*, *Logistics Technology*, 2005, 6: 91-94.

Qing Xiao, *Port Planning*, Dalian: Dalian Marine Press, 1998.

Oxford Dictionary, 2006.

Rentang, Ouyang, *China's Port Logistics Present Situation and Development Strategies*, Economic Frontline, 2004, 11: 37-39.

“Report of Overall Plan for the Environmental Impact of Yingkou port”, *Planning Institute Ministry of Transportation*, 2006.

Report by the UNCTAD secretariat, *Review of maritime transport 2006*, United Nations, New York AND Geneva, 2006.

Rivers State (1991b), Rivers state environmental protection agency edict, Government Printing Press, Port Harcourt.

Robert C, Wilson, Identifying Your Plant's Environmental “Aspects,” *Pollution Engineering*, 2000, (7):33.

Rodhe, H. (1989). *Acidification in a Global Perspective*. *Ambio* Vol.18, pp. 155–160.

Rong Lu, Jianguo Lin, Honglei Xu, Research of Evaluation Index System of Port Planning Environmental Impact, *Ocean Environment Science*, 2006,25(2):92-95.

Rong Yao, Xiaofeng Chen, Na Zhang, *A Brief Analysis of Green Ecological Port*, People's Yangtze River, 2003, 5(34): 36-38.

Ruilin Jin, *China's Environmental Law*, Beijing: Law Press, 1998.

Saundry, Richard and Peter Turnbull. 1997. Private profit, public loss: The Financial and economic performance of U.K. ports. *Maritime Policy Management* 24(4): 319.

Shanghai Harbour Bureau, *The Road of Environmental Protection and Sustainable Development of Shanghai Port*, 2000, 21(6): 37~38.

Shouqiu Cai, *Environmental Resource Law Study*. Beijing: People's Court Press, 2003.

Shuhua Li, *Environmental Strategy of Transportation Sustainable Development, Transportation and Environmental Protection*, 1995, 16(4):6-9.

Stake, Robert (1995). *The Art of Case Study Research*, Thousand Oaks London, New Delhi: Sage Publications

Strauss, A. and J. Corbin. 1990 *Basics Of Qualitative Research: Grounded Theory Procedures and Techniques* (Newbury Park: Sage)

Streets, D.G, Carmichael, G.R, Amann, M, Arndt, R.L (2000) Sulphur dioxide emissions and sulphur deposition from international shipping in Asian waters. *Atmosphere Environment* Vol.31, pp. 1573–1582.

The Port of Hamilton, 2005: Partial materials are from <http://www.hamiltonport.ca/corporate/environment.aspx>

The Port of Montreal, 2005: Partial materials are from <http://www.port-montreal.com>.

The Port of Qingdao, 2005: <http://www.qdport.com>.

The Port of Tianjian, 2005: <http://www.ptacn.com>.

The Port of Yingkou. 2005: <http://www.ykport.com.cn>.

The Port of Vancouver, 2005: Partial materials are from <http://www.portvancouver.com>.

- The World Bank Group, Ports and Logistics Overview,
http://www.worldbank.org/transport/ports_ss.htm, Last visited September 26, 2003.
- United Nations Conference on Trade and Development(UNCTAD), 2006
- United Nations Educational Scientific and Cultural Organization (UNESCO), 1991
- U.S. Public Port Facts, Position Paper of the American Association of Port Authorities,
www.aapaports.org/govrelations/facts.pdf
- Walker, N. (1997). Britain's Port Industry: A Brief Guide to Britain's Port Industry, it's Structures, Activities and Ownership. In *Compass UK Ports Directory 1996/97*. Compass Publications Ltd. pp 12-19. Cited in L K Granier, C McMullon and C F Wooldridge, *Environmental Management of Port and Harbour Operations*. Paper presented to the Marine Forum for Environmental Issues, 18 April 1997. In *Marine Forum Report Number 6, the marine environment and shipping including port development and litter*, University College Scarborough, October 1997, pp. 10-15.
- Wangyi Dai, *Development towards Green*, Shanghai, Fudan University Press, 1998.
- Wei-qun Yang, Predicting China's Port Environmental Protection in 21st Century, *Transportation and Environmental Protection*, 2000, 21(5): 17-20.
- Williams, Mark Lloyd, Bill Jamieson, and Norton Rose. 1999. "BOT Schemes and Port Development." *World Ports Development*, p. 20.
- World Bank (2002). *Integrated coastal management coastal and marine management: key topics*. The World Bank Group, Washington USA. Available at <http://inweb18.worldbank.org/ESSD/essdext.nsf/42ByDocName/KeyTopicsIntegratedCoastalManagement>.

