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SUSTAINABLE DEVELOPMENT OF INLAND WATERWAY TRANSPORT IN CHINA

(Theme I of a World Bank Project: Comprehensive Transport System Analysis in China - P109989)

PREPARED FOR:

THE WORLD BANK

AND THE MINISTRY OF TRANSPORT, PEOPLE'S REPUBLIC OF CHINA

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MAY, 2009

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Acronyms and Abbreviations

ADN	European Provisions for International Carriage of Dangerous Goods by Inland Waterway
AIS	Automatic Identification System
CCNR	Central Commission for Navigation of the Rhine
CCR	Committee for Co-ordination of the Rhine
CEVNI	European Code for Inland Waterways
CIND	China Inland Navigation Database
CMTS	US Marine Transportation System
CNY	Chinese Yuan
CO_2	Carbon dioxide
CRIS	Coastal and River Information Services (a development program in the USA)
DC	Danube Commission
DWT	Deadweight Tonnes
EC	European Commission (Executive branch of the European Union)
ECDIS	Electronic Chart Display and Information System
EU	European Union
EUR	EURO: a currency unit used within the European Union
FEMA	Federal Emergency Management Agency
FPMSP	Flood Plain Management Services Program
GHG	Greenhouse gases
GIWW	Gulf Intra-coastal Waterway
ICPR	International Commission for Protection of the Rhine
IEA	International Energy Authority
IT	Information Technology
IWT	Inland Waterway Transport
IWTF	Inland Waterways Trust Fund
IPCC	Intergovernmental Panel on Climate Change
IWUB	Inland Waterways Users Board
km	kilometer
kW	kilowatt
MARAD	Maritime Administration (of the USDOT)
MOR	Ministry of Railway
MOT	Ministry of Transport, the Peoples' Republic of China (formerly Ministry of Communications)
m	meter
NAIADES	Navigation and Inland Waterway Action and Development in Europe
NDRC	National Development and Reform Commission
NIWPP2020	National Inland Waterways and Ports Plan to 2020
NLTA	Non-lending Technical Assistance
NOAA	National Oceanic and Atmospheric Administration
RIS	River Information Services
SMEs	Small and Medium-sized Enterprises
TEN	Trans-European Networks (includes Transport, Telecoms and Energy)
TEN-T	Trans-European Transport Network
TEU	Twenty-foot equivalent unit (the standard unit of measurement of container numbers)
Tonne-km	A unit equivalent to the movement of one metric tonne by one kilometer
UNECE	United Nations Economic Commission for Europe

USACE	United States Corps of Engineers
USCG	US Coast Guard Service
USDOT	United States Department of Transportation
US/USA.	United States of America
VHF	Very High Frequency
WCED	World Commission on Environment and Development
WP	Working Papers of this Report (WP1- China, WP2 - European Union, WP3- USA)
WTI	Waterborne Transportation Institute

Note on Units of Measurement

Fleet and market data for the United States is available in US units of measurement. In this Report, such data has been presented in metric units consistent with those used in the European Union and China so as to facilitate comparison between the three regions. For this purpose, the following conversion factors have been used:

1 US short-ton = 0.907 metric tonnes;
1 US mile = 1.609 kilometers
1 US gallon =3.785 liters
1 US horse power = 0.746 kilowatts
1 foot = 0.3048 meters

Acknowledgements

The authors would like to acknowledge the guidance and advice of the Ministry of Transport and the World Bank in undertaking the Study and preparing this Report, in particular the Study managers Ms. Li Ying, Deputy Director, Planning Department, Ministry of Transport and Mr. Zhang Wenlai, Senior Transport Specialist, Sustainable Development Department, the World Bank.

Drafts of the Report were also helpfully reviewed by Messrs. Yu Shengying, Cui Xuezhong, Mao Jian and Li Hongyin (MOT), James Walker (USACE), Harrie de Leijer (NEA Transport Research and Training, Netherlands), and Jose Barbero, Michel Audige, John Scales and Aurelio Menedez (the World Bank).

The emerging findings and recommendations were discussed at a seminar held in the World Bank's Beijing Offices on June 17, 2008 which was attended by representatives of the Ministry of Transport, the Transport Department of the National Development and Reform Commission, China Academy of Transport Science, Changjiang Waterways Management Bureau, China Changjiang National Shipping (Group) Corporation, Hubei Port and Channel Bureau, China Ports and Harbors Association, China Ship owners' Association, Minsheng Shipping Co Ltd, the Waterborne Transportation Institute and the World Bank.

EXECUTIVE SUMMARY

A. Background

China's inland waterway transport (IWT) network is the world's largest, in terms of length and freight tonneage. Since the year 2000, China's IWT has experienced fast growth with annual increase over 7% in traffic tonneage and more than 10% in tonne-kms. Nevertheless, IWT in China does not yet realize its full potential role in providing a sustainable transport system. The Ministry of Transport (MOT) of China recognizes the high energy efficiency and low greenhouse gas emissions associated with the IWT, and the importance of conserving scarce land resources by more efficient use of inland waterways. MOT seeks for a strategy to maintain a sustainable development of China's IWT industry.

As requested by MOT, the World Bank financed this Non-Lending Technical Assistance (NLTA) study on sustainable development of China's IWT, which was jointly undertaken by the Bank's consultant and the team of Waterborne Transportation Institute (WTI) of MOT. The Study, through a comparative overview of the experiences in the IWT industry in the USA, the EU and China, aims to identify possible impediments to sustainable development of China's IWT and propose recommendations to overcome these impediments. The outcomes of the Study will help MOT to make strategic policies in sustaining the development of the IWT industry.

B. Three Regions Overview

The comparison of the three IWT sectors in the USA, the EU and China, was made in the areas of physical features and traffic utilization, institutions and administration, policies and programs, and industry and market development.

Physical features and traffic utilization

IWT's share of the inland traffic task (excluding pipelines) is similar in China and the USA at 8.7 percent and 8.3 percent respectively, while it is slightly lower in the European Union at 5.6 percent. However, the modal share of IWT has declined significantly in the USA and the EU over the last 10 years. In China the mode share of IWT declined between 1995 and 2000 but has since rebounded by around a fifth.

China has 123,000 km of navigable waterway of which 61,000km is classified, and about 24,000 km is considered 'commercially significant'. The length of commercially significant system is about equal to that of the USA and EU's combined commercially significant waterways. China also has about the same volume of freight in 'tonnes handled' as the USA and the EU combined.

Traffic on the China IWT system has been increasing rapidly in recent years with an annual average growth rate of tonneage of 9.1 percent during the period 2000-2006. IWT traffic in the USA appears to be marginally declining while EU traffic, although fluctuating, appears to be broadly constant. China and the EU have both been successful in developing IWT container operations and China's container traffic between the coast and inland ports has nearly trebled in the last five years.

IWT is a niche mode in each region, but regional differences make it likely that the long-term role of IWT in China will be more expansive than in the USA or the EU. Analyses carried out for NIWPP2020 estimate that the total of cargo traffic in China will increase from 1.16 billion tonnes in 2006 to 1.6 billion tonnes in 2010 and to 2.35 billion tonnes in 2020. China's IWT market is likely to experience very substantial growth in the next 15 years, whereas both the EU and USA have neither traffic trends nor

emerging growth drivers that lead to an expectation of a similar expansion of IWT traffic over the same period. One key factor is that, given their stage of development, bulk cargo markets are simply not growing in EU and USA as they are in China. However, the success of some EU member states, such as the Netherlands and Germany to develop new specialist shipping markets implies the China can both grow and diversify its IWT markets.

Institutions and administration

China has a tripartite system of IWT management. MOT is responsible for overall IWT sector policies and regulation, as well as planning of the nationally important waterway systems. Delivery of IWT infrastructure and enforcement of regulations on the two most important sub-systems, the Yangtze and Pearl Rivers, are delegated to specialized River Administrations that are responsible to MOT. Provincial governments are responsible for waterways of provincial significance administered through provincial navigation administrations. This delegated and decentralized structure follows earlier reforms and is logical and appropriate for China.

By comparison, the administration of IWT in the EU is, by its own admission, fragmented and inefficient. The USA's strongly integrated management of water resources has advantages. However, its integrated structure is militarily administered by the US Army Corps of Engineers. China's governance of the sector via a civil administration is considered to be more suitable.

Policies and programs

Transport strategies in China, the USA and the EU all have the stated aim of increasing the role of IWT, although the greater unrealized value of IWT in China suggests that it has a more realistic basis for such hopes.

A useful reference for China's IWT policy makers regarding a sustainable strategy for IWT development may be the Netherlands' Strategy for the Sustainable Development of IWT although the content would need to be tailored to China's different range of challenges and faster growing markets. Also, increasing attention is being given in the Netherlands, Belgium and Germany to improving the interface between IWT and major seaports with the aim of creating increased opportunities for onward distribution or collection of international freight by inland waterways. China's IWT planners may be interested to study such developments in more detail as China faces very similar opportunities and challenges.

The main IWT systems in the EU and USA are essentially mature assets and most of the main EU and USA commercial waterways are already at a comparatively high navigation standard, as good as or usually better than China's Class III waterways. Therefore, China's infrastructure is much less mature than in the other two regions and, as a result, has a more ambitious program with a higher degree of commitment for IWT development. But despite this the question remains as to how the NIWPP2020 will be funded. In all three regions, funding the construction programs, and the long-term recovery of the costs of infrastructure, remains a contentious and challenging issue.

Industry and market development

Cabotage: While China, like the USA, operates a policy of cabotage in IWT, it is trying to encourage international investment and participation in inland port and logistics industries. In contrast, the main EU waterways are inherently international waterways by both geography and treaty.

Industry structure: China's IWT shipping sector has an industry concentration which is relatively low. One of the biggest IWT companies owns about 1,700 vessels which is about the same capacity as Germany's total IWT fleet, although it is only one of numerous operators. By contrast the USA market is more highly concentrated.

Operating methods: In the USA, barge tows are mostly used to push a configuration of multiple, standardized dumb barges. This is allowable by the proliferation of wide waterways. In contrast, on most of the EU's waterways, this approach is not feasible and self-propelled vessels are mainly used. In China, both self-propulsion and barge tows are employed. The international experience shows that free markets will create different fleets to match different circumstances.

Transport services: Like the USA and the EU, China's IWT transport services industry operates according to market principles and China's experience demonstrates that bulk freight shippers in China are cognizant of the cost advantages of IWT. Similarly, China's barging industry has shown itself to be responsive to the demands of bulk shippers.

Vessel sizes: With 183,000 vessels on its whole navigable waterway system, China has by far the biggest fleet of freight vessels. However, while China has implemented supporting policy measures to encourage larger and standardized vessels, its IWT system and markets remain more varied than the USA or Europe because a fleet containing a range of vessel types and sizes is likely to serve China's IWT transport market more efficiently and effectively.

Vessel designs: Not many countries have a significant IWT industry, so sharing international experience on vessel design as well as vessel loading and unloading methods is expected to be fruitful for China, USA and the EU. It is noted that the implications of high crew numbers employed on Chinese vessels compared with USA or EU may also constrain adoption of some vessel designs.

Small barge operators: Smaller inland waterways in China are often the first link in the transport chains for economically disadvantaged riparian communities. Smaller barges and country boats in upper reaches and tributaries are crucial to these communities. As the industry modernizes it is important to avoid disrupting the local transport services that they offer.

Ports sector: China's port reforms since the 1980's have seen a major decentralization, corporatization and commercialization of the ports function. There remains a high degree of public ownership of common user ports at lower levels of government, just as in the USA and the EU, but China is making good progress toward implementing international practice in terms of port administration and institutions. Reducing the simultaneous ownership of both ports and shipping companies by lower level governments would help reinforce non-discriminatory access of shipping service providers to facilities and could improve utilization of capacity.

Inter-modal connections: Inter-modal transport connections at IWT ports, particularly connections with railways, are generally superior in the USA and the EU than in China. The IWT industry in the EU in particular has close links with wider logistics service suppliers such as freight forwarding and storage functions. Moreover there are specific policies (both at EU level and within member States) that may bear useful further investigation to encourage the role of IWT in co-modal logistics chains (such as interchanges between seaports and IWT, and between IWT and land transport). China's transport system and economy will benefit by the provision at ports of modern inter-modal infrastructure and the development of inter-modal transport services. This can widen the market 'reach' or catchment areas for IWT and permit a more economically efficient allocation of traffic to different modes. Similarly, there is a

case to be made for continuing progress in developing logistics services and taking trade facilitation measures that will benefit both IWT and the efficiency of transport generally.

C. Sustainability of IWT in China

Research in the USA and the EU indicates that an efficiently run IWT system has environmental and social benefits over other modes of freight transport. Utilization of waterways for transport can, for each tonne-km carried, help minimize the loss of agricultural land, reduce congestion on roads, reduce road accident costs, reduce the average energy consumption of freight transport, and reduce the greenhouse gases (GHG) that are contributing to climate change.

Sustainable overall transport policies in any particular country may therefore need, among other measures, to consider whether and how to alter the modal distribution of transport in an attempt to mitigate the social and environmental costs of other forms of transport, as well as to reduce aggregate carbon intensity. This may imply trying to enhance the role and scale of IWT within national transport strategies, including the way the sector is administered and managed. In all three regions reviewed in the report, it is stated policy to try to expand the role of IWT. However, for IWT to perform that greater role the sector must be robust and enduring; the system, as a whole, must be sustainable.

Sustainability in transport systems has financial and economic, operational, environmental and social dimensions. When applied to China's IWT industry, these dimensions have been interpreted as follows:

- Economic sustainability: This depends on the availability and utilization of *economic resources* to meet freight market needs in a way that provides positive economic value to society as a whole. Economic resources in the sector include adequate and reliable water resources (taking account of other water users), navigation channels that can handle efficient vessels and are free of impediments, effective engineering structures such as locks and ship-lifts, general and specialized ports and an effective vessel fleet, etc.

- Financial sustainability: This requires that the IWT sector obtains sufficient and reliable income to enable it to pay for the construction, maintenance and operations necessary to meet the market needs. For transport service operators, financial sustainability depends mainly on commercial revenue from freight customers. For infrastructure providers, it depends on a mix of commercial revenue from infrastructure users and funding from governments (at various levels).

- Operational sustainability: This means the management, technical and technological capability to construct IWT infrastructure, and operate and maintain an increasingly busy and sophisticated IWT transport system more safely, efficiently and reliably.

- Environmental sustainability: This requires that the IWT industry should meet ever-increasing public and political expectations of environmental performance, including energy efficiency and low carbon generation, as well as more stringent environmental regulations.

- Social sustainability: This means trying to ensure that the IWT industry develops as a good neighbor with communities who live alongside waterways and that IWT policies try to take account of livelihoods of barging families who live and work on the waterways.

D. Impediments to Sustainability and Recommendations

The Report finds that the IWT sector in China has great economic importance and unrealized potential with a fundamentally sound institutional framework. It also considers that it has an improving balance in the roles of public and private sectors, an ambitious and well-founded public infrastructure development plan, and a vibrant and dynamic transport services industry that is delivering growth and innovation.

As the main focus of the Study, the Report has identified a number of possible impediments to the sustainability of the IWT sector, and provided recommendations to overcome the impediments. The sector has to meet the challenge of how to remain successful in a changing world. The solutions should reinforce and build upon the successes, while mitigating adverse side-effects and anticipating and accommodating future changes. It is hoped that most of the information in this Report will provoke further interests and ideas to contribute to the long term sustainable development of China's IWT.

The Report has identified the following eleven specific impediment areas and accordingly provided recommendations in terms of the sustainability criteria defined. The Report has also proposed a monitoring framework for assessing objectively success in the development of the IWT industry.

- China's IWT industry has now been growing rapidly for nearly a decade and is expected by its planners to double its traffic task by 2020. The sector is bigger, more complex economically and more technologically advanced than previously. It will require increasingly rigorous and sophisticated approaches to its administration, planning and management.

  Recommendation-1: A feasibility study is undertaken to define the scope of best processes, institutional responsibilities and resource requirements for the implementation of a Comprehensive Inland Navigation Database for China (CIND).

- Financing of capital expansion and recurrent costs and long-term budgetary supports for infrastructure are necessary if the system is to be financially sustainable.

  Recommendation-2: Financial experts are commissioned to undertake a detailed financial investigation of the financial needs and funding sources of IWT navigation infrastructure, including both provincial and national uses and sources of funds; quantify the long-term need and case for national and provincial budgetary financial support.

- High operational performance and effectiveness of navigation authorities is central to the long-term sustainability of the IWT.

  Recommendation-3: The performance of navigation authorities should be considered a matter of importance to the long-term sustainability of IWT in China; their financial and operational performance records (for example in lock productivity and waterway dredging) should be gradually improved to enable monitoring and comparisons of value for money in the use of funds; they should be encouraged to undertake pilot programs of competitive maintenance procurement (including both specification-based and/or performance-based dredging and other maintenance contracts).

- The application of modern information technology can enhance navigation infrastructure, the productivity of vessels, navigation safety and environmental protection.

Recommendation-4: High priority is to be given to implementing its 2007 River Information Services project, including continued dialogue with experts involved in similar programs internationally.

- Although MOT has legal obligations to consult with other government departments in matters regarding water resource utilization, there is no legal or regulatory obligation on China's IWT infrastructure providers to consult with the users of IWT infrastructure even though in practice, MOT and its navigation authorities consult the industry through trade associations.

  Recommendation-5: MOT continues to contribute actively to inter-departmental consultations and planning of water resources to ensure that the interests of IWT are positively and comprehensively represented in decisions, policies and projects that may have an impact on the IWT industry; and similarly that the channels of communication with all stakeholders in the transport services industry, and with major freight shippers, are kept active and harmonious.

- Many port reforms over the last thirty years have successfully handled larger and more diverse traffic volumes. However, despite the significant investment in many ports, there is still a great need for a higher number of larger, modern and more specialized berths and handling equipment.

  Recommendation-6: The port reform policies that have been adopted should be continued and built upon to continue encouraging more diverse participation and investment, and higher private participation in specific terminals and competition in port services where feasible.

- There is a scope to expand market reach through better interfaces between international shipping at seaports and IWT, and improved inter-modal connections at ports. These kinds of improvements are unlikely to emerge through simple workings of the market alone. They need to be given specific policy and project focus in national and regional transport plans.

  Recommendation-7: MOT investigates how the market reach of IWT can be expanded by improving the infrastructure and operational interfaces between seaports and IWT and by improving inter-modal access at river ports, where such connections may be shown to be economically desirable.

- A large number of small and medium-sized ports on China's waterways exist in close proximity to residential and other built-up areas and the activity in these ports has the potential to be environmentally intrusive or physically dangerous. Increasing environmental expectations and standards in China could prove to be a significant constraint on the sustainable development of the IWT unless it adapts to these rising expectations.

  Recommendation-8: MOT prepares and disseminates guidance to IWT ports and operators about the importance of harmonious relationships with local communities, the need for compliance with prevailing environmental standards, and practical measures that can be taken for IWT activities to become a better 'neighbor' to others who live and work alongside China's rivers.

- The long-term success of the IWT industry depends on the partnership between public infrastructure and private transport services. While the central role of national and provincial governments is essential, the ultimate sustainability of the IWT will depend even more on how successfully barge transport companies use the infrastructure to deliver transport services to freight customers. China's experience suggests that an open industry structure for barge transport service, which avoids unnecessarily restrictive market regulations on vessel operators.

Recommendation-9: Existing market-based policies for the barge transport services industry should be retained in which competition is encouraged, industry capacity quotas and tariff regulations are avoided, and standards-based regulation is retained to ensure navigational competence, safety and environmental performance.

- China's IWT system will have progressively less tolerance of vessels that are unsafe or unreliable or heavily polluting. However, provincial navigation authorities often inconsistently apply standards. This situation is not conducive to maintaining safety standards or for environmental sustainability. Moreover, China does not currently have any vessel engine energy efficiency or emissions regulations.

  Recommendation-10: MOT considers the case for progressive introduction of vessel engine efficiency and emissions standards, while increasing its efforts to ensure by provincial navigation authorities comply with all prevailing national environmental, safety and competence standards for vessels and crews.

- While modernizing and maintaining economic sustainability of the IWT industry, IWT policies and strategies should take account of and try to mitigate the impact of modernization on the small family operators. Small barge-owners are at risk that policy-makers, at both central and provincial levels, may not fully take their needs into account.

  Recommendation-11: Long-term policies for sustainable development of the IWT industry should explicitly contain mitigation measures for those small family barge owners/operators who may be adversely affected by the modernization process.

Chapter 1. Introduction

1.1 Background

This Study is a Non-Lending Technical Assistance (NLTA) study financed by the World Bank, which was jointly undertaken by the Bank's consultant and the team of Waterborne Transportation Institute (WTI) of MOT. The Study, through a comparative overview of the experiences in the IWT industry in the USA, the EU and China, aims to identify possible impediments to sustainable development of China's IWT and propose recommendations to overcome these impediments. The outcomes of the Study will help MOT to make strategic policies in sustaining the development of the IWT industry.

1.2 Three-region overview of IWT systems

One of the main parts of the Study was a comparison of IWT systems, institutions and policies in China, the USA and the European Union (EU). The EU is considered mainly at the Union-wide level rather than in detail of individual member states. It was anticipated that such a comparison might provide useful experiences and lessons, with positive and negative aspects, that would be helpful in the review, while also recognizing that many of China's challenges are unique, and will require locally-tailored solutions.

The three regions are each endowed with valuable natural river systems that have been supplemented by public works in canals, investment in river channels and other waterway infrastructure to create waterway systems that have transport capability. IWT plays an important role in freight transport in the three regions. The review indicates that China's IWT system is at a stage of development which is more vibrant and dynamic than in either of the other two regions. Moreover, China's economic geography suggest that, given appropriate development policies and management, its IWT system has much greater unrealized potential value to freight transport, and the economy generally, than that of either of the other two regions. These factors make it important to be discerning in interpreting the international experience and selective in drawing lessons.

Chapters 2-5 of this Report summarize the experiences and lessons of the three regions. Chapter 2 provides an overview of the IWT networks and their utilization. Chapter 3 compares institutions and administrative arrangements. Chapter 4 compares policies and programs. Chapter 5 compares the development of the barging industry and its markets. In each case the experiences are examined, topic by topic, for their possible usefulness for IWT policies in China.

1.3 Sustainability in Inland Waterway Transport

Following the comparisons of international experiences, the Report turns to the specific issue of the sustainability of China's IWT system in the future. Sustainability is treated as having five dimensions as follows that are described in more detail in Chapter 6 of the Report.

- economic sustainability;
- financial sustainability;
- operational sustainability;
- environmental sustainability; and
- social sustainability.

The Report identifies areas where China's IWT policies may be strengthened to help create an IWT system that is more sustainable in all these dimensions, so that it will provide a broadly-based and durable value to China's economy and people's livelihood.

In 2007, China adopted the **National Inland Waterways and Ports Plan to 2020** (referred to in this report as NIWPP2020). NIWPP2020, jointly agreed by MOT and the National Development and Reform Commission (NDRC) is an ambitious plan. It was developed through detailed economic and engineering feasibility studies in 2005, and sets out prioritized plans for upgrading of navigation standards and major port facilities of those waterways designated as being of national importance. The Plan will substantially increase the length of waterway that will, after investment, have navigation standards comparable with the busier waterways in the USA and the EU. The Plan is summarized in Chapter 4 of the Report. Given the importance of these standards to inland shipping economics, and to long-term competitiveness of IWT, the NIWPP2020 should remain the physical centerpiece in a sustainable IWT strategy, together with complementary plans that are being pursued by Provincial Governments on provincial level waterways.

But the financial sustainability of the Plan is not yet assured and physical infrastructure alone is not sufficient. The IWT system only has value because of the transport services that operate on it. Unless these transport services remain valuable to freight customers and the economy, the IWT network, as a transport system, will not be viable or durable, even if the engineering structures remain for decades. Therefore, the Report pays attention to maintaining the emerging competitive markets for barge transport and port services, as much as to the provision of infrastructure. The Report also argues that the sector will only meet its full potential if it is able progressively to meet more stringent environmental regulations and its social obligations to those communities who depend on it or live alongside it.

1.4 From Sustainability to Results

Taking account of the international experiences, and more particularly China's own experiences and circumstances, Chapter 7 of the Report sets out the main impediments to sustainable development of IWT in China identified in the Study. It then recommends how MOT can help to overcome or mitigate these impediments. These recommendations are divided into three main areas:

- navigation infrastructure;
- ports and terminals; and
- the barging industry.

Finally, a suggested framework for monitoring the attainment of MOT objectives and for measuring performance and results is set out.

An important aspect of both economic and environmental sustainability not directly addressed in this Study is that of access to water resources. However, in the process of developing NIWPP2020, we understand there has been consultation with and approval of the Ministry of Water Resources (that has overall responsibility for water resources management in China) in accordance with statutory obligations. This Study does not make any recommendations that would require water resources incremental to those assumed in NIWPP2020.

Chapter 2. IWT in China, USA and EU - Physical and Traffic Overview

2.1 Length of Waterways

Table 2.1 provides a summary of the total length of waterway that is 'classified' or otherwise defined in official documentation in each region, and an estimate of the length of commercially significant inland waterway. Annex A provides information on where maps of the waterway systems of USA and the EU can be sourced, together with details of navigation standards.

Table 2.1: Waterways Length (Km)

	CHINA	USA	EU
'Designated' waterways	61,000*	40,000	35,000
Commercially significant	24,000	16,000	8,000

* plus an additional 62,000 km navigable but unclassified.

For the purposes of this Report, 'commercially significant' in China has been defined as the five highest classes of waterway Classes I to V , where Class V denotes a channel with a usual minimum of 1.3-1.6 meter water depth and which is normally navigable by vessels of up to 300 tonnes.[1] Nearly all such waterways in China carry significant levels of traffic and are commercially important at least at the provincial level. IWT plays a critical role in China's industrialization.

The USA designates a total of 40,000 km of navigable waterways. These include rivers of environmental and recreational value not appreciably used for commercial freight, and also include certain coastal waterways. The commercially significant US 'inland waterway' transport system is normally taken as the legally defined Fuel-Taxed Inland Waterway System which is about 18,000 km in total. This report excludes the Atlantic Intra-Coastal Waterway which, although 'fuel-taxed', has very low traffic density compared to its length. This exclusion implies a commercially significant length of about 16,000 km of waterway.

EU literature refers to a total length of navigable waterway system of around 35,000 km, but the majority of this is mainly of historical, environmental, recreational and/or scenic value with no significant role in the carriage of commercial freight, either at EU-wide or domestic level. The commercially significant IWT network in Europe is dominated by the Rhine/Meuse-Main-Danube corridor (approximately 4,500 km of waterway). Adding in the lower reaches of the Rivers Scheldt, Mosel, Seine, Rhone-Saone, Weser and Oder, plus the busier canals (such as Germany's Mittelland Canal) gives a total of about 8,000 km of waterway that may be judged commercially significant for freight transport

These definitions are based on judgment, informed by both engineering class and traffic levels. As a result the comparisons are indicative rather than directly comparable. For example, many of the waterways of the navigation standards represented by Class IV and V in China would be most unlikely to attract

1. China's National Standard of Inland Waterway specifies the waterway classification in corresponding to vessel tonnage and water depth as follows:

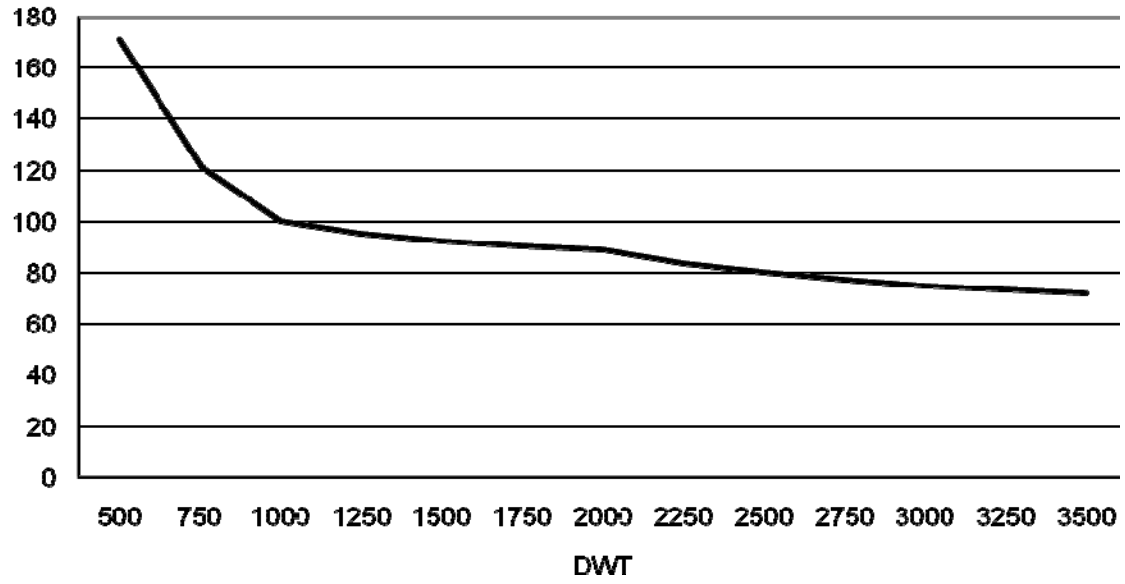
Channel Classification	I	II	III	IV	V	VI	VII
Vessel Tonnage (t)	3,000	2,000	1,000	500	300	100	50
Water Depth (m)	3.5-4.0	2.6-3.0	2.0-2.4	1.6-1.9	1.3-1.6	1.0-1.2	0.7-0.9

significant commercial activity in the EU or USA. Nevertheless, based on the definitions used, the length of China's IWT network that is judged to be commercially significant to China is similar to the commercially significant networks of the EU and the USA combined.

However, in the part of the network that is defined as commercially significant, China's IWT system differs markedly in navigation standards. Similarly, it also differs markedly in its potential in the part of the network which is not considered to be commercially significant.

Navigation standards: A critical issue when comparing the three systems is the navigation standards of waterways. One useful benchmark in assessing waterway standards is the ability of a waterway to provide the draft and configuration that will enable it to handle at least a 1,000 DWT barge. There are economies of scale in vessel sizes, with generally lower costs/ traffic unit for larger vessels. In the range up to 1,000 tonnes, there is a very steep fall in the average costs/tonne-km of operating larger barges. Figure 2.1 provides an indication of this. It is based on the results of a consultant regression analysis from published European data showing how total vessel operating costs, including both capital and working expenses, vary with vessel size for self-propelled dry cargo vessels used on the River Rhine. Although this is European data, China's experts have found similar results.

Figure 2.1: Estimated unit cost/tonne-km index for self-propelled dry cargo barge, Europe (1000 DWT barge = 100)



Source: Consultant regression analysis

Given the importance of vessel size, it is therefore critically important to recognize that at the end of 2006, the length of Class III and above waterway in China which could reliably handle 1,000 tonne vessels, was only 8,700 km. This represents only 7 percent of the total navigable waterway and is less than 20 percent of the commercially significant waterways. Nearly all the commercially significant waterways in the USA and the EU are of a standard equivalent to or better than China's Class III. Therefore, in more developed higher-income economies, which have a range of well-developed transport modes, IWT exists and survives as a significant mode where it can handle large modern vessels with low unit operating costs.

The implication of international experience is that, as China's economy, wages and transport systems develop, the long-term competitiveness of IWT versus other modes of transport depends on being able to offer not only high capacity, but also lower average transport costs, to offset the often longer transit times. International experience supports the priority given in NIWPP2020 to upgrade lower classified national waterways to create a significant core network of Class III routes, along with complementary investment in ports, so as to realize the economic potential of its main waterways to handle larger vessels.

The residual network: Apart from the 24,000 km of commercially significant network, as defined, China has an additional 37,000 km of classified inland waterway in classes VI-VII that are capable of carrying barges of up to 100 tonnes. By contrast the USA and the EU have comparatively little activity on waterways that are not classified as commercially significant.

In addition to the 61,000km of classified waterways are China's remaining 62,000 kms of unclassified but still navigable waterways. Many of these are used by very small barges and country boats for local and feeder cargo transport, and passenger transport (fleet statistics are provided in Chapter 5). While of minor significance to national freight totals, their services are often crucial for local production and distribution to riparian communities in the upper tributaries of more important rivers. On social grounds, they cannot be overlooked in China's national policies for IWT. Again, by contrast, this issue is not apparent on the same scale in the USA or the EU.

2.2 Traffic Task

Table 2.2 summarizes the overall traffic estimates provided by the statistical bureaus in each country. Definitions of IWT in each region are broadly consistent, though not precisely. In each case, they exclude international and coastal shipping, and also exclude Great Lakes traffic in the case of the USA. For purposes of traffic levels and trends, the EU refers to the 27 current member states with trend numbers including the 27 countries throughout the time-series, irrespective of when they actually joined the EU.

In terms of tonne-km, which takes account of transit distance, China has nearly two and a half times the freight task of the EU, but only around three-quarters that of the USA. The average trip length in the USA is more than two and a half times that of China. This is due to much longer average transit distance in the USA, which is over 700 km compared to about 260 km in China and 314 km in the EU. This is partly because of the much greater penetration of high-standard IWT on the Mississippi system and its prime role in consolidation and transport of long-distance movement of the mid-western grain harvest for export from gulf ports.

Table 2.2: IWT Freight Utilization

	CHINA	USA	EU-27
Tonnes (millions)	1,160 (2006)	566 (2005)	440 (2006)
Tonne-kms (billions)	303 (2006)	400 (2005)	138 (2006)
Increase in tonne-km since 2000	+95%	-8%	+4%

* In each region, the above comparison excludes international or coastal shipping movements but includes pipelines.

IWT traffic in the USA appears to have marginally declined in the last few years. The EU traffic has fluctuated, depending upon water levels in the Rhine, but overall may be marginally increasing. By contrast, traffic in China is increasing rapidly, with tonne-km carried having nearly doubled since the year

2000. The Pearl River area leads the growth with an annual increase of tonneage of 12 percent (14.3 percent p.a. in tonne-km). Table 2.3 gives details.

Table 2.3: IWT Freight by River System, 2000 and 2006

YEAR	TotalFreight	Yangtze River	PearlRiver	Heilong River	GrandCanal
	Tonnes (mil.)	Tonnes (mil.)	Tonnes (mil.)	Tonnes (mil.)	Tonnes (mil.)
2006	1,160.90	460.28	179.95	13.87	214.75
2000	687.38	314.84	91.08	7.53	143.09
Growth p.a.	9.1%	6.5%	12.0%	10.7%	7.0%
	TotalFreight	**YangtzeRiver**	**PearlRiver**	**HeilongRiver**	**GrandCanal**
	Tonne-km (bil.)	**Tonne-km (bil.)**	**Tonne-km (bil.)**	**Tonne-km (bil.)**	**Tonne-km (bil.)**
2006	302.53	167.58	28.55	1.43	56.10
2000	155.12	86.71	12.80	1.44	32.69
Growth p.a.	11.8%	11.6%	14.3%	-0.1%	9.4%

The Yangtze River is clearly the busiest system, representing over half the tonne-km carried. The freight traffic on the Yangtze River is mainly concentrated in the provinces of Jiangsu, Hubei and Hunan. This traffic accounts for more than half of the total Yangtze River traffic. Since 2000, the freight traffic growth in Chongqing and Jiangxi Province has been above 20 percent, the highest in the whole river area. In the lower reaches of the River, such as Shanghai and Jiangsu, the traffic has grown more slowly, as detailed in Table 2.4. Based on two-way sectional statistics, from upstream to downstream, 46 million tonnes of freight pass through the Three Gorges Lock, 70 million tonnes through the Wuhan section, 240 million tonnes through the Nanjing section and 700 million tonnes through the Waigaoqiao section in Shanghai. Traffic details by province for other river systems are provided in Table 2.4.

Table 2.4: IWT Freight on Yangtze River by Province

Province/Municipality	Freight 2006 (Tonnes mil.)	2000~2006 (Annual Growth Rate)
Shanghai	35.38	2.1%
Jiangsu	103.11	2.6%
Anhui	45.71	6.7%
Jiangxi	36.24	21.4%
Hubei	76.79	11.7%
Hunan	67.93	12.8%
Chongqing	44.50	21.5%
Sichuan	31.67	5.9%

No independent estimates of future IWT demand in China have been made for this study, but analyses carried out for NIWPP2020 estimate that the total cargo traffic in China will increase from 1.16 billion tonnes (303 billion tonne-km) in 2006 to 1.6 billion tonnes (432 billion tonne-km) in 2010 and to 2.35 billion tonnes (658 billion tonne-km) in 2020. Cargo traffic will continue to be concentrated mostly in the Yangtze River system and Pearl River systems, while specialized transport of container, liquid bulk cargo and automobiles is expected to increase most rapidly. Overall traffic projections for China are shown in Table 2.5.

Table 2.5: MOT's Traffic Projection for China's IWT to 2020

IWT Traffic	2000 (Actual)	2006 (Actual)	2010	2020
Tonnes (millions)	690	1,160	1,600	2,350
Tonne-kms (billions)	155	303	432	658

The China projections assume strong continued economic growth at the macro-level as well as the delivery of the improvements in the NIWPP2020. Representing an average annual growth rate of around 5.7 percent, the assumptions appear reasonable, similar to those being used as a planning basis in China's railway freight sector and lower than trends in the road freight sector. In the absence of a comprehensive database in the IWT sector (such as an up-to-date origin-destination matrix by commodity) and the need for speculative long-term assumptions of economic development and system investment, any long-term projections are subject to some degree of uncertainty. However, even allowing for those uncertainties, China's IWT market is likely to experience very substantial growth over the next 15 years. By contrast the EU and USA, which have neither existing trends nor emerging growth drivers, can expect at best only gradual expansion of IWT traffic over the same period.

2.3 Mode Shares

Table 2.6 shows the overall freight transport task in each region for the years shown (but excluding international sea transport to/from countries outside the region). China's overall freight task in 2006 was just over 6 trillion tonne-km. This freight task has grown rapidly and is now similar to that of the USA, and about 50 percent higher than that of the EU.

Table 2.6: Distribution of Total Freight by Mode in the Three Regions (Tonne-kms, billions)

	China			USA			EU		
Mode	**1995**	**2000**	**2006**	**1996**	**2000**	**2005**	**1995**	**2000**	**2006**
Road	469	613	975	1,550	1,741	1,887	1,289	1,519	1,888
Railway	1,305	1,377	2,194	2,010	2,257	2,530	386	401	435
Oil Pipeline	59	64	166	904	842	835	115	126	135
Air	2	5	9	20	23	23	2	3	3
IWT	159	155	302	433	441	400	121	133	138
Coastal Sea	403	511	988	683	502	463	1,150	1,348	1,545
TOTAL	2,397	2,725	4,634	5,600	5,806	6,138	3,063	3,530	4,144

NOTES

(1) China pipelines include gas pipelines

(2) USA coastal shipping includes Great Lakes

(3) EU coastal includes intra-EU sea traffic

(4) Sources include China Statistical Yearbook, EU Eurostat and US DOT freight statistics

Table 2.7 shows the modal shares for the four main multi-purpose modes of inland transport: road, rail, air and IWT. The share of the IWT in 2006 is similar in China (8.7 percent) and the USA (8.3 percent) but lower in the European Union (5.6 percent). However, the modal share of IWT has declined significantly in the USA and the EU over the last 10 years. In China the mode share of IWT declined between 1995 and 2000, but has since rebounded by about a fifth.

Table 2.7: Mode Shares of Inland Transport (Proportion of Tonne-kms)

	China			USA			EU		
Mode	**1995**	**2000**	**2006**	**1996**	**2000**	**2005**	**1995**	**2000**	**2006**
Road	24.2%	28.5%	28.0%	38.6%	39.0%	39.0%	71.7%	73.9%	76.6%
Railway	67.4%	64.0%	63.0%	50.1%	50.6%	52.3%	21.5%	19.5%	17.7%
Air	0.1%	0.2%	0.3%	0.5%	0.5%	0.5%	0.1%	0.1%	0.1%
IWT	8.2%	7.2%	8.7%	10.8%	9.9%	8.3%	6.7%	6.5%	5.6%
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Notes: Same as Table 2.6

However, it is important not to confuse mode share across large regions with market share. IWT can only 'share' or compete for, markets in any particular transport corridor where it actually exists. In all three regions, most transport corridors do not offer a realistic IWT option. Market shares in IWT corridors in all three regions are therefore much higher than regional averages. For example, though the overall mode share of IWT in the EU is quite low, in the Netherlands, which has many excellent waterway routes, IWT carries more tonne-kms than any other mode.

2.4 Commodity Types

Table 2.8 summarizes the main types of commodity using IWT in the three regions, based on each country's classifications. These classifications are not exactly consistent but the comparisons provide a good indication of the role of IWT. In all three regions, IWT is mainly used for consignments which are (a) large enough to justify regular use of barges (b) shipped to/from sources or consolidation points (such as grain silos) that are very close to a river or canal (c) neither highly perishable (given proper stowage) nor particularly time sensitive, and (d) most sensitive to transport costs because of relatively low value per tonne.

As would be expected, in all three regions IWT corridors tend to carry the bulk commodities for primary industries such as coal and coke; sand, gravel and other building materials; agricultural products (particularly bulk grains in the USA); bulk timber, as well as less time-sensitive consignments of bulk products of heavy process industries such as oil and petroleum products; iron and steel; chemicals and fertilizers.

Table 2.8: Main Commodity Types Using IWT

CHINA	USA	EU
Cargo tonnes (2006)*	**Cargo tonne-kms (2005)**	**Cargo tonne-kms (2005)**
Coal & coke 17% Oil & oil products 8% Metallic & non-met. ores 19% Building materials 34%# Steel 7% Containers 6% Others 9%	Coal & coke 22% Oil and oil prods.14% Food, grains, farm 25 % Crude materials 18% Chemicals 11% Manufactures 9% Others 1%	Coal & coke 11.6% Oil & oil products 16.2% Agriculture & food 14.6% Building materials 20% Chemical and fertilizers 11.1% Manufact. & Iron/steel 16.6%
Containers handled at inland ports: 7.82 million TEU handled/year (2006) (incl. 2.98 mill in lower Yangtze and 3.55 million in lower Pearl). Increasing at over 30% p.a.	**Containers by IWT:** Negligible	**Container trips by IWT:** About 2 million TEU trips/year Increasing about 7% p.a. (concentrated on Rhine system)

*China estimates based on aggregated port statistics # includes sand, gravel, stone, and cement

When examining the China's traffic profile in more detail, it is clear that the main commodities served by IWT in China are dry bulk cargoes and their proportion of the total tonnes has been increasing. Based on port handling statistics, which exceed flow data because the same tonnes are included when loaded and discharged, the dry bulk traffic handled in China's IWT ports in 2000 was 577 million tonnes accounting for 63.1 percent of tonnes handled, while in 2006, the number reached 1.455 billion tonnes and 71.3 percent of tonnes handled respectively. The second main cargo of IWT is general cargo, but its percentage reduced from 23.6 percent in 2000 to 16.6 percent in 2006. Bulk liquid is the third main cargo, but its percentage was also reduced, from 10.4 percent in 2000 to 7.1 percent in 2006. The container and Ro-Ro (roll-on roll-off) traffic developed very quickly, but overall it represents a low proportion of the total traffic task (Table 2.9).

Table 2.9: Main Commodities Handled at China's IWT Ports by Tonnes Handled (2000 and 2006)

YEAR	Total	Liquid bulk	Dry bulk	General cargo	Containers		Ro-Ro	
	Tonnes millions	Tonnes millions	Tonnes millions	Tonnes millions	TEU millions	Tonnes millions	Units millions	Tonnes millions
2006	2,040.03	14,435	1,455.43	339.12	7.82	79.03	1.06	22.07
%	100.0%	7.1%	71.3%	16.6%		3.9%		1.1%
2000	914.80	9542	577.20	216.03	3.02	25.55	0.09	0.61
%	100.0%	10.4%	63.1%	23.6%		2.8%		0.1%

The breakdown of port throughput at the main IWT ports in 2006 is shown in Figure 2.2, while Figure 2.3 shows the comparison between cargo structure in 2006 and 2000. Figure 2.3 demonstrates the emerging demand for more specialized terminals because of sharply increasing transport demand of coal, construction materials, metal ore, steel and containers.

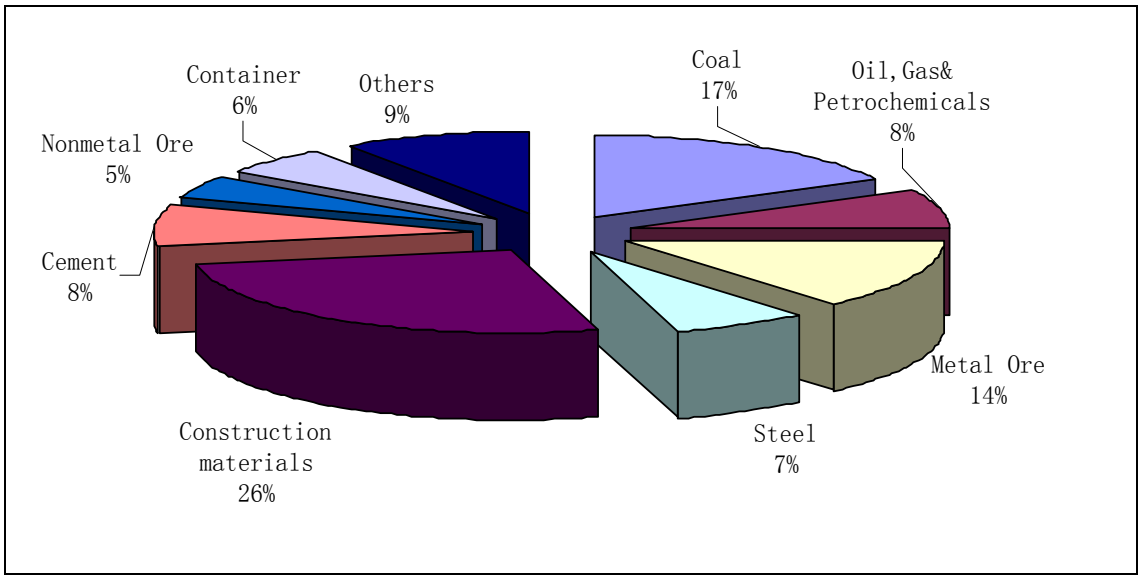


Figure 2.2 Breakdown of Throughput in China's Main (28) IWT Ports (2006)

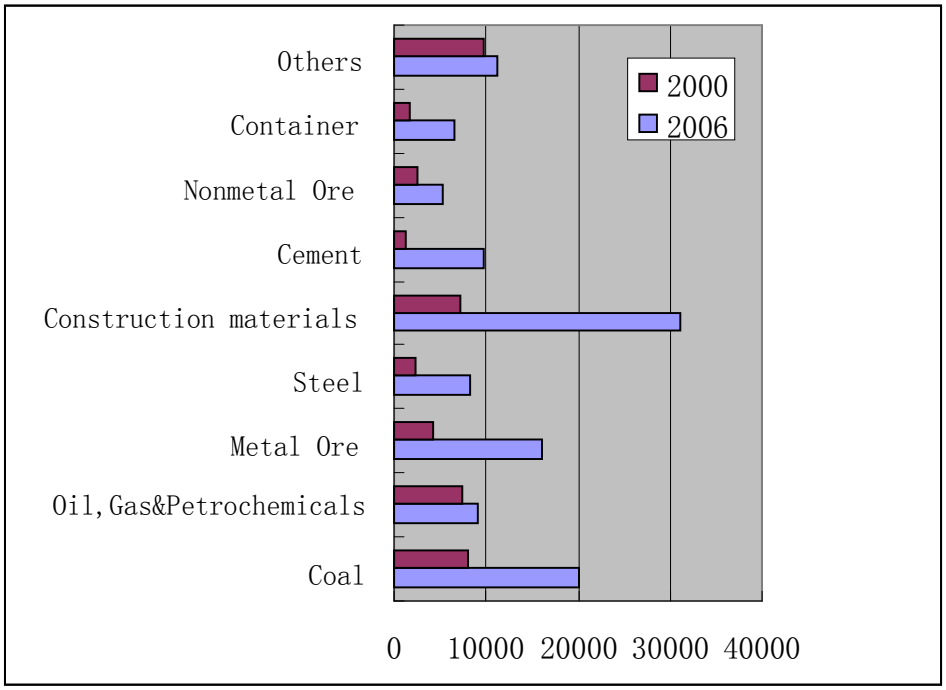


Figure 2.3 Comparison of Cargo Structure (2000 and 2006)

2.5 Containers by IWT

Although low value traffic is drawn to IWT, not all IWT traffic is of low value. Time-sensitivity is a more important factor than value per se. International containers, for example, often carry very high value cargo. But as part of a total journey that can take several weeks, a couple of days extra on a barge is found by many customers in Europe and China to be acceptable given the considerable saving in transport

cost compared to road transport. Flows of international containers to and from ports therefore effectively transform a variety of high value individual consignments into a bulk flow of boxes, suitable for either IWT or railway modes.

There are considerable differences between the three regions in regard to development of container traffic.

USA: In the USA, only a very small amount of container (or other) inter-modal traffic uses the IWT system. This is probably because the waterway system flows north-south whereas the predominant USA inland container flows are east-west to/from Pacific and Atlantic Coasts. Moreover, while in the USA there is substantial international container traffic to/from the deep water Mississippi ports such as South Louisiana to win traffic for onward distribution/collection, Mississippi barge operators would need to compete with the most efficient railway container operations in the world provided by the privately-owned USA Class 1 railway companies. There also appears to have been little USA national policy or budgetary support for encouraging container transport by IWT.

European Union: The EU has a significant container operation along the Rhine River especially for the on-carriage of international containers from the sea ports of Rotterdam and Antwerp. For example, in 2006, the Port of Rotterdam handled 5.85 million containers (incoming and outgoing) which is equivalent to 9.65 million TEU's. Not counting ship-to-ship traffic that did not travel outside the port, some 4.47 million containers were distributed to/from hinterland destinations as shown in Table 2.10 below. It can be seen that barges carried around 30.5 percent of the containers by IWT to/from hinterland origins and destinations. About 30 percent of the traffic comes from or goes to Germany, Belgium or other destinations within the Netherlands while other EU destinations and Switzerland account for the rest. The main Belgium origin/destination is Antwerp which is about 160 km away. The various Netherlands destinations are less than 100 km distant. The major German inland container port of Duisberg that is capable of handling river-sea vessels is only 221 km from Rotterdam, while other destinations include cities such as Cologne, Bonn and Karlsruhe. IWT is typically used for container transport in the EU because of lower transport costs but there are also targeted national government subsidies available in the Netherlands, Germany and Belgium for investment in IWT terminals, particularly inter-modal terminals.

Table 2.10: Distribution of Containers at Port of Rotterdam to/from Hinterland (2006)

Mode of distribution	Containers (millions)	Proportion (%)
Barge	1.364	30.5
Railway freight	0.486	10.9
Road haulage	2.619	58.6
Total	**4.469**	**100.0**

Source: Port of Rotterdam

China: China's inland ports handle nearly 8 million TEUs per year, including both origin and destination handling. This is similar to the EU, and is growing more rapidly. The sector has developed very fast in the lower reaches of the Yangtze and Pearl Rivers, based around the major seaports and is similar in nature to the Rotterdam operations. The national IWT container traffic in 2006 reached 7.82 million TEU, of which, 2.98 million TEU were carried in Jiangsu Province in the lower reaches of Yangtze River, while 3.55 million TEU were carried in Guangdong Province in the lower reaches of the Pearl River. However, containers are now penetrating much further inland. After improvement of navigation infrastructure in the

Three-Gorges Dam area, container traffic in Chongqing, and also in Hubei Province reached 0.76 million TEU. Container traffic between the coast and inland ports has nearly trebled in the last five years.

2.6 Price and Service Levels

Due to evident differences in navigation standards, fleet characteristics, and IWT markets (such as average trip distances) comparisons of prices and service levels by IWT in the three regions have not been undertaken. To obtain meaningful results would require comparison of 'like-with-like' market segments and normalization of results for different input unit costs levels such as labor and energy costs. However, MOT currently does not monitor and has no market database on IWT rates or service levels in China so to collect such information would require a survey that was beyond the resources of the Study (the Study recommendations address this deficiency). Moreover, while there is more market data available internationally, it is by no means complete. This section therefore provides some limited information about the situation in each region, yet refrains from attempting a comparison.

China: Consultants Deloitte and Touche have derived comparisons of transit time and tariffs for containers carried between major city pairs on the Yangtze. These are shown in Table 2.11. They illustrate the substantial tariff advantages of IWT compared to road transport that are driving growth, despite a significant local time cost penalty (though much less significant if the total international transit time were considered). IWT has a smaller tariff advantage compared with rail transport, but the overall transit time is of the same order of magnitude as for the rail alternative.

Table 2.11: Indicative Transport Cost and Time Comparisons for Containers on Yangtze River

Chongqing-Shanghai	Distance (km)	Transit time (days)	Cost (CNY/20-foot Container)
Road	2,150	3-4	12,000
Rail	2,250	7-10	4,300
IWT	2,400	8 (11 upriver)	2,500
Chongqing-Wuhan			
Road	700	3	6-7,000
Rail	1,000	6	2,800
IWT	1,280	4 (6 upriver)	2,200
Wuhan-Shanghai			
Road	920	1-2	5,500
Rail	1,030	6	2,300
IWT	1,125	2 (3 upriver)	1,700

Source: Deloitte and Touche: The Yangtze River Transport Corridor (2005)

USA: As noted, few containers are carried on the USA system. The key service characteristic of the USA system is the use of large capacity tows of standard barges for regular shipments of bulk commodities carried at contract freight rates from point to point on the waterway system. Single tows of 15 barges lashed together in the upper and lower Mississippi basin above Baton Rouge are common, while up to 45 barges are lashed in a tow below Baton Rouge. Apart from the Ohio River, where 366 meter locks are the norm, the standard lock size on the Mississippi system is 183 meters. This requires that 15 barge-tows, which are twice that length, must be split and 'double-locked' which adds to barging costs. A small

number of 366 meter lock chambers have been added in recent years at congested locks and some others are planned, though constrained by limited funding.

The basic objective of the industry has been to provide reliable transport to non-time sensitive bulk traffic, at lowest possible cost. In this regard, IWT has been very successful in specific bulk markets. These include grain from the mid-west heartlands (e.g. Minnesota, Iowa, Illinois, Indiana, Ohio, Kentucky, Tennessee, Arkansas) down the Mississippi for export from deep water ports; agricultural fertilizers in the reverse direction; coal from mines to power plants (particularly in the Ohio Valley between Pennsylvania and Tennessee); petroleum (to over 1000 terminals along the inland and intra-coastal waterways); and others.

Although there is little published data on the (mainly) contract freight rates charged by barging companies, it has been estimated that, on a like-with-like basis, IWT costs in the USA are about two-thirds of the costs of railways and about a third of the costs of transport by road truck.[2]

Freight tariffs by IWT, as in US railways, are normally determined by confidential individual contract between barge operators and freight customers. Price differentiation is used for more favorable contracts involving larger volumes or longer-term contracts.

However, some traffic is carried at short-term spot-market rates and these are published by the US Department of Agriculture for grain. Vachal et al concluded from these that there has been a significant decline in average yield (revenue/tonne-km) in the period 1980-2003. This is attributed to improved productivity that was passed on to customers through price competition in a very competitive market. However, most of the effect occurred in the 1980's and little of this gain has been made in the last few years. More recent revenue yield comparisons for road truck, rail and IWT are provided in the same study. This shows that over the period 1997-2002, average freight yield (revenue/tonne-km) declined by 14 percent for road trucks and 23 percent for railways, but was stable or even increased slightly for IWT. It is therefore perhaps not surprising that IWT in the USA is losing traffic in some markets and faces significant modal decline overall.

European Union: The relative importance of different aspects of transport service has been the subject of several studies involving IWT in Europe. These generally conclude that for bulk commodity users of IWT, the most important factors affecting choice of mode is the transport tariff per tonne. Reliability, flexibility and speed are more important for transport of containers and other manufactures and consumer goods. Actual speed of vessel is rarely considered a major factor. Total door-to-door transit time (including loading and transshipment etc) is more important than speed, but is not as important as cost and reliability.

The wide range of general and specialist vessels types, and barges up to 3,000 tonnes and more, provide the basis for IWT to exploit some of the unit cost economies that can be gained from use of large vessels. Moreover, the Rhine provides 24-hour navigation throughout. In practice, independent owner-operators of smaller vessels may be worked for around 14-15 hours a day. Larger self-propelled vessels are more likely to be worked 18 or 24 hours per day. Continuous operation is typical for barge tows.

A high proportion of traffic is carried at contract prices. These are not publicly available. There is a 'spot market' for non-contract 'casual' carriage, but these prices can fluctuate depending on the supply and

[2] David Grier, Waterway Services, Issues and Capacity: The Corps of Engineers Role, paper to Midwest Agricultural Conference, 2007.

demand conditions in different markets and also sometimes the state of the river. Therefore, it is difficult to make an average estimate of IWT tariffs, or make consistent price comparisons between modes. However, it is known that the average real tariff level for IWT (EUR/tonne-km) has declined steadily through most of the last 15 years, as did transport tariffs for other modes.

Consultants NEA (1995) made some indicative comparisons of door-to-door transit times and costs for a number of IWT routes and commodities in Europe (not only the Rhine). These examples, cited in the PINE report, included containers from Rotterdam Port to Heidelburg (a road distance of 500 km); bulk liquids from Rotterdam Port to Vienna (a road distance of 1,200 km); and motor vehicles from Vienna to Romania (a road distance of 1,250 km). The comparisons are given in Table 2.12. They show that IWT operated with larger efficient barges can have a substantial cost advantage over other transport modes, although the total transit time is usually longer.

Table 2.12: Indicative Door-to-Door Prices and Transit Times, Illustrative Consignments

		Road	Rail	IWT
Rotterdam-Heidelberg Container (1.44 TEU)				
Transport cost	Index	100	105	73
Transit time	Days	1.5	2.5	3.5
Rotterdam-Vienna Bulk liquids				
Transport cost	Index	100	80	67
Transit time	Days	2	4	8
Austria-Romania Motor vehicles				
Transport cost	Index	100	93	35
Transit time	Days	3	6	7

Source: PINE Report

2.7 Comparison of IWT Systems: Physical and Traffic Potential

In subsequent chapters, the Report will compare the institutional and administrative structures, policies and programs, and industry and market development measures that exist in the three regions. When assessing the experience of the different regions, it is important to take into account the context in which their policy-makers and industry participants make decisions. It is evident that there are some fundamental differences in the context in which IWT policies are being formulated in each of the three regions. While IWT is a 'niche' mode of transport in all three regions, the long-term boundaries of this niche depend on three main factors:

- the physical geography of a region in terms of its resource endowments of river systems and on their man-made improvements through investment in infrastructure;
- the economic geography of the region in terms of the existence of commodity markets to which IWT is suited and the strength of competition;
- the 'match' between the physical resource and the markets available; namely the match between supply and demand.

Regional differences in these factors make it likely that the long-term niche of IWT in China may have more expansive boundaries than in the USA or the EU.

First, this is because of the physical nature of inland waterways. Only a small portion of the USA's inland waterways that are not included in the 16,000 km defined as commercially significant, have the realistic potential to be upgraded. Indeed, some parts of the said 16,000 km, such as the Alabama/Coosa River and the Apalachicola-Chattahoochee and Flint Rivers, are becoming increasingly insignificant in volumes of commercial freight. Some of the navigable waterway length in the USA was historically important but now lacks commercial significance not so much owing to infrastructure constraints, but mainly because it is in areas of low population density or of little industrial activity, or in wilderness areas, or in the wrong place to serve freight of the kind to which IWT is suited, or because there would be few freight customers it could realistically win from the USA's large, dense and mature railway network (which is the closest competitor for IWT transport).

In the EU, most of the little-used 27,000 km in individual countries of residual navigable waterway consists of unconnected and comparatively short rivers and regional canal systems which have long been overtaken or by-passed by economic development. Despite their navigability, and in some cases importance to specific companies, most are unlikely to play a significant future role in EU freight transport. Allowing for the rather limited traffic projections and optimistic levels of public investment, the EU may well have a long-term commercially significant network no more than about 50 percent greater than the existing 12,000 km.

As already noted, China's commercially significant inland waterway system is already as large as those of the USA and the EU combined, but it also has an additional 37,000 km of classified navigable waterways, many already carrying more than 3 million tonnes/year using small vessels. This is a level of traffic that would be considered commercially significant in Europe or USA. Moreover, much of this residual waterway length is conjoined with the busy core national network and flows through heavily populated, industrial regions. Experience suggests that the barging industry is likely to rapidly extend into these rivers offering lower cost operations by larger vessels when the navigation standard is improved. China's Class VI and VII waterways do not consist mainly of short and isolated rivers and narrow canal systems like the majority of inland waterways in Europe; nor are they predominantly in sparsely populated rural or wilderness areas as are many of the navigable waterways in the USA that are not used commercially. China has a larger "reserve" of waterways that have the potential of being upgraded to commercially significant status than does the USA or the EU.

Second, the market context differs between regions. Demand for transport in China's economy is growing more than four times faster than in either the EU or the USA. Additionally, China is at a stage of development that demands transport of increasing volumes of bulk raw materials, such as sand and gravel, coal, iron and steel, timber, fertilizer and many others that are best suited to IWT, and will gravitate toward it should that option exist. In more developed economies, by contrast, many such traffic flows are slow-growing, static or declining.

Thirdly, it is important to consider the scope for improvements. The main IWT systems that exist now in the EU and USA, though capable of improvement, are essentially mature assets that serve mature economies. Much of the investment in the US and European inland waterway systems, such as removal of river obstructions, dam building, ship-lock construction, canal building and canalization of rivers, occurred during earlier stages of development, though much of it is now due for renewal. Most of the main EU and USA commercial waterways that are likely to be commercially significant are already at a

comparatively high navigation standard, as good as or usually better than China's Class III. There are relatively few projects in the USA or the EU that would offer high returns of the type that are still widely available in China if a Class IV or V river is upgraded to Class III.

China, with the notable exception of the historical construction of the Grand Canal, still has most of its basic investment in modern IWT infrastructure ahead of it. Only 7 percent of China's classified waterways are at Class III or better, whereas virtually all the significant USA and European waterways meet this standard. Decisions on how much to invest in China's IWT infrastructure can therefore potentially have a greater influence on its future role than may be realistically available to policy-makers in the USA or the EU.

Noting these important differences in context, the Report now undertakes more detailed comparisons of the three regions in terms of institutions and administration (Chapter 3), policies and programs (Chapter 4) and market and industry development (Chapter 5).

Chapter 3. International Experience - Institutions and Administration

3.1 Summary of Main IWT Administrative Institutions

Table 3.1 summarizes the main institutions involved in the policy and administration of IWT in the three regions.

Table 3.1: Main Policy and Administrative Institutions in IWT Sector

CHINA	USA	EU
• Ministry of Water Resources • Ministry of Transport (MOT) • Yangtze and Pearl River Navigation administrations (report to MOT) • Provincial Governments and their navigation authorities.	• Maritime Administration of the US Department of Transportation (MARAD) • US Army Corps of Engineers (USACE)	• European Union • River Commissions set up by international treaty • National Governments • United Nations Economic Commission for Europe (UNECE) (harmonization of pan-European navigation rules)

3.2 China

As stipulated in the ***Water Law of the People's Republic of China***, the Ministry of Water Resources is the supreme administrative department in overall management and co-ordination of water resources. Specialized plans for IWT infrastructure and ports have to be coordinated through the Ministry of Water Resources and cohere with the integrated plans for overall use of water resources. It is also stipulated in the ***Port Law of the People's Republic of China***, that the design of ports should accord with national, provincial or municipal plans, and should also be compatible with other plans, such as those for land utilization, cities, river management, flood prevention, oceanic regions, other transport modes and other plans stipulated in relevant laws, and administrative regulations. The ***Regulation on Administration of Waterways*** stipulates that the activities undertaken by national and provincial transport administrative departments who are responsible for development plans and engineering designs of rivers/canals projects relevant to water resources and hydroelectricity, must consult with the administrative departments of water resources and hydroelectricity at the same level, and with forestry and fishery departments if appropriate. Conversely, all other departments with policies and projects that affect water resources should also take into account the impact on and needs of IWT.

Within this overarching framework, the central MOT has the overall responsibility for policy and administration of IWT in China. As stipulated in the ***Regulation on Administration of Waterways***, MOT is responsible for planning channels of national importance, which include those Class IV and higher channels (suitable for vessels of 500 tonnes-plus) that are part of the national network, plus Class V and better channels (suitable for vessels of 300 tonnes-plus) which have important trans-provincial traffic functions.

MOT has decentralized responsibility for day-to-day administration and management of the main waterways of national importance to the Yangtze River Authority and Pearl River Authority, which are agencies of MOT. Provincial governments are responsible for most other waterways, and indeed for most of the total network, which they administer through provincial navigation authorities. These authorities are required to submit a report to MOT semi-annually.

Both the two main MOT navigation authorities, and the provincial navigation authorities, have a similar schedule of responsibilities, though these apply to the waterways under their own jurisdictions. These responsibilities are specified in the administrative regulation as follows:

- draft plans for IWT within their jurisdictions;
- draft industry and financial policies within their jurisdictions;
- prepare and implement infrastructure projects;
- draft industry policies, regulations and technical standards regarding infrastructure construction, transport operation, safety and pollution prevention (consistent with national policies and regulations);
- grant licenses to IWT enterprises;
- keep the IWT market competitive;
- manage projects relevant to construction of IWT infrastructure;
- manage and maintain IWT infrastructure;
- be responsible for levying fees and dues in waterway transportation and administration of IWT, ports and other waterway services;
- organize and carry out transport of key commodities and emergency transportation;
- control waterway traffic safety and vessel pollution prevention, supervise ship owners' safety conditions and safety management system of waterway transportation enterprises, investigate and tackle waterway traffic accidents, vessel pollution accidents, and waterway traffic violation cases;
- administer ship survey activity; issue license certificates to eligible ships; approve ship survey institutes; grant licenses to ship surveyors; approve and administer foreign ship survey institutes and their representative; be responsible for registration, certificate issuing, inspection of vessels with national flag and visa of entry and exit; supervise vessels with foreign flag entry and exit; be responsible for safety, supervision and administration for shipping dangerous goods;
- be responsible for training and examinations for qualification of sailors, and issuing of certificates; oversee and manage the qualification of training institutes for sailors and pilots and their quality systems;
- manage the orderliness and environment of navigation. Be responsible for classification and supervision of waterway areas (such as prohibited areas, waterways, traffic control areas, anchorage and safety operation areas) and maintain the traffic order; supervise safety conditions of berthing, use of coastline if relevant to voyage safety, and construction and operation of waterways; manage the salvage of sunken vessels and retrieval of commodities, and clearance of hindrances to sailing; manage and promulgate warning/advice of national shipping; inspect and approve vessels with foreign flags in areas not open to foreigners; and be responsible for examination and approval regarding ports' opening up to foreigners.

The technical regulations for vessels and crews are set nationally by MOT, but vessel surveys and registrations are undertaken by the provincial navigation authorities. It is believed that there is a significant divergence between provinces in their compliance with the national standards, partly because of an attempt by some provinces to encourage vessels to register in their jurisdiction and partly because of a concern by some provinces that poorer operators cannot afford to meet the standards and might be forced out of business.

Each provincial navigation authority drafts a plan for the waterways under its supervision, consistent with national waterway planning policies. The plan is implemented after approval by provincial governments,

and is submitted as a record to MOT at same time. If the channel crosses between provinces, the Plan needs to be agreed by all the relevant provinces.

3.3 USA

Two Federal Government agencies have the main responsibilities for the IWT system in the USA; the Maritime Administration of the United States Department of Transportation (MARAD) and the US Army Corps of Engineers (USACE). The role of each is discussed below, and their policies and programs discussed in more detail in Chapter 4 of the Report.

US Department of Transportation: Maritime Administration (MARAD)

The United States Department of Transportation (USDOT) has responsibility for developing overall Federal transport policies in the USA. In the IWT sector it is also specifically responsible for vessel and navigation safety. While USDOT determines overall transport policies, the executing agency for most of its IWT and other maritime responsibilities is the MARAD, one of ten operating administrations of the USDOT.[3]

US Army Corps of Engineers (USACE)

USACE's overall responsibilities include: planning, designing, building and operating water resources and other civil works projects; designing and managing the construction of military facilities for the Army and Air Force; and providing design and construction management support for other Defense and Federal agencies. USACE employs predominantly civilian personnel (34,600 civilian and 650 military).

USACE has the responsibility to facilitate safe, reliable and economically efficient movement of IWT vessels which it does by building and maintaining navigation channels and harbors, operating most locks[4], and regulating water levels on inland waterways. It's responsibilities in the IWT area are supported by its Institute for Water Resources (IWR). The IWR was set up by USACE in 1969 to provide the USACE with long-range research and planning capabilities to assist in improving the civil works planning and evaluation process. IWR provides specialist expertise in hydrological engineering, integrated water resources management, international trends and experience, planning, policy analysis and project management.

The USACE defines its mission in IWT as:

> *providing safe, reliable efficient, effective and environmentally sustainable waterborne transportation systems for the movement of commerce, national security needs and recreation*[5].

[3] The other nine are: Federal Aviation Administration; Federal Highway Administration: Federal Motor Carrier Safety Administration; Federal Railroad Administration; Federal Transit Administration; National Highway Traffic Safety Administration; Saint Lawrence Seaway Development Corporation; Pipeline and Hazardous Materials Safety Administration; Research and Innovative Technology Administration

[4] A few of USACE-owned locks (particularly seasonal locks) are operated by companies under contract and a few by State administrations. On the Tennessee River, locks are owned by the Tennessee Valley Authority, but operated by USACE.

[5] http://www.marad.dot.gov/

Military administration of IWT is rarely adopted internationally. USACE attained this role in the early nineteenth century through the constitutional authority of the US Federal Government to regulate commerce and navigation between states (maritime and inland waterway transport were then the main trading modes), to clear river obstructions and to provide improvements to navigation. In 1824, Federal laws authorized the USACE to improve safety on the Ohio and Mississippi Rivers and several ports. During the Civil War of 1861-1865, federal military domination of the Mississippi River and its tributaries was of strategic value to the Union (federal) forces and reinforced the policy of federal control of inland waterways. USACE now maintains 18,000 km of commercially active waterways, operates 235 locks, and maintains 300 commercial ports and more than 600 smaller ports.

In addition to its responsibilities for navigation, the USACE is responsible for various other aspects of water resources management on the inland waterway system including:

- environmental management;
- flood protection;
- hydro-electric power
- recreational use of waterways
- regulation of development affecting waterways
- water supply

The USACE explicitly endorses the concept of environmental sustainability. It has published a set of Environmental Operating Principles applicable to all its decision-making and programs. These include, among other environmental aims, the intention to:

- try to achieve environmental sustainability;
- recognize the interdependence of life and the physical environment;
- seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another;
- seek ways and means to assess and mitigate cumulative impacts to the environment.

USACE is not a transport policy maker, but a planning and implementing body that focuses on:

> *'developing and implementing solutions through collaboration with stakeholders (regions, states, tribes, local entities, other Federal agencies and other governments, etc.) and playing a leadership or support role as appropriate'.*

In addition to this general aspiration of co-operating with other groups, the need for more structured stakeholder input into the governance of navigation is reflected in the establishment of the Inland Waterways User Board (IWUB). The IWUB is a Federal advisory committee established by the 1986 Water Resources Development Board. The eleven-member Board represents all geographic areas on the fuel-taxed inland waterways system of the United States. (The significance of the fuel tax is explained in Chapter 4 of the Report). The composition of the Board is balanced between freight customers and barge companies of different sizes and specializing in different commodities. The IWUB is chaired by the Director of Civil Works of the USACE. It makes recommendations to the Congress and the Secretary of the Army on the priorities and spending from the Inland Waterways Trust Fund for construction and rehabilitation projects on the fuel-taxed system. The Board typically meets three times a year with the meetings open to the public.

3.4 European Union

The IWT industry within the European Union is governed at four levels:

- Individual European national governments (usually by the Ministry of Transport of the country and/or its national IWT agency);
- Multi-national River Commissions established by International Conventions: the two most important Conventions are the 1868 Mannheim Convention on the Rhine River and its tributaries, and the 1948 Belgrade Convention on the Danube River and its tributaries;
- The European Union (EU) itself, established in 1957 by the Treaty of Rome;
- United Nations Economic Commission for Europe (UNECE), which is not an administrative body, (it has no powers of implementation) but which seeks harmonization of IWT navigation and environmental standards across the whole of Europe (including EU and non-EU countries).

Before the European Union was created, the IWT sector in Europe was administered at the first two levels. However, the progressive widening of the membership and powers of the EU has added a third level of administration and policy-making in IWT for those countries that are members ('EU Member States').

The following sections summarize the roles and responsibilities of these four main tiers of administration: national governments, international river commissions, EU, and UNECE. Chapter 4 of the Report describes EU policies to promote IWT in Europe and improve the institutional and administrative framework.

National governments' responsibilities

Individual EU countries are responsible for the management and operation of the inland waterways within their territories. They plan their waterway system, construct infrastructure, operate and maintain waterways, license vessels and regulate and enforce safety. Each country organizes this function in different ways. But for the international waterways these responsibilities are subject to those International Conventions to which they are members, relating to international waterways; to the Directives and Regulations of the EU, and to ratified international agreements entered into under the auspices of the UNECE. The volume of IWT traffic in Europe that is carried within countries, but not on international waterways, is relatively small. Therefore in practice, the policies and practices of national governments, with regard to most IWT activity, are heavily influenced by the other three levels of administration.

Four countries accounted for over 95 percent of all IWT traffic carried in the EU in 2006 (measured by tonne-kms). These were Germany (about 50 percent), the Netherlands (34 percent), Belgium (7 percent) and France (6 percent). Nevertheless, even in these countries until recently, policy attention to IWT by national governments tended to lag behind other modes and public investment levels often fell below those necessary to maintain and renew infrastructure assets.

More recently, the development of IWT is being given more attention and being treated as an important component of national 'sustainable' transport policies, in coherence with the broader EU umbrellas policies (see below). The German ministry responsible for transport notes that the 240 million tonnes of bulk goods transported per year via the German Federal waterways, (equivalent to between 60 and 65 billion tonne-kilometres) equals almost 90 percent of the goods transported by railway in Germany or about 14 million truck journeys. Moreover, some 1.5 million twenty-foot equivalent units (TEUs) of

containers carried via inland waterways correspond to another 700,000 truck journeys.[6] As a result of the new emphasis given to waterways, the German Federal Government approved an increase in funding for investments in IWT infrastructure over the next few years of about EUR 800 million/year, which is approximately double the annual real level that was invested in the 1990s.

Similarly, the Netherlands has published an impressive strategy for the sustainable development of IWT in the form of a Policy Letter[7]. It sets out 34 measures, including 10 new policy initiatives. The strategy seeks improvements in all aspects of the industry, including a comprehensive Waterways Management Plan, recovery from the waterway maintenance backlog, improved traffic management on waterways, new construction, port and terminal development, innovations in vessel design, improved environmental performance throughout the industry, safety measures, river information systems and research and development. The strategy emphasizes the need for concerted action by many stakeholders in the IWT industry, with the Dutch government co-ordinating, but not necessarily leading, all the individual measures.

Collectively, Germany, the Netherlands. Belgium and France appear to be investing around EUR 1.5 billion/year in the IWT system, though no precise estimate has been made for this Study.

International River Commissions

Central Commission for Navigation of the Rhine: The most important of these commissions by far is the Central Commission for Navigation on the Rhine (CCNR). It was established by the authority the Congress of Vienna in 1815 which was responsible for creating a new European political settlement after the Napoleonic Wars. The CCNR is the world's oldest international organization. Its members are Switzerland, France, Germany, Belgium and the Netherlands. Its responsibilities and modes of working were further set out in the Convention of Mannheim in 1868.

CCNR's main tasks are to safeguard freedom of navigation and to monitor uniform technical regulations on the Rhine and its tributaries[8]. The chairmanship of the CCNR revolves among its five members on a two-yearly basis and all of its resolutions are by unanimous vote. The functions of CCNR are to:

- promote freedom of navigation, equal treatment of ships of all nations, exemption from any taxes and duties on navigation[9], absence of physical or administrative obstacles to navigation, and commitment to maintain the navigability of the waterway;
- ensure the safety and environmental acceptability of IWT;
- establish policing and inspection regulations, transport regulations for dangerous cargo, regulations for accrediting vessels captains and for radiotelephony usage;
- monitor major river projects and structures built (by member countries) across the river(s);
- promote the economic prosperity of IWT on the Rhine through proposals made by the governments of the member States;

[6] http://www.bmvbs.de

[7] Ministry of Transport, Public Works and Water Management: Setting the Course for a Strong Economy: A Safe and Sustainable Inland Navigation (2007)

[8] The CCNR's website is at http://www.ccr-zkr.org

[9] The Congress of Vienna established this principle in 1815, following seventeenth century experience when each city and principality through which the Rhine passed charged its own toll: a vessel that traveled from Basel to Rotterdam could pay more than 100 separate tolls.

- examine proposals made by the member States, particularly those proposals which aim at completing or amending the Mannheim Convention;
- examine any complaint about the implementation of the Mannheim Convention and the enforcement of regulations or measures decided and jointly agreed upon by the five governments.
- administer a European Agreement concerning working conditions of boatmen on the Rhine;
- liaise with other relevant international organizations.

Danube River Commission: The second important river Commission, though less powerful than the CCNR, is the Danube Commission (DC)[10]. This was established by the Belgrade Convention in 1948 and consists of Austria, Bulgaria, Croatia, Germany, Hungary, Moldova, Slovakia, Romania, Russia, Ukraine and Serbia. Under the Convention, the member countries undertake to maintain their sections of the Danube in navigable condition, to carry out works for the maintenance and improvement of navigation conditions, and not to obstruct or hinder navigation. However, the Danube Commission's powers are advisory and decision-making powers remain with its member countries.

The Danube Commission:

- prepares a general plan for navigation works on the basis of proposals and projects presented by the DC Member States and Special River Administrations[11] and, likewise draws up an evaluation of the costs of such works;
- consults with, and makes recommendations to the Member States in respect of the execution of the above mentioned works;
- consults with, and makes recommendations to the Special River Administrations and exchanges information with them;
- establishes a uniform system of traffic regulations on the whole navigable portion of the Danube and, taking into account the specific conditions of various sections of the river, lays down the basic provisions governing navigation on the Danube, including those governing the pilot service;
- unifies the regulations governing river, customs and sanitary inspection;
- harmonizes regulations on inland navigation with the European Union and the CCNR (the Danube and Rhine systems are connected by the Main canal);
- coordinates the activity of hydro-meteorological services on the Danube, and publishes short-term and long-term hydrologic forecasts for the Danube;
- collects statistical data on aspects of navigation on the Danube within the Commission's competence;
- publishes reference works, sailing directions, nautical charts and atlases for purposes of navigation.

Other River Commissions: Other International River Commissions include the Moselle Commission which was established in 1957 (Luxembourg, France, Germany) and the Sava Commission established in 2002 (Slovenia, Croatia, Bosnia & Herzegovina and Serbia). These are minor waterways compared to the Rhine and Danube.

[10] The Danube Commission's website is at http://www.danubecom-intern.org

[11] The Belgrade Convention also established Special River Administrations on specific sections of the Danube to execute and administer major hydraulic works affecting more than one member state and administer navigation in their vicinity: the Special River Administrations contained only those member states.

While some members of the River Commissions are also members of the EU, not all of them are. Within the CCNR, Switzerland is not an EU Member State. In the DC, more than half the members are non-EU Member States. These are Croatia, Moldova, Russia, Ukraine and Serbia. The EU does not have any legal jurisdiction over either of the River Commissions, though, by invitation, it is an observer at them.

It should be noted that while the CCNR and DC are responsible for navigation, there are other international agreements that affect the environmental quality, protection and management of European waterways.

EU responsibilities

The EU's responsibilities and policies for IWT in EU Member States cover six areas:

- functioning of and access to the IWT market;
- safety and technical regulations;
- specific policies and programs including 'Marco Polo', River Information Services (RIS); the EU program for Navigation and Inland Waterway Action and Development in Europe (NAIADES); and Trans-European Network policies and projects. (These programs are discussed further in Chapter 4)

Functioning of and access of IWT shipping companies to the market: In terms of market functioning and market access, common rules are applicable to the transport of goods or passengers by inland waterway, and all other modes, between EU Member States with a view to establishing freedom of market entry to provide such transport services. All carriers of goods or passengers by inland waterway have the right to carry out transport operations between EU Member States, and in transit through them, without discrimination if (a) they are registered in a Member State in accordance with the laws of that State; and if (b) they are entitled to carry goods or passengers by inland waterway on an international basis and also if for the purpose of those transport operations, they used a craft that was registered in a Member State.

These provisions do not affect the rights of third country carriers on the Rhine and the Danube under the Mannheim Convention or the Belgrade Convention.

EU rules for access to the profession of IWT involves two principles: proof of professional competence and the mutual recognition of diplomas, certificates and other credentials

- Professional competence means that the carrier of goods by inland waterway must prove that they possess the necessary knowledge in certain areas; e.g. of law, commercial and financial management, access to the market, technical standards and operation, and safety. Provision is made for certain exceptions in special cases. Knowledge may be acquired either by taking courses or by acquiring practical experience in an inland waterway transport company, or by combining the two systems. The national authorities note that knowledge and then issue a certificate.
- The professional competence certificates issued by Member States must be recognized by the other EU Member States. When an EU Member State also requires its nationals to meet certain conditions it will accept equivalent documents issued to nationals of other Member States as sufficient proof.

The directive is limited to the carriage of goods (not passengers) and does not apply to ferries or to operators of vessels of 200 tonnes or less.

Safety and technical regulations – boatmasters: The EU has standardized the conditions under which national inland waterway boatmasters' certificates are obtained for operations between the Member States. This is to combat distortions of competition among carriers and to enhance inland waterway safety. It introduced a 'model' boatmasters' certificate for the carriage of goods and passengers by inland waterway that is issued by the Member States. The certificate is valid for all EU waterways, except for those waterways covered by Rhine boatmasters' licenses under the Mannheim Convention. However, the latter licenses are valid for all of the Community's waterways.

The conditions for obtaining a certificate include, among others: proof of physical or mental fitness by means of a medical examination; proof of professional experience (four years' minimum as a member of the bridge crew on board an inland waterway vessel); passing an examination to test professional knowledge (such as a knowledge of navigation, vessel maneuvering and operation, vessel machinery, loading, etc.).

These provisions apply to all masters of inland waterway vessels (self-propelled barge, tug, pusher craft, towed barge, pushed or side-by-side convoy) intended to carry goods or passengers. They do not apply to goods-vessel masters where their vessel is less than 20 meters long or to passenger vessels carrying less than 12 passengers.

Safety and technical regulations – vessels: The EU has established an EU-wide certificate for inland waterway vessels that validates the compliance of such vessels with common technical requirements that are valid for all EU waterways, apart from the Rhine. By contrast, The Rhine certificate covers the Rhine and (because it is a superior certificate) all other EU waterways. The EU certificate is then issued to vessels by the relevant authorities in the EU Member States, following a technical inspection. The European Commission is currently proposing that a single system of technical requirements be introduced for all Community waterways, including the Rhine. This harmonization would bring about equivalence between the EU certificate for inland waterway vessels and the Rhine certificate.

United Nations Economic Commission for Europe (UNECE)

The UNECE promotes economic development in Europe as a whole. Its work in the IWT sector is largely concerned with agreement and compatibility of standards for international movements of goods between individual European Countries. This work has also evolved to similarly cover standards between the EU and non-EU countries of Europe. Many aspects of safety and environment for IWT throughout Europe (not just EU) are covered by the UNECE European Code for Inland Waterways (CEVNI) and the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN).

3.5 Assessment of International Experience: Administration and Institutions

The EU arrangements are most complex, reflecting two geo-political realities: (a) that the commercially significant waterways in Europe are international waterways subject to international rights, obligations, and institutional arrangements that have been defined by international agreements and treaties between sovereign nations over two centuries; and (b) that the nations with interests in IWT in Europe include both EU and non-EU member countries which creates a further challenge to both policy harmonization, technical regulation and economic integration.

The administration of IWT in the EU is therefore fragmented and cumbersome. The EU itself describes the current institutional framework for IWT within the EU as having a '*patchwork of resources and efforts, overlapping regulatory activities, frictions and duplication of work, insufficient strategic management, low political impact'*. It also notes that the EU can only adopt binding rules for EU Member States while the Rhine's River Commission can only adopt binding rules for the Rhine, and the Danube Commission cannot adopt binding rules at all.

The USA is, in principle, a much better comparison for China. In both China and the USA, the IWT systems are predominantly sovereign national waterways. Moreover, both countries are federal in nature with strong sub-sovereign divisions of government. In China these sub-sovereign divisions are the Provinces and in the USA they are the States. Nevertheless, despite these similarities, the approaches that the USA and China have adopted to sector governance are quite different.

In the USA, the Federal Government (through USDOT MARAD) is responsible for overall IWT policy. But the management and operation of the IWT network is almost wholly delivered by a single, integrated military agency, the US Army Corps of Engineers. The States themselves have no executive role in IWT policy or administration of navigation infrastructure, except through consultative mechanisms and contributing to the funding of projects which they might sponsor.

Some of the key areas for comparison and assessment of USA and China's approaches are described below.

Civilian or military administration

One interesting feature of the USA system is its management by the military. In this regard it is something of an international oddity. It appears to work reasonably well in terms of efficiency of administration, and certainly in terms of coordinated management of the many water resource issues, but is based on historical factors and the development of specialized structures, processes and skills built up by the USACE over 180 years.

However, if this military structure did not already exist, the US government would be unlikely to choose it today as the most appropriate administrative model for a civil transport network. All other transport networks in the USA use civilian administrative models and it has been proposed in the past (though not accepted) that USACE functions should also be subject to overall supervision of the USDOT.

It seems appropriate and advantageous that China's waterways continue to be administered by civil authorities.

Centralization or decentralization of responsibility

One of the advantages of the USA system is that centralization has delivered a nationally integrated system of administration and development. In China, administration of much of the IWT system has been decentralized to provincial governments and this has undoubtedly created challenges to attaining consistent policies and coordinated actions. However, this does not mean that a single national waterway authority, as in the USA, would provide a better solution for China.

The context in China differs from that of the USA, in two main ways:

- the navigable inland waterway system in China is much larger than in the USA and China has at least three substantial waterway networks in its IWT system (Yangtze and Pearl Rivers, plus the Grand Canal/Huaihe River system), whereas one main integrated system, in the Mississippi basin, dominates the core IWT network of the USA;

- in China, average freight trip length is much shorter than in the USA, and some parts of the IWT classified freight network are of higher provincial significance than national significance.

These factors suggest that a single centralized administration would not necessarily be a better solution for China. China's division of administration, in which MOT is responsible for IWT infrastructure on the main waterways of the two most important rivers, the Yangtze and the Pearl, through specialized River Administrations, while provincial governments administer the rest through provincial navigation administrations, is logical and appropriate for China.

However, as will be seen, there are inconsistencies and a lack of harmony between provinces in the application and implementation of policies and standards in areas such as vessel licensing, environmental compliance, pricing and cost recovery etc. There is certainly a need for attention to attaining consistency and much better co-ordination in the administration and management of the IWT networks. But this seems to be a question of making the existing structure work better, rather than dispensing with it.

Consultation among stakeholders

A big policy challenge to China's vast and diverse IWT industry is to ensure that public policy makers involved in providing navigation infrastructure and in regulating the industry do not become too remote or disconnected from the barging industry that provides the transport services on the waterways. There is a strong case for a regular high level consultation with barging industry providers (including both large and small operators), industries that rely on IWT services, and port operators. It would be advantageous if these groups were consulted with regularly to try to bridge this gap.

The USA provides a useful example of structured stakeholder input into the governance of inland waterway navigation in the form of the Inland Waterways User Board (IWUB). The IWUB is an industry advisory committee, but with its authority established by law. The composition of the Board is balanced between freight customers and barge companies of different sizes which specialize in different commodities.

In the EU there have also been established mechanisms for structured consultation between industry stakeholders. The European Union's "NAIADES" Action Program (described in Chapter 4) is intended for the period 2006–2013 and focuses on five strategic areas for a comprehensive IWT policy: Market, Fleet, Jobs and Skills, Image and Infrastructure. Apart from formal channels for consultation between policy-makers, infrastructure suppliers and the barging industry, all the main Program reports have been made publicly available and comments are invited on proposals and activities.

The Netherlands Strategy for the Sustainable Development of IWT also puts strong emphasis on the need for partnership and co-operation between all the parties in the industry to realize the overall strategy. Many parts of the Dutch strategy will be primarily the responsibility of other stakeholders, with the Government undertaking a co-ordinating role.

Chapter 6 of this Report emphasizes the importance of harmony between China's IWT infrastructure providers, port authorities, barging industry and freight customers to the sustainable development of its waterways and recommends that MOT consider if there are ways of creating better consultation mechanisms between industry stakeholders.

Chapter 4. International Experience - Policies and Programs

4.1 Summary of Main Policy Objectives and Programs

Table 4.1 summarizes the main stated strategic aims of IWT policy in each region and the main programs by which those aims are sought to be achieved. More detail of each is given in subsequent sections and in references cited.

Table 4.1: Stated Strategic Objectives and Programs

CHINA	USA	EU
Strategic objectives: • to increase the utilization of IWT by substantially upgrading the waterway system by 2020: -increase Class III+ from 8,687km to 14,300km -increase Class V+ from 24,000 to 36,000 km; • and to promote a more efficient and effective fleet of vessels	**Strategic objectives:** • USDOT transport objective to alleviate transport congestion by increasing use of IWT and intermodal transport using IWT • main sector objective stated by MARAD is to protect the industry and preserve it for US operators/ships/crews	**Strategic objectives:** • to promote and strengthen the competitive position of IWT to help create a more sustainable transport system overall • to overcome bottlenecks and increase connectivity of waterways of EU-wide significance
Programs: • Long-term Waterway Development Plan to 2020 • 11th 5-year plan to 2010 • Vessel standardization program • Early framework design for an integrated river information service	**Programs:** • USDOT Strategic Plan 2005-2011 and MARAD Strategy 2003-2008 • Coastal and River Information Services development and implementation (CRIS)	**Programs:** • National programs, plus • Navigation and Inland Waterway Action and Development Plan in Europe (NAIADES) • Marco Polo Program • Trans European Network program (TEN-T)：2 IWT projects • Harmonized River Information Services (RIS)

4.2 China

IWT sector objectives

The Government of China considers that, compared with road and railway transport, IWT has many advantages in terms of limited land consumption, better energy efficiency and pollution prevention. Therefore it will be beneficial to increase the development of IWT. Although China does not yet have an overall transport strategy encompassing all modes of transport, this objective is implicit in a number of IWT sector policy and program developments that have given IWT increasing prominence over the last decade.

Navigation infrastructure program

In 1999, MOT commissioned a study named **the Development Strategy of IWT Sector**. This study reviewed the development of IWT in China since 1949, analyzed the condition of rivers, and the present situation of IWT, and proposed future goals taking into account the experiences of other countries. It set out a series of suggested development strategies and safeguard measures with construction of improved standards of waterway as the core component.

In MOT's 2002 study **the Development Strategy for Waterway and Road Transportation**, an 'inland waterways advantage strategy' was proposed which would take into account the natural properties and industrial regions, their economic development level, and waterways system by proposing transport measures that would support sustainable development. The objective was to make full use of the advantages of IWT, to attain higher classified waterways, greater standardization of vessel types, improved ports and berths, and an optimized and comprehensive utilization of water resources under the programs of the Ministry of Water Resources and in association with other agencies.

In 2005, MOT agreed with seven provinces and two municipalities along the Yangtze River to jointly construct the Yangtze River 'golden waterway' to promote the economic development in Yangtze River area. The Yangtze River IWT Co-ordination and Steering Commission was established. Under the auspices of the Commission, an overall promotion plan for the Yangtze River waterway construction during the 11th Five Year period (2006-2010) was approved. This is the guiding document for development. This plan indicates six core projects of navigational waterway regulation, port construction, ship design standardization, Three Gorges navigation capacity measures, safeguards, and coordinated measures with provincial waterways. Under this program, MOT will strengthen the main channel improvements in the Yangtze River and support other important provincial branches, and common-user berths construction in western areas. Construction of the Yangtze 'golden waterway', as well as the Yangtze River Delta and Pearl River Delta high class waterway networks is being implemented as part of the 11th Five Year Plan.

Figure 4.1 shows clearly how, since 2002, the increasing policy attention paid to the advantages of IWT has resulted in increasing infrastructure investment.

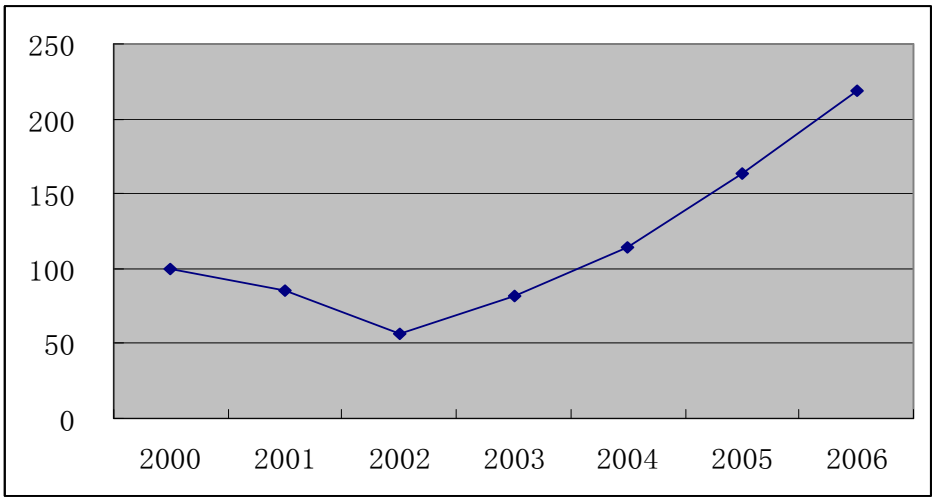


Figure 4.1: Index of Total Investment in IWT Infrastructure (Year 2000=100)

In 2007, the NDRC and MOT co-issued the NIWPP2020 which further evaluated the present situation of inland waterways, ports and transportation, analyzed the advantages and functions of IWT, and proposed

a comprehensive long-term future inland waterways and ports plan to 2020. The Plan details improvements to each of the main IWT systems in China (those based on the Yangtze River, Pearl River, Grand Canal/Huaihe River, Heilongjiang/Songliao Rivers and the Minjiang River). In each case it is taking a network approach of creating interlinked, high standard routes. The improvements include a mixture of channel dredging, upgraded and new locks (many combined with hydropower generation facilities), ship lifts, and new and upgraded terminals for both bulk and container traffic. The planned 'high class' waterway (Class III and above), when complete, will be around 19,000 km compared to less than 9,000 km in 2006. The high class system will extend to 20 provinces, including 56 cities with populations greater than 500,000, and will serve as a catchment area that contains approximately a quarter of the population of China.

The Plan acknowledged the importance of supporting policies that:

- seek to secure a stable long-term financing model;
- seek external sources of finance;
- enhance co-operation with other relevant departments in the areas of shipping services, power supply, flood control, irrigation and water supply;
- enhance the planning of ports;
- strengthen measures to standardize and modernize the vessel fleet;
- increase and improve the application of information technology to IWT management;
- ensure safety and environmental performance;
- attain a sustainable development of the system.

Vessel modernization program

Due to concerns about congestion and other environmental and safety concerns in the key inland waterways of the Jinghang Canal and the Yangtze River Delta, MOT has been pursuing a policy of vessel standardization. In 2004, MOT carried out a series of studies concerning 'inland waterways ship design standardization'. The study undertook a sample survey of the fleet situation in China's main inland waterways, and proposed the future development goals for the inland waterways fleet and incentives for their achievement.

MOT took the view that the wide array of ship types in the canal with low average tonneage, were causing congestion in the waterways and locks thereby reducing their effective capacity and utilization and contributing to delays. This was rendering the IWT less competitive. About 40,000 small, 'hang-screw' motor-boats using the Jinghang Canal and the Yangtze River Delta were singled out as one of the primary contributors to congestion and water pollution.

Since 2004, the standardization of vessels in the Jinghang Canal has been formally promoted. From July 1, 2004, concrete vessels were prohibited completely from entering the Jinghang Canal. Also effective from January 1, 2007, hang-screw motor-boats were prohibited from entering the Canal. They were encouraged to be scrapped and replaced, with financial assistance, by more standard vessels meeting suitable safety and environmental standards.

The ***Outline of Inland Waterway Vessel Standardization*** was issued by MOT in June, 2006. It indicates that by 2010, standardization of vessel models will be substantially achieved on the Chuanjiang River and Three Gorges reservoir, Jinghang Canal, Yangtze River and Pearl River Delta as well as their mainstreams. Also the average tonneage per vessel will be doubled, compared to 2006, and safety performance will be further improved. By 2020, it is intended that standardization policies should be

complete, by which time the average tonneage per vessel will have been increased twice, and technical performance and vessel safety will be approaching or at international standards. MOT intends to set up a series of measures to attain this goal including economic incentives through a specific subsidy and compensation mechanism.

Meanwhile, it is also intended to use economic and administrative measures (such as differential charges and lock priority rules) to facilitate the elimination of non-standardized vessel types. Central and provincial governments will also provide financial support for promotion of standardization of inland vessels as well as research and development of standardized vessel models. Provincial governments are to provide financial support for elimination and withdrawal of obsolete vessels.

MOT is also working more broadly on developing a program on transportation energy-saving. The energy-saving target for IWT vessels is presented in the MOT document '*Some Opinions about Promoting Modern Transportation Industry Development*'. The current target is, by 2010, to reduce by 10 percent the unit energy consumption of IWT vessels (compared to a base of 2005). Removing obsolete and sub-standard vessels, such as the 'hanging-engine' vessels from major waterways, will assist this aim.

IWT infrastructure cost recovery policies

It is not clear that China has an explicit cost recovery policy for IWT as such, though the trends in recent years suggest that it has intended to minimize funding from the Central Government budget and increase the use of special purpose funds, provincial funds and income earned by navigation authorities from user charges (of various kinds) as well as from ancillary income such as the sale of hydro-electric power. Moreover, there is no statement of overall sources and uses of funds in the sector, or the net revenues contributed by the IWT industry towards the construction and financing costs of infrastructure projects, so any statements that the Report makes in this area are somewhat speculative.

However, it is clear that the funding system is changing. Before 1995, the funding for construction, maintenance and management of inland waterways depended mainly on government subsidy and navigation charges and lock charges, but these proved insufficient. In 1995 the Government established a IWT Construction Fund with an allocation of income hypothecated from various transport charges, such as vehicle purchase surcharge, port construction dues, and waterways passenger and freight surcharges. This national fund was used for the construction of Yangtze and Pearl River improvements and Jinghang Canal projects.

At the same time, according to what is known as the principle of 'comprehensive planning, strips and blocks combining together, delegation of responsibility and coordinating construction', provincial governments were encouraged to raise their own funds for IWT through user charges, from power generation income from dams, and cross-subsidy from land transport modes. The model of 'coordinated power generation and IWT' was encouraged. Large enterprises (such as power generation enterprises) were also encouraged to invest in inland waterways construction according to the principle that 'the investor makes the investment decisions, reaps the profits and bears the risks'.

While the funding mechanisms appear obscure, they have underpinned some success to date. Since 1991, the investment in inland waterway construction has increased very rapidly. By 2006, the total investment in inland waterway construction was 9.1 billion yuan, about 30 times the level in 1991.

Before 2001, governments (national and provincial) had been the most important source of investment financing and about 80 percent of investment was financed by governments. After 2002, the percentage

began to decrease, to only 54 percent by 2006. The amount of this funding that was sourced from the Central Government budget was negligible. Conversely, loan financing was used for less than 5 percent of the total investment in 2001, but was 39 percent by 2006, most of it consisting of loans taken by provincial governments.

Table 4.2 summarizes total investment and financing sources for the years 2004-2006. Financing sources do not necessarily coincide with ultimate funding sources, and no data has been made available to the Study of how much of loans and enterprise income is from the IWT industry, or how much of the loans will be repaid by income from users. However, it seems probable that in practice, most loans will be paid back from government budgets, not from users income. The total capital cost recovery from users is probably no greater than about 10-20 percent. The Report considers the security of funding as a key risk to sustainable development of the IWT system and it is examined further in Chapter 6.

Table 4.2: Total Investment and Financing Sources in IWT, China 2004-2006

	2004	2005	2006
TOTAL (CNY billions)	**5.147**	**7.362**	**9.852**
Proportions:			
National budget	0.3%	0.3%	0.1%
Domestic loans	38.7%	29.9%	39.0%
International loans	5.1%	2.1%	3.4%
MOT port construction fees	2.4%	11.0%	2.6%
MOT inland waterway fund	17.4%	14.6%	18.0%
Enterprises and institutes	4.6%	1.7%	2.3%
Provincial budgets	28.8%	40.0%	33.6%
Other	2.7%	0.3%	0.9%
TOTAL	**100.0%**	**100.0%**	**100.0%**

In terms of operating and maintenance costs of IWT infrastructure, the main sources of financing are the charges of the national and provincial navigation authorities, and include a waterway maintenance fee, profit from related activities (such as hydropower generation), local financial subsidies, other waterborne charges, and cargo port charges. The waterway maintenance fee is thought to fund about 50 percent of the total maintenance cost, but this has not been verified. In addition, there is considerable default in the payment of this fee. The actual annual amount of waterway maintenance fee collected is about 70 percent of total accounts receivable. Taking account of this fee and other user-related costs, maintenance cost recovery may be in the range of 50-70 percent, though again this cannot be verified from the information available to the consultants. China officially started implementing the fuel tax in 2009, and accordingly stopped collecting the waterway maintenance fee, passenger and cargo transport surcharge, and waterway transport administrative fee. Specific fund is earmarked for construction and maintenance of waterways. Introduction of fuel tax is expected to effectively overcome tax evasions, and increase the assurance of funds for waterway construction and maintenance.

River information services

On most of China's IWT system there is limited use of Information Technology (IT). There are many 'blind-spots and bottlenecks', and many 'islands' where different application systems are used by different administrations. There is no basic standard for IT applications to IWT. The current status of the information services is as follows:

Navigation information: The navigation aids service usually is supplied through physical traffic signs and markers. The information on river conditions is compiled by navigation administrations, and is published in traditional media such as newspapers, TV and radio broadcast. It is also accessible through the websites of navigation administration, or by sending messages to captains via mobile phone. Generally, the operating companies or captains call the relevant navigation authority by VHF radio to ask the state of the river before they navigate through it. Sometimes, the navigation authorities inform the companies who in turn relay the information to vessels. In parts of the Yangtze River, the authorities supply GPS services to vessels which setup a receiving facility.

Traffic information, tracking and management: The maritime administrations can monitor the vessel in key segments of rivers through vessel tracking systems or closed-circuit television. In inland segments the authorities depend on patrol vessels to control the traffic.

Information on traffic loading: Large container terminals such as in Nanjing and Chongqing depend heavily on IT systems, often linked with customers, agencies and customers. The IT systems of larger shipping companies are also very advanced and they can track or monitor the cargo transported by their vessels. Many small ports are managed through more traditional methods with the cargo information recorded manually or by isolated computers.

Statistics: In some key river segments, maritime administrations capture vessel data and cargo information, but the information is recorded in isolated system, and cannot be shared.

Charging data: Navigation authorities levy charges from shipping operators through payment stations set up in ports or on patrol vessels.

To upgrade the application of ITA technology to IWT, a river information service (RIS) project started in 2007. The first stage of the project, framework for the development of RIS in China, has been completed. The second stage is to implement a demonstration system in the upper reaches of Yangtze River (Chongqing to Yichang). The third stage will be to extend a successfully tested system to all of the Yangtze River system. The final stage, which is clearly in the long-term, is to extend the system to all inland waterways of China. The functional priorities for development are for navigation information, traffic control and tracking information, especially for dangerous goods cargo.

4.3 USA

IWT sector objectives

MARAD's main stated objective is to improve and strengthen the USA marine transportation system, including infrastructure, industry and labor, to meet the economic and security needs of the USA. Following the 1920 Merchant Marine Act (also known as the Jones Act), MARAD promoted the development and maintenance of a US-owned, built and crewed domestic fleet of vessels sufficient to carry all domestic waterborne commerce and a substantial portion of its waterborne foreign trade. This fleet was also to be capable of service as a naval and military auxiliary in time of war or national emergency. MARAD also seeks to ensure that the USA maintains adequate shipbuilding and repair services, efficient ports, effective intermodal water and land transportation systems, and reserve shipping capacity for use in time of national emergency.

MARAD also gives particular weight to the goal of commercial mobility by reducing congestion on the nation's inland waterways, marine channels and landside infrastructure. USDOT policy on IWT is based

on the concept that the waterway system could help alleviate some congestion in the land-transport system.

IWT programs and measures

Those parts of MARAD's own published strategy (2003-2008) that that are most relevant to IWT, include measures to:

- preserve USA cabotage laws which, among other things, preserve the IWT for US owned, built and crewed vessels;
- support maritime education institutions and the development of public-private partnerships to expand maritime education and training;
- work closely with state and local governments to implement programs to educate the public regarding the importance and impact of the maritime transportation system;
- manage financial assistance programs in an effective and efficient manner to preserve and protect the interests of the government while maximizing flexibility and efficient operations for the private sector;
- enter into partnership with public and private organizations to increase the use of waterborne transportation to relieve landside congestion, improve overall transportation safety and mitigate environmental problems;
- enter into partnership with industry, state, and local governments, and other Federal agencies to identify new business opportunities for US inland, domestic, and international maritime industries;
- foster public-private partnerships to improve land and waterside access to ports and marine terminals and transportation infrastructure;
- partner with industry and other government organizations, both foreign and domestic, to reduce barriers to inter-modal transportation through the adoption of safe and environmentally responsible national/international containerized and non-containerized standards;
- transfer surplus Federal property to State or local ports to improve services at those facilities. Support efforts to eliminate unnecessary US regulatory standards, to reduce major bridge impediments that restrict full utilization of navigable waterways, and to assure effective solutions to environmental issues, including dredging, which inhibits the throughput of US ports and waterways;
- support and facilitate development of innovative, safe, secure, and environmentally sound vessel designs, technologies, shipbuilding processes, and consensus standards to improve US maritime efficiency;
- exercise leadership in working with national and international partners to develop and implement marine transportation related to national and international environmental standards and requirements;
- adopt transport policies and promote marine related technologies and systems that reduce degradation of environmental quality;
- serve as a catalyst with Federal and state agencies and stakeholders to conduct research and identify, demonstrate, and promote energy efficient, alternative fuels, and air pollution reduction technologies for maritime applications;
- work proactively with transport partners to implement integrated multi-modal approaches to resolve transport challenges that harmonize transportation and environmental protection goals and enhance inter-modal transportation planning tools through the development and use of multi-modal models that incorporate environmental impact considerations;

- partner with Federal and state environmental regulatory agencies and the private sector to develop guidelines and best management practices to assist maritime industry partners in improving environmental stewardship and compliance;
- continue to partner with other Federal agencies and stakeholders to establish appropriate testing protocols and test and verify ballast water treatment technology to reduce the introduction of aquatic nuisance species.

IWT Infrastructure cost recovery policies

Vessels using the US inland waterway system pay vessel licensing fees, harbor (port) maintenance fees, inspection fees and a fuel tax on commercial vessels.

Of these, the fuel tax is the intended main mode of cost recovery of the capital costs of IWT navigation infrastructure. The funds for financing the USACE's civil works program on inland waterways come from a Federal Energy and Water Development budget, not the Defense budget. To help recover these costs, the fuel tax was introduced by the 1978 Inland Waterways Revenue Act on designated waterways. The tax was established in 1978 at a level equivalent to US$ 1.06 cents/liter. The 1986 Water Resources Act increased it progressively to US$ 5.3 cents/liter by 1995. It remains at the 1995 level and accordingly its real value has since progressively declined.

The fuel tax revenue is used to replenish an Inland Waterways Trust Fund held by the US Treasury. The Fund is available, through the budget appropriation process, for construction and rehabilitation expenditures for navigation on inland and coastal waterways. It currently generates around US$ 100 million per year.

However, the 1986 Water Resources Development Act also established that not more than 50 percent of construction costs can be funded from the Trust Fund. Project sponsors are, in principle, required to supply at least half of the funding need. After building up in the 1990's, the balance of the Inland Waterways Trust Fund has fallen markedly in recent years reaching a balance at the end of 2006 of about US$ 240 million. This has been ascribed to lack of industry growth, industry consolidation, fewer empty voyages, better vessel utilization, more fuel-efficient vessels and less long-haul grain transport. But construction costs of IWT infrastructure have increased substantially since 1995 as the purchasing power of the fuel tax, fixed since 1995, has been reduced by inflation by up to a third.

The Trust Fund is only used for capital investment in construction or major rehabilitation of infrastructure. The costs of operations and maintenance costs are mainly funded by taxpayers. These costs may be 3-4 times as high as the Trust Fund revenue, taking account of both capital and recurrent expenditure, while the annual level of recovery of USACE's total inland waterway expenditure is probably somewhere between about 10-15 percent. However, the operations and maintenance costs of waterways are not solely attributable to IWT. These expenditures also provide flood mitigation, recreational uses, drinking water, hydropower, wetland conservation and other benefits. Even within the IWT sector only commercial freight boats contribute to the Trust Fund. Ferries, passenger boats and recreational users do not pay the fuel tax or contribute to the Inland waterway Trust Fund.

The proportion of costs which is not recovered from users is funded by Federal taxpayers. With much inland waterway infrastructure ageing, costing more to maintain or requiring early rehabilitation, the current restricted financing regime may be a constraint on MARAD's strategies and measures to increase the role of IWT.

In April 2008, a proposal to phase out the tax and replace it with a User Fee was submitted for consideration by the US Congress. The User Fee would be based on a charge per barge for each use of locks, whether the barge is full or empty, and would tend to encourage more efficient utilization both of vessel capacities and lock facilities, as well as generating revenues.

River information services

The USACE already has a comprehensive Navigation Data Service[12]. It is now planning to develop a number of new waterway management and safety sub-systems based on Automatic Vessel Identification Systems (AIS) technology. The objective is to develop, integrate and implement Coastal and River Information Services (CRIS) that will transmit real time operational data to and from vessels. The information will include electronic navigation chart updates, availability and queues at locks, real time river current and wind velocities, dam water release information, navigation safety hazard notification, and information on vessels and commodities.

CRIS is still in developmental phase. There has not yet been a final agreement on how the program will be funded. The focal point for the establishment of CRIS has been agreed to be the Federal Committee on the US Marine Transportation System (CMTS). CMTS is a partnership of Federal government agencies established in 2005 with responsibility for the Marine Transportation System– waterways, ports, and their inter-modal connections – to ensure that the development and implementation of national marine transport policies are consistent with national needs.

CRIS is likely to progress under the umbrella of CMTS through specific collaboration between the USACE, the US Coast Guard service (USCG) and the National Oceanic and Atmospheric Administration (NOAA). As all three services will benefit from the sharing of the developmental and infrastructure costs of the system, it seems probable that CRIS will progress through use of the budget appropriations made to these three organizations in proportions yet to be agreed.

4.4 European Union

IWT sector objectives

The EU is trying explicitly to put the concept of sustainability at the center of its transport strategy. Its 2001 Policy Paper proposed measures aimed at revitalizing the railways, promoting sea transport and IWT, and controlling the increase in air transport. These measures were designed to restore the balance between different modes which were thought to have inclined too far towards road transport. However, of 60 measures proposed, only 4 related to IWT and they were fairly modest:

- to eliminate IWT bottlenecks;
- to standardize technical specifications in IWT;
- to harmonize pilots' certificates and the rules on rest times;
- to develop navigational aid systems.

The EU's 2001 policy was subject to a major review and update that began in 2005 and is still in progress. The review is an opportunity to examine how the EU's 2001 Sustainable Transport principles

[12] http://www.ndc.iwr.usace.army.mil/

have worked in practice[13]. The most pressing challenge that had been identified in the 2001 Policy Paper was the imbalance between different modes of transport. However, the review admits that in this regard, things have deteriorated since 2001. For example, IWT traffic has not increased significantly over the period since the 2001 Policy, while road freight transport in these countries increased by around 15 percent. The review estimates that road congestion has escalatet to the point where each year it is costing the EU one percent of GDP. The most favorable view that can be taken is that EU policies may have very marginally slowed down the shifting modal share towards road transport.

The review also acknowledges that GHG and global warming has become more prominent and that the measures previously envisaged to be adequate by the Commission in 2001 are now deemed insufficient. The review therefore re-affirms the principles of 2001, but argues for a strengthening of the role of sustainability principles in policy. The review notes that it is necessary to:

- separate mobility from its side effects, (congestion, accidents and pollution);
- optimize the potential of each mode of transport, noting that some modes, including IWT, do not reach their full capacity;
- promote 'green' propulsion and encourage the use of more environmentally friendly, energy efficient and safer transport;
- promote co-modality, i.e. the efficient use of different modes of transport on their own and in combinations, resulting in an optimal use of resources.

On this basis, part of EU policy remains to promote IWT, short-sea shipping, railways, and intermodal transport and make them all more competitive with road transport. It argues that the role of IWT could be enhanced through its integration into co-modal logistics chains. In terms of implementation, the EU strengthened its Marco Polo Program, introduced a new program called NAIADES, and increased its efforts to sponsor trans-European transport networks. Two of these major projects are aimed at improving IWT. These three programs are summarized below.

Marco Polo Program

To shift the balance between modes of transport, the EU considered it necessary to adopt an active policy to promote inter-modality and transport by rail, short-sea shipping and IWT. It introduced the so-called 'Marco Polo Program[14] with an annual budget of (since updating in 2005) EUR 400 million for the period of 2003-2007. The funds were to be open to all appropriate proposals to shift freight from road to other more environmentally friendly modes such as IWT. EU funding is up to 35 percent of cost and depends on the number of tonne-kilometres transferred from road haulage to IWT, sea or rail transport, or alternatively, the number of vehicle-kilometres of road freight avoided.

Navigation and Inland Waterway Action and Development in Europe (NAIADES Program)

Following the 2005 Policy review, the EU initiated an Action Program called Navigation and Inland Waterway Action and Development in Europe, which has been shortened to NAIADES.[15]

[13] Details of the mid-term review of EU Transport Policy can be viewed at http://ec.europa.eu/transport/white_paper/mid_term_revision/

[14] Details of which can be found at http://ec.europa.eu/transport/marcopolo/

[15] Detailed documents on NAIADES can be accessed at http://ec.europa.eu/transport/iw/prospect/index_en.htm

The Program followed extensive consultations with both EU Member States and representatives and industry associations in the IWT industry. The Program recognizes the need for close co-operation with national authorities and the European River Commissions. It contains five strategic areas for action: market, fleet, jobs and skills, image and infrastructure.

- ***Markets***. The aim is to extend inland navigation services beyond bulk and containerized services to new growth markets such as the transport of dangerous goods, vehicles, indivisible loads, or even refuse and recycling, and river-sea services. The Commission hopes to encourage new multi-modal services, which require close cooperation with freight forwarders, affected businesses and the ports. NAIADES argues that problems related to access to capital are restricting financing capacity. It recommends that access to capital be improved by tax incentives, particularly for the most affected operators, namely small and medium sized enterprises (SME's). To promote the prosperity of the IWT sector, the policy endorses efforts to enhance and simplify the administrative and regulatory frameworks used for IWT in each country.

- ***Fleet***. NAIADES recognizes that even better environmental performance in IWT requires the use of new technologies, and in particular commercially viable alternative fuels. It also argues that safety, although already at high standards in the IWT industry, could be improved further. It recommends that the legal framework be enhanced so that new technologies can be implemented more quickly.

- ***Jobs and skills***. According to NAIADES research, there is a severe shortage of labor in the sector. The EU hopes to attract labor by offering to improve working and social conditions in the IWT industry throughout Europe. The policy proposes the mutual recognition of such qualifications throughout the EU and improved technical training to meet modern needs.

- ***Image***. The NAIADES Plan calls for increasing the general public and shipper awareness and knowledge of the potential of IWT in terms of quality and reliability. Promoting the sector would ideally result in the coordination of promotion activities by all the parties concerned. The European IWT promotion and development network is already in existence in some Member States. It notes that the EU and the CCNR are developing a European system for the observation or monitoring of the market, so as to provide better statistics about the IWT industry.

- ***Infrastructure***. Bottlenecks restrict the use of some inland waterways and reduce their competitiveness with other modes of transport. NAIADES asserts that removal of these bottlenecks is a priority. (See TEN-T Program below). The European Commission believes that funding opportunities could emerge in the long term on the basis of a framework for infrastructure charging for all transport modes. River Information Services should enhance the competitiveness and safety of IWT.

The Program notes that the current organization structure of the IWT in Europe is characterized by a fragmentation of resources and legal provisions. Although many of the organizations have engaged in co-operative efforts to promote IWT, NAIADES argues that the success of the program will depend on institutional and administrative reforms.

The Program is still in its early stages, but the first Progress Report of the NAIADES Program (December 2007) did not yet suggest any major transformation of the role of IWT. Some individual member countries have taken useful steps to promote IWT in the movement of urban waste and containers, there have been preliminary steps in preparing the way for the two TEN-T projects (see below), and there has

been 'social dialogue' on working time of vessel crews. But in 2006, only one IWT project was submitted for the Marco Polo Program and only EUR 9 million (CNY 90 million) of the TEN-T budget was used for IWT.

Trans-European Transport Network (TEN-T) policies and projects

The idea of Trans-European Networks (TENs) emerged by the end of the 1980s in conjunction with the proposed Single Market**,** and was adopted into EU Law by the Treaty of Maastricht in 1990. The networks involved were transport, energy and telecommunications networks. EU policy makers argued that the concept of a bigger, unified single European market could only be effectively realized if the various regions and national networks making up that market were properly linked by modern and efficient infrastructure. The actual construction of TENs was also considered by policy-makers to be an important element in economic growth.

The EU has developed guidelines covering the objectives, priorities and identification of projects of common interest for the Transport TEN (TEN-T). A large number of projects of common interest have benefited from financial support of the Community budget through the TEN budget, as well as the Structural Funds and Cohesion Fund for impending and new members of the EU. The European Investment Bank has also contributed to the financing of TENs projects through loans.

However, the EU admits that the results of the TEN-T concept have been disappointing to them. Plans for building and/or upgrading the TEN-T were less than a third complete by 2003. Therefore, in 2005, the EU announced a list of 30 priority axes (corridors) and projects for development of the TEN-T. It was hoped that a process of prioritization, and concentration of effort, would be more likely to deliver real physical improvements than continued discussions about a much longer 'wish-list' of projects for which there is insufficient money or enthusiasm.

The 30 priority projects were selected on the basis of proposals from EU Member States, according to the value that they add to EU economic integration and their *'contribution to sustainable development'*. The total cost of the 30 projects is estimated to be EUR 225 billion. It is thought unlikely that EU Member States could finance them on their own. The EU has therefore proposed to contribute a significant proportion of these costs from its own funds.

Of the 30 priority projects in the TEN-T program, there are two IWT projects:[16]

- ***The Rhine/Meuse-Main-Danube Inland waterway Axis***: this connects the North Sea at Rotterdam in the Netherlands and Antwerp in Belgium with the Black Sea at Constanta in Romania. It therefore involves Europe's two largest inland waterway routes, the Rhine and the Danube as well as the connection between them (the Main) and the junction into Belgium (the Meuse). The intention is to achieve a minimum draught of 2.5m throughout, allowing access to vessels of 3,000 DWT. The project also includes attainment of a 3.5m draught on the River Meuse that will allow movement of 6,000 DWT vessels between Belgium and the Rhine. In terms of its sustainable development objectives, the EU estimates that 5 billion tonne-kms of freight could be transferred to IWT by increasing the capacity of this link by 30 percent, with an accompanying reduction in vessel operating costs of between 20-30 percent. RIS will also be deployed throughout. The EU has agreed to contribute EUR 190.2 million towards this project

[16] Further project details and maps can be downloaded at:
http://ec.europa.eu/ten/transport/projects/doc/2005_ten_t_en.pdf

which is currently estimated to cost a total of EUR 1.9 billion, but which will probably have a final cost of at least EUR 2.5 billion.

- ***Seine-Scheldt Inland Waterway:*** This project will improve IWT between the Paris region and the Belgium, Netherlands and Luxembourg region waterways. It will remove the bottleneck that currently exists north of Paris where barges are in some places restricted to 400-750 DWT. The plan is to build a new large-gauge canal for about 100 km that will permit barges of 4,400 DWT which could reduce the freight costs of IWT vessels by about two-thirds. Belgium is planning corresponding navigation works north of the bottleneck. The French Government's financial contribution is to be financed by a national Transport Infrastructure Fund set up in 2005 whose income mainly comes from dividends earned from the government's shareholdings in expressway concessions. The EU has agreed to contribute EUR 420.19 million towards this project which has a currently estimated cost of EUR 2.5 billion and which will probably have a final cost of at least EUR 3.0 billion.

IWT Infrastructure cost recovery in the EU

Charges for use of IWT in Europe are determined at individual country level but are subject to any Treaty obligations as a result of the Conventions that established the River Commissions. As a result, under the 1868 Mannheim Convention, navigation charges are prohibited on the Rhine River, which carries nearly three-quarters of the EU's inland waterway traffic. Similarly, on Europe's second most important waterway, the Danube, which carries a further 10 percent of the EU IWT traffic, navigation is also free, as was agreed by the 1948 Belgrade Convention. The countries through which the Rhine and Danube pass do of course have registration fees for vessels, and individual river ports have their own port and pilotage charges, but these do not, of themselves, significantly fund navigation infrastructure.

Each country in the remainder of the European IWT network (i.e. excluding the Rhine and Danube) has its own individual set of navigation and other charges. These can include port, lock, canal and bridge dues, pilotage and charges for pushing and towing. These charges can have varying structures and levels and within each country these can vary according to the type and size of vessel, type and volume of cargo, or number of passengers, frequency of waterway use, and by time of day for congested facilities. However, in the biggest IWT country, Germany, not only are navigation charges not levied on the international waterways of the Rhine and Danube, but they are also not levied on the German stretches of the Elbe and Oder. However, they are charged on the Mosel under the Mosel Convention, and on some other waterways.

Although the charging systems differ by country, EU Member States have obligations under EU law not to discriminate in tariffs charged as between barging enterprises from their own or other EU Member States.

The revenues that are collected on the EU's waterways, in so far as they are levied at all, usually contribute only a small amount to their maintenance and management costs. With no navigation charges on the EU's biggest and busiest waterways, the overall level of cost recovery from the maintenance and management of navigation is inevitably very low. Even in the specific areas of Germany where navigation charges are levied, the level of recovery of the costs of those waterways is thought to be only about 25 percent. Overall, IWT infrastructure cost recovery, excluding the ports, over the EU as a whole is probably well under 10 percent.

However, as in China and the USA no consistent estimates of IWT infrastructure capital and operating cost recovery appear to be available. This is partly due to the difficulties of attributing infrastructure costs to IWT. In Europe, the other functions of rivers such as for recreation, water management, irrigation, industrial use and flood control probably account for the major portion of the public costs of infrastructure, construction and maintenance. Similarly, part of the costs of structures such as river and canal bridges are jointly attributable to the crossing mode of transport, either road or rail.

EU policy is to support the development of more transparent and consistent charging principles in all modes of transport. As a result, its objectives in IWT are, as for other modes of transport to develop common accounting and cost allocation methodologies for infrastructure, and common standards for charging, preferably reflecting marginal social costs. However, because of the methodological difficulties, the low level of marginal costs of IWT, and the fact that current (low) pricing policies are not thought to cause any significant distortion of competition, IWT infrastructure pricing is being treated as an area of low policy priority by the EU.

River information services

Like the USA, the EU is developing a comprehensive framework for integrated development and deployment of the Information Services on the EU's inland waterways. It sets out the obligation for Member States (which have inland waterways of a certain waterway class and which are linked to another Member State) to take the necessary measures to implement the Information Services as defined and sets the principles for their development.

The EU's RIS concept is intended to transform inland waterway transport into a transparent, reliable, flexible and easy-to-access transport mode. The RIS includes services such as:

- ***information on routes***: the information systems contain geographical, hydrological and administrative data that are used by boat masters and fleet managers to plan, execute and monitor a voyage (e.g., water levels, traffic signs, opening hours of locks);
- ***traffic information services***: these consist of tactical traffic information, in particular a display of the present vessel characteristics and movements on a limited part of the waterway, and strategic traffic information. This involves a display of vessels and their characteristics over a larger geographical area, including forecasts and analyses of future traffic situations;
- ***traffic management***: this is aimed at optimising the use of the infrastructure as well as facilitating safe navigation. Currently, the 'VTS centres' (vessel traffic service centres) are designed to improve the safety and efficiency of vessel traffic and to protect the environment;
- ***information for accident and emergency services***: these services are responsible for registering vessels and their transport data at the beginning of a trip and updating the data during the voyage with the help of a ship reporting system. In the event of an accident, the responsible authorities are capable of providing the data immediately to the rescue and emergency teams;
- ***information for transport management***: this information includes estimated times of arrival provided by boat masters and fleet managers based on fairway information making it possible to plan resources for port and terminal processes. The information on cargo and fleet management basically comprises two types of information - information on the vessels and the fleet and detailed information on the cargo transported;
- ***statistics and customs services***: the RIS will improve and facilitate the collection of inland waterway statistical data in the Member States;

- ***waterway charges and port dues:*** the travel data of the ship can be used to automatically calculate the charge and initiate the invoicing procedure.

Integrated standards and procedures for RIS are set out in EC Regulation No 414/2007[17]. The RIS in each country is to be implemented by the 'competent authority' which is responsible for arranging the funding. The competent authority will usually be the Navigation Authority or Commission, or Government Department responsible for regulation and safety of IWT in each country. The regulation allows neighboring countries to join together to establish a joint RIS if desired.

The competent authorities must supply to RIS users all relevant data concerning navigation on the inland waterways referred to above; ensure that electronic charts suitable for navigational purposes are available to RIS users; enable the competent authorities to receive electronic ship reports on the voyage and cargo data of ships; ensure that notices to boat masters, including water level and ice reports for the inland waterways, are provided as standardized, encoded and downloadable messages; establish RIS centers according to regional need; make available the VHF channels for the purposes of automatic identification systems; encourage boat masters, operators or agents of vessels shippers or owners of goods carried on board vessels navigating on their waterways to make full use of these new services.

The competent authorities in the EU are mainly budget-financed with minimal recovery of costs from users. Naturally, the barging industry will be expected to pay for on-board equipment necessary for using RIS. The recommended equipment is:

- a radio equipped for simultaneous reception on two VHF channels suitable for ship-to-ship and ship-to-shore;
- radar showing traffic that is in close proximity to the vessel;
- a PC with mobile communication facilities (GSM) for internet and e-mail communications, and for electronic reporting;
- an inland ECDIS device with electronic navigation charts (a) in information mode and (b) in navigation mode with a radar overlay;
- a vessel tracking and tracing system, such as inland AIS, with position receiver and radio transceiver using ECDIS visualization.

It is likely that the financing structure that will emerge in most countries is that individual country budget funding will be used for the development and installation of RIS infrastructure, while the barging industry will pay for the on-vessel equipment.

As noted earlier, by a recent EU decision (EC 2158) in 2007, the individual country funding of RIS may be partly supported by the EU's budget under the TEN-T Program. The first call for proposals from countries for EU support was made in December 2007, so it is too early to assess the scale of EU-level funding. If individual countries support RIS and apply for EU grants, then EU budget funding could be somewhere around 10-20 percent of total RIS development and infrastructure costs.

[17] The complete regulation can be downloaded from the Internet at:
http://ec.europa.eu/transport/iw/legislation/index_en.htm

4.5 Assessment of International Experience: Policies and Programs

Objectives of IWT policies

Transport strategies in the USA and the EU both contain the stated aim of increasing the role of IWT. China's NIWPP2020 also has this aim, though the greater unrealized value of IWT in China suggests that it has a more realistic basis for succeeding. The notion of a sustainable transport system for IWT is very strongly represented in the policies in the EU and its member states, although less so in the USA policies, while in China it appears to fall somewhere between these two regions.

In both the EU and the USA, the policy of increased utilization of IWT is favored as a way of attaining a transfer of traffic, or diversion of growth in traffic, away from road transport. In the EU this is explicitly argued to be a contribution to a more 'sustainable' transport system that is more energy efficient, environmentally friendly and which will generate less greenhouse gas overall. In the USA, the case for IWT is argued more on the financial grounds of taking at least some pressure off the imminent need to invest huge resources in the renewal of the US Interstate Highway System. Nonetheless, it is inevitable that any environmental benefits of channeling traffic from highway to IWT would be an incidental result of the policy, regardless of its main goal.

However, China does not yet have an integrated national transport strategy in which the objective of transferring traffic between modes is made explicit. Essentially, road haulage and railway sectors share the same aim. Even if it is not articulated, China is the only one of the three regions that is actually experiencing an increasing volume and modal share of freight carried by IWT.

China recognizes the environmental advantages of IWT, but the more compelling strategy behind transport investment policy in China is the need to increase investment and capacity in all transport modes, including IWT, to meet projected increases in freight traffic caused by continued economic growth. There is no overall transport strategy in China explicitly aimed at influencing modal shares, but there are programs within all modes to attain maximum affordable increments to system capacity and quality.

Long-term infrastructure development policies

China has a more comprehensive long-term infrastructure strategy than the other two regions. The current total scale of investment is higher than in the USA, though it appears to be somewhat lower than that of the EU, especially when EU Member Countries own national programs are included.

Of the three regions, China has in its NIWPP2020 the most ambitious long-term infrastructure strategy. China has an agreed network improvement program to 2020 with the investments planned to 2010 being implemented as part of the 11th Five Year Plan. However, although the total level of funding for IWT has been greatly increased, the sources of funding to fully meet the 2020 targets do not yet appear to be secure, and the program may be lagging as a result.

In the USA, the Strategy of the MARAD wishes to encourage greater private sector participation, but it is unlikely that the private sector will seek to take investment risks on very long term navigation infrastructure, other than perhaps in ports. The MARAD's strategy contains no major infrastructure upgrading component, nor has the USACE received funding appropriations for a major system upgrade. Indeed, the ageing of existing locks and other infrastructure is creating increasing lock closure time and the ability to maintain the current level of system capacity from the existing funding sources is questioned

by some, including by the USACE that is responsible for managing it. The development of the Coastal and River Information System will help make better use of existing capacity, but is unlikely to create a significant movement in modal shares.

The EU does have programs that are aimed at helping achieve its aims. But the Marco Polo grants for projects involving IWT have, in practice, been relatively small, and have not materially influenced aggregate IWT traffic levels. The recent NAIADES program also contains positive industry initiatives, but it does not have a large construction budget. The EU is also committed to supporting the funding of two projects in the Trans-European Networks (TEN-T) program. EU central funds will provide about EUR 610 million (about CNY 6.1 billion) which represents about a third of China's Central Government contribution to IWT in the 11th Five Year Plan. But the projects are at an early stage, are long-term, and the remaining funding, which is likely to be at least EUR 5 billion, is not yet secured.

Of the national programs in the EU, Germany and Netherlands also have ambitious IWT investment upgrade programs. The Netherlands Inland Waterway Strategy document (described in Chapter 3) may provide a useful reference for China's IWT policy makers as they consider how a long-term sustainable strategy for IWT might be comprehensively presented. However the content would of course need to be matched to China's different range of problems and faster growing markets. Increasing attention is being given in the Netherlands, Belgium and Germany to improving the interface between IWT and major seaports to create opportunities for onward distribution/collection of international freight by inland waterways. China's IWT planners may find it productive to study such developments in more detail.

In overall terms, China has a more ambitious program with a higher degree of commitment for IWT infrastructure development than either the USA or the EU, although the plans of individual EU member states, particularly the Netherlands and Germany, are instructive. However, in all three regions, the funding of infrastructure construction programs, and the long-term recovery of the costs of providing and maintaining IWT infrastructure, remains a contentious and challenging issue.

Recovery of IWT navigation infrastructure costs

Table 4.3 summarizes the main sources of finance for the construction and maintenance of IWT infrastructure in each region, and the approximate proportion of those costs that are recovered from the barging industry.

China currently attempts to recover some IWT infrastructure costs through a variety of central and provincial government charges, including waterway maintenance fees, transport management fees, freight surcharges and several others. It is a complex and rather ad hoc system and differs significantly between provinces, and between provincial waterways and the main waterways. Nevertheless, it is clearly more broadly-based than in the EU and the USA and appears to yield higher recovery, although is certainly less than full cost-recovery.

China's IWT cost recovery level is less than for China's railway system. But it is probably much higher than the recovery of the costs of highway provision and maintenance from the road haulage industry, other than on tolled Expressways.

This study does not assert the feasibility nor advocate the desirability of full infrastructure cost recovery from users either in IWT or other forms of national transport infrastructure (the physical and policy context in every country is differs). Nevertheless, the main lessons to be learned from the international experience appear to be cautionary ones. The very low levels of direct cost recovery from IWT users in

the USA has probably contributed to the situation in which funding may now be insufficient to renovate or renew ageing assets or build new infrastructure. This includes renewal such as enlarging lock size to permit single-locking of large barge-tows which could enhance capacity and barging efficiency. Similarly, on the EU's main waterways, free navigation has meant that countries have little income from IWT and this is likely to have contributed historically to a reluctance to fund infrastructure spending.

Table 4.3: Financing of IWT Infrastructure Investment and Maintenance Costs

	CHINA	USA	EU
Main sources of finance	• MOT budget for approved capital projects of national significance • Waterway maintenance fee, government subsidy and commercial income for operations and maintenance of high class waterways • National waterways freight and passenger surcharges • Provincial budgets • Hydro-electricity income	• Federal budget for waterway operations and maintenance • IWT fuel tax on designated waterways funding an Inland Waterways Trust Fund for construction and rehabilitation • Matching State or City funds for new capital projects	• National budgets for waterway operations and maintenance • Small navigation and other charges on domestic waterways (but none on major waterways e.g. Rhine and Danube) • National budget and loans for most construction and rehabilitation • EU funds for 2 projects of EU-wide significance
Cost recovery from barging industry	Not known but appears to be in range 50-70% for operating and maintenance costs and less than 20 percent for capital costs	Thought to be about 10-15% overall	Thought to be about 5-10% overall

China appears better to have understood the importance of avoiding such heavy reliance on general tax revenues for commercially significant infrastructure funding. This seemingly applies to not only IWT, but also other forms of transport. But there remains a significant question as to how the NIWPP2020 will be funded. Increasing user charges is difficult while there is a widespread feeling in the barging industry that existing government charges are already too high and that they tend to support inefficient navigation authorities, rather than fund waterway improvements.

Use of infrastructure funding as a policy lever

There are some difficulties in China in co-ordination and lack of policy or program consistency in the overall IWT network between MOT and provincial navigation authorities.

Nevertheless, there are specific programs in the USA and the EU for promoting IWT with the means of influencing policies at subsidiary levels of government through making available funds that can be used if the subsidiary governments provide part of the total funds themselves and also if they meet specific policy conditions. This use, in both the USA and the EU, of centrally-controlled special-purpose infrastructure funds both as a 'carrot and stick' to influence the policies and programs of other levels of government may be of interest to China.

Project evaluation techniques

The EU's emphasis on considering the full social costs of transport in determining transport investment priorities, and its adoption of an Impact Assessment in which economic, social and environmental policies are reflected, may be useful experiences in establishing overall transport investment priorities in China. However, since this Study is focusing only on IWT and not other modes of transport, this issue is not further addressed.

Development of River Information Services

Work in the USA on the CRIS system, and in the EU on the RIS system, demonstrate that these regions, like China, are convinced of the benefits of applying information technology in an integrated way to IWT. However, harmonized and comprehensive systems have not yet been implemented in the EU and budget funding for the USA program does not yet appear to have been secured beyond specific demonstration projects.

It is likely that the financing structure that will emerge in most countries is that individual country budget funding will be used for the development and installation of RIS infrastructure, while the barging industry will pay for the on-vessel equipment. By a recent EU decision (EC 2158) in 2007, the individual country funding of RIS may be partly supported by the EU's budget under the TEN-T program. If individual countries support RIS and apply for EU grants, then EU budget funding could be somewhere around 10-20 percent of total RIS development and infrastructure costs.

The USA's CRIS system, is also still in developmental phase. As in the EU, it is likely that the development and infrastructure costs will be largely paid for from budget sources, with little if any direct cost recovery from users, while vessel owners will be responsible for financing all the costs of purchasing on-board equipment for CRIS.

However, given the developmental stage of River Information Services in each region this is a topic on which China and other regions may find it productive to pursue opportunities for consultation or collaboration.

Chapter 5. International Experience - Industry and Market Development

5.1 Summary of Industry and Market Development

Fleet size and ownership

Some of the key characteristics of the barge industry in each region, including fleet size and tonneage, industry ownership and concentration, are summarized in Table 5.1.

Table 5.1: IWT Barging Industry Overview

	CHINA	USA	EU
Year	**2006**	**2005**	**2005**
Total freight fleet size (units)	About 163,000 total	About 31,700 (Mississippi and GIWW system)	About 13,200 total
Freight capacity (freight carrying units only, excluding tugs)	49.2 million tonnes total	41.3 million tonnes, (Mississippi and GIWW system)	11.3 million tonnes total
Industry ownership	Public companies account for at least 20 percent of fleet tonneage	Private	Private with some residual public companies in new east European Member States)
Industry concentration	Some concentration of big (public and private) companies on the major waterways, with about 80,000 individuals and 4000 companies. In total. Around 48 percent tonnes and 29 percent tonne-kms carried by the owner-operators.	Quite highly concentrated: • 8 companies operate over 50 percent of total carrying capacity (but also large numbers of smaller operators) • 45% of vessels in fleets of over 1000 vessels	Low level of concentration: • dominated by small owner-operator enterprises, average less than 2 vessels/enterprise • but higher value segments (eg containers, chemicals) dominated by larger companies who sub-contract smaller operators

With 163,000 vessels on its whole navigable waterway system, China has by far the biggest fleet of freight vessels. These include self-propelled vessels, 'dumb' barges, and tugs. This compares with about 31,700 USA vessels on the Mississippi and GIWW system and about 13,200 IWT vessels in the EU as a whole (2005). China has about four times the haulage capacity of the EU and about 15 percent more than the USA if both the Mississippi and GIWW systems and the much smaller Columbia/Snake River system are counted. The tonne-km estimates indicate that fleet productivity (tonne-km/capacity) in China is about two-thirds that of the USA and just over half of that of the EU, although it must be conceded that this is rough estimation of productivity.

In China, the majority of fleet tonneage is owned by private companies and individual owner-operators. However, the distinction between public and private ownership can be somewhat blurred and at least 20 percent of fleet tonneage is estimated to be owned by the public sector, mainly state and provincially-

owned shipping companies. By contrast, the USA barging industry is privately-owned and operated. The EU IWT shipping industry in western Europe, which accounts for most traffic, is privately-owned (though some state-owned shipping companies remain in the new Central and Eastern European member states of the EU). Industry concentration is low in the EU, where capacity is dominated by small companies, but is much higher in the USA.

According to China's ***Regulation on Inland Waterway Transport***, every organization that intends to establish a waterway transportation enterprise, operate inter-provincial IWT or alter fleet capacity, as well as all transportation enterprises that intend to operate in the carriage of dangerous cargo or passenger transportation in the Three Gorges area of the Yangtze River, should apply for MOT's approval. Other applications to operate Yangtze River, Pearl River and Heilongjiang River (with exception of international tourist passenger operations) are approved by MOT's river administrations. Intra-provincial operations and individual private vessels are licensed at the provincial level.

Under the ***Provision on Administration of Operational Qualification for Domestic Vessel Transport,*** there are minimum standards for training and competency to operate in the IWT industry, crew training requirements and requirements for vessel licensing to meet safety and environmental standards. On the main waterways these are handled by the relevant MOT river navigation authorities. Provincial navigation authorities handle the provincial applications and are required, in principle, to apply the same standards. It is widely considered that to encourage registrations in their provinces, or to avoid unduly penalizing local barge operators, some provinces may not strictly enforce the stipulated standards.

Like the USA, China applies a policy of cabotage to its inland waterways. The ***Detailed Rules about Regulation on Inland Waterway Transport*** stipulates that only Chinese enterprises or individuals can operate vessels in rivers, lakes and other navigation areas of China. Cabotage does not extend to IWT shipbuilding (as it does in the USA) or to port operations, or to what are known as IWT service companies, including shipping agencies and freight forwarders. Consequently, several international freight forwarding joint-ventures now operate in the IWT sector.

While there are these various tests regarding competence, crew qualification and vessels standards, these do not create any major economic barriers to entry by Chinese operators who are qualified to operate with a vessel that meets the standards. In other words, there is no attempt to regulate overall capacity or protect the market. In practice, IWT in China is a very competitive market which is not distorted by capacity or tariff regulations. Indeed, some operators consider that the rather lax approach which is applied to crew and vessel standards by some provinces may be a form of unfair competition.

With some 80,000 individual operators and 4,000 companies, the industry generally is not greatly concentrated. Industry concentration in China is greatest on the major waterway channels. For example, the biggest IWT company, China Changjiang National Shipping (Group) Corporation, owns about 1,700 vessel of combined tonnes 2.5 millions, equal to the same capacity as Germany's total IWT fleet, yet it is only one of many operators. A larger proportion of owner-operators are naturally found on China's lower classified waterways, but even on the Yangtze River, the average scale of IWT company is less than 5,000 tonnes capacity.

Fleet structure

Table 5.2 summarizes fleet characteristics in the three regions. The fleet structure in China and the EU is similar in that most vessels are self-propelled. However, in the USA the predominant operating mode is a

'tow' of multiple un-powered barges pushed by a powerful tug. As a result, around 96 percent of vessels are 'dumb' barges.

Table 5.2: Freight Fleet Structures

	CHINA	USA	EU*
Fleet structure (nos. by vessel types)	• 80% barges • 20% tugs and other	• 79% dry barges • 11% tankers • 10% tugs	• 72% dry barges • 13% tankers • 15% tugs
Fleet structure (by number, excluding tugs)	• 80% self-propelled • 20% dumb barges	• 4% self-propelled • 96% dumb barges	• 74% self-propelled • 26% dumb barges
Average barge capacity (tonnes)	• self-propelled barge: average 308 • dumb barge 322	• dry cargo: 1,353 • tankers: 2,149	• dry cargo: 1,031 • tankers: 1,358
Power/propelled vessels (kW)	• self-propelled barges average 138 • tug 227	• dry cargo barge 1,110 • tanker N/A • tug 1,318	• dry cargo barge 456 • tanker 579 • tug 361
Total unit size	Multiple barge tows of 20,000 tonnes plus are common in the lower reaches of Yangtze and elsewhere	Typical barge tow of 15 units on main rivers, carrying +20,000 t. Tows of 45 barges possible south of Baton Rouge	Typically run as single self-propelled vessels but larger barge tows on Danube and very large barge tows in upper Rhine in Netherlands

*EU proportions are based on the 11,900 barges based in Netherlands, Germany, Belgium, France, Switzerland and Luxembourg which represent over 90 percent of the EU total.

China: The average barge capacity in China of 308-322 tonnes is very low compared both to the USA and the EU. For example, for dry cargo, this is less than a quarter of the average US barge size and just under a third of the average for the EU. For tankers the difference is greater. Given smaller vessels, the average power rating in China is also much lower for powered vessels. However, the averages mask wide local differences. Average barge size on the Yangtze River is probably closer to 800 tonnes/unit, nearly three times the Chinese average.

Though comparatively low, the average size of IWT vessel in China is increasing rapidly. The average capacity of a self-propelled vessel has increased from 51 tonnes/unit in 1995 to 308 tonnes/unit in 2006, while the average power rating has increased from 23 kw/unit in 1995 to 138 kw/unit in 2006. The tugs and barges sector is experiencing a similar trend. Changes in fleet structure in China (including passenger vessels) are shown in Tables 5.3 and 5.4 and (between 2000-2006) in Figure 5.1.

Although there are some gradual changes in vessel sizes and power in the USA and Europe, those changes are occurring to an already mature fleet and there is no comparable transformation of any fleet such as happening in China.

Table 5.3: Trends in IWT Fleet Development, China

Year	All Freight vessels	Self-propelled Freight Vessels	All freight vessels net tonnes	SP Freight Vessels net tonnes	Passenger Vessels	Total Power (All SP Vessels)
	Units	Units	(1,000)	(1,000)	Units	Kw (1,000)
2006	182,869	121,774	49,423	37,489	902,580	18,888
2000	219,298	152,300	20,519	11,968	872,437	7,520
1995	346,148	267845	22,713	13,653	823,316	8,497

Table 5.4: Trends in Average Vessel Characteristics

Year	Self-propelled Freight fleet			Tugs	Barges
	Average Tonnes	Average Power Rating	Capacity/Power Rating	Average Power Rating	Average Tonneage
	Tonnes/unit	Kw/unit	Tonnes/Kw	Kw/unit	Tonnes/unit
2006	308	138	2.24	227	322
2000	79	36	2.16	188	189
1995	51	23	2.19	161	157

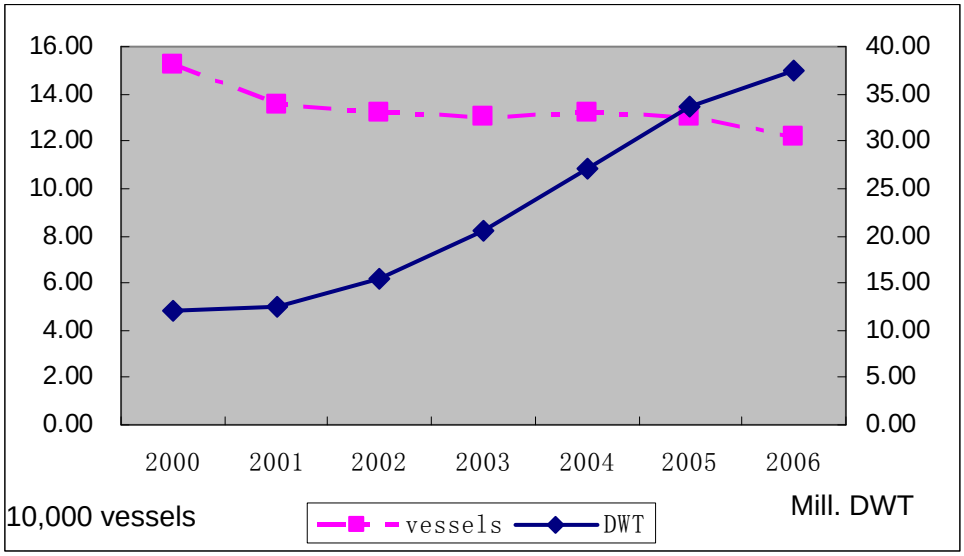


Figure 5-1 Transformation of China's SP Freight Fleet, 2000-2006

USA: The Mississippi and GIWW inland waterway fleet (which is used to illustrate fleet characteristics) consists of 24,901 dry cargo barge units, 3525 tanker barges and 3,303 tugs, giving a total fleet of just over 31,700 units (Table 5.5) The total haulage capacity of the fleet, excluding tug capacity, is about 41.3 million tonnes.[18]

[18] Waterborne Commerce Statistics Center at http://www.ndc.iwr.usace.army.mil/wcsc/wcsc.htm

Table 5.5: IWT Vessels Operating or Available for Operation on Mississippi and GIWW (2005)

Fleet	Units	Capacity (Tonnes)	Power (Kw)	Tonneage /unit	Power /Unit
Ordinary barges	23,739	33,473,335	N/A	1,410	N/A
Ordinary self-propelled barges	1,162	219,939	1,289,462	189	1,110
Sub-total dry cargo	24,901	33,693,274	N/A	1,353	N/A
Tanker barges	3,525	7,575,209	N/A	2,149	N/A
Self-propelled tanker barges*	N/A	N/A	N/A	N/A	N/A
Sub-total tankers	3,525	7,575,209	0	2,149	N/A
Tugs	3,303	N/A	4,352,026	N/A	1,318
Total	31,729	41,268,483	N/A	N/A	N/A

Source: USACE Navigation Data Center

* Excluding 6 very large sea-going vessels used in intra-Gulf coastal trade

Dry cargo fleet: Of the US dry cargo fleet about, less than 5 percent of units are self-propelled. These tend to be relatively small freight vessels used in narrow upriver tributaries plus passenger vessels used mainly for tourism[19]. Over 99 percent of the dry cargo capacity is provided by dumb barges of average freight capacity 1,410 tonnes that are strung together in convoys (known as tows) of up to 15 units (just over 20,000 tonnes capacity/tow) and pushed by tugs.

Tanker fleet: The tanker fleet consists of nearly all dumb barges, of an average capacity of just over 2,000 tonnes that are also towed by tugs (This excludes six large deep-draught self-propelled tankers). The average capacity of a barge has increased by a total of around 5 percent over the last ten years

Tug fleet: The tugs, with an average rating of 1,318 Kw, are much larger and more powerful than the EU IWT counterparts

Table 5.6 shows trends in the total domestic (dumb) barge fleet. Over the last twenty years, the vessel numbers have declined marginally, but the average dry barge capacity has increased by about 22 percent and the tanker barge capacity by about 15 percent.

Table 5.6: Trends in Total Domestic (Dumb) Barge Fleet

Fleet	1985	1990	1995	2000	2005	2005/1985
Dry cargo barges:						
Units (no.)	29,287	27,170	27,342	29,107	27,876	0.95
Capacity (tonnes)	35,040,400	34,637,867	36,254,099	40,646,929	40,612,876	1.16
Tonnes/unit	1,196	1,275	1,326	1,396	1,457	1.22
Tanker barges:						
Units (no.)	4,252	4,003	3,985	4,011	4,151	0.98
Capacity (tonnes)	9,834,084	9,756,867	10,130,362	10,592,484	11,040,496	1.12
Tonnes/unit	2,313	2,437	2,542	2,641	2,660	1.15

Source: USACE Navigation Data Center

Table 5.7 shows the total US barge fleet by barge type. It is dominated by the Mississippi and GIWW fleet but includes vessels operating on the rivers of the Pacific Coast. Taken across all types, the average capacity of the US barge fleet is about 1,613 tonnes and the average vessel age is about 19.5 years.

[19] Excludes road and rail ferries from the total.

However, there are several vessel types and ages. The workhorses of the system are the dry covered and dry open barges, with an average age of 18 and 16 years respectively. Tankers represent about 12 percent of the fleet, but with much higher average tonneage capacity. Of these, most are now double-hulled for safety and environmental protection. Under 1990's environmental legislation aimed at reducing the risk of spillage from accidents to vessels carrying hazardous materials, all single-hulled tankers will need to be off the system by 2015. The remaining single hull tankers on the system are therefore now very old.

Since 1999, all members of the American Waterways Operators were required to participate in its Responsible Carrier Program as a condition of membership. This followed an accident in 1994 involving a barge which struck an unlit railway bridge in fog, causing the railway track alarm to malfunction. As a result, a passenger train derailment killed 42 people. The Responsible Carrier Program requirements exceed Federal safety standards and regulations.

Table 5.7: Total USA Barge Fleet Composition and Age,* 2005

All Barges	Number of Units	Capacity (tonnes)	Tonnes /unit	Percent of Fleet	Percent of Capacity	Average Age
Dry covered	13,322	21,467,779	1,611	41.6%	41.5%	18
Dry open	8,264	11,902,039	1,440	25.8%	23.0%	16
Dry deck	5,318	6,513,282	1,225	16.6%	12.6%	25
Lash/seabee	839	316,170	377	2.6%	0.6%	25
Other dry	158	491,657	3,112	0.5%	1.0%	28
Single hull tanker	518	1,577,979	3,046	1.6%	3.1%	34
Double hull tanker	3,014	7,665,559	2,543	9.4%	14.8%	20
Other tanker	619	1,796,957	2,903	1.9%	3.5%	25
Total	32,052	51,731,423	1,613	100.0%	100.0%	19.5

Source: USACE Navigation Data Center

* Includes self-propelled vessels but excludes tugs

EU: Since the year 2000, statistics on fleet structure in the EU, plus Switzerland, are now monitored by the CCNR under an agreement with the European Commission. The CCNR collates the data from individual country statistics. While there are some inconsistencies both in the cross-sectional data between countries and the time-series for some countries, a reasonable picture of the overall situation can be attained by aggregating the six main fleet owning countries in Europe: Germany; Netherlands; Belgium; France; Luxembourg; and Switzerland. These countries operate over 90 percent of the vessel tonneage in IWT in the EU. Table 5.8 shows the structure of the fleet in these countries in 2005.

Within these six countries there are about 8,557 dry cargo barge units, including container barges, 1,557 tanker units and 1,836 tug units, giving a total fleet of about 11,919 units. The total tonneage of the haulage fleet, excluding tugs, is about 10.9 million. The fleet is already old, and, on average, is continuing to age, particularly in Germany. Table 5.9 gives the average age of self-propelled vessels in Germany, Netherlands and France in 1994 and 2000.[20]

[20] From Planco (2003), Potential and Future of German Inland Waterways Shipping, prepared for the Federal German Ministry of Transport, Construction and Housing.

Table 5.8: Fleet Structure in Six Main Countries in 2005

Freight Fleet	Units	Tonneage	Power (Kw)	Tonneage/ unit	Power Kw/Unit
Ordinary barges	2,481	2,879,693	N/A	1,161	N/A
Ordinary self-propelled barges	6,076	5,942,269	2,772,331	978	456
Sub-total dry cargo	8,557	8,821,962	2,772,331	1,031	N/A
Tanker barges	141	210,094	N/A	1,490	N/A
Self-propelled tanker barges	1,385	1,862,471	801,238	1,345	579
Sub-total tankers	**1,526**	**2,072,565**	**801,238**	1,358	**N/A**
Pusher tugs	1,176	N/A	531,887	N/A	452
Tugs	660	N/A	130,605	N/A	198
Sub-total tugs	**1,836**	**N/A**	**662,492**	N/A	361
TOTAL	**11,919***	**10,894,527**	**N/A**	**N/A**	**N/A**

Source: CCNR Market Observatory 2006

* Total Units for EU plus Switzerland in 2005 given as 13,200.

Table 5.9: Average Age of Self-propelled Vessels, 1994 and 2000 (Years)

Vessel