- World Bank, (2003). Port Reform Toolkit. The World Bank Group, Washington USA.
- Wren, J. (1997). Pollution from shipping. In R Earll, ed, Coastal and Riverine litter: Developing effective solutions. Proceedings of a one day Conference organised in conjunction with the National Aquatic Litter Group, London, 2 December 1997, pp. 7-10.
- Xianlei Kong, Changxin Xu, Port Development under the Sustainable Development Perspective, *Port Technology*, 2004, 9(3): 21-23.
- Xinling Wang, Kongxiu Wang, Xirong Wang, *General Theory of Sustainable Development*, Shandong, People's Press, 2000: 64-68.
- Xueheng Pang, Hua Qin, Review and Prediction of Port Environmental Protection Work of Hebei Province, *Transportation and Environmental Protection*, 2003,24(S1):117-119.
- Xue Liu, *Theory and Practice of Environmental Economics Theory*, Beijing: Economic Science Press, 2001, 12.
- Xueqiang Lu, Guanghuan Guo, Case Analysis of the Environmental Impact of Oil Storerooms in Port Area, *Transportation and Environmental Protection*, 1998, 19 (6):1-5.
- Yanqiao Jiang, *Pollution Prevention Technology of Marine Ships*, Shanghai, Shanghai Jiaotong University Press, 2000.
- Yeung, G. (2001). *Foreign direct investment and investment environment in Dongguan Municipality of Southern China*. Journal of Contemporary China Vol.10, pp. 125-144.

- Yin, R.K.2003. *Case Study Research: Design and Methods*. 3rd ed. Vol. Applied Social Research Methods Series, Volume 5. Thousand Oaks: Sage Publications.
- Ying Sun, Chengqing Sun, *Introduction Theory of Sustainable Development Management*, Beijing Science Press, 2003:23-41.
- Yiying Sun, Xiaoning Zhou, Yi Zhou, *Identification of Environment Factors and Evaluation of Important Environment Factor*, China ISO14000 Authentication, 2002, (3):35-37.
- Yinxing Hong, *Sustainable Development Economics*, Beijing, Commercial Press, 2000: 19-21.
- Yunfang Zhang, Yanli Lu, *Canada's Environmental Law*: <http://www.7265.cn/.205-5-30>.
- Zhiming Zhang, Bo Yao, New Features of China's Coastal Port Planning and Construction in Economic Globalization, *Water Transportation Projects*, 2004, 12: 34-38.
- Zhiwen Feng, Ruiqing Zhao, The Problems and Strategies of China's Port Industry and Environmental Protection Problems, *China Port*, 1999, 5: 34-36.
- Zhongmei Lu, *New Perspective of Environmental Lay*, Beijing: Chinese Politics and Law University Press, 2000.
- Zhongyan Zhang, Evaluation and Several Advice about China's "Port Law," *Water Transportation Management*, 2003, (13):23-25.
- Zhuan Xiao, Genfa Lu, General Introduction of European Union Sustainable Development Transportation Policies, *Environmental Protection*, 2002, 12:68-70.

Zuyi Ma, Consideration of Emergent Functions of Perfecting Oil Leakage in Port,
Transportation and Environmental Protection, 2002, 23(6):32-34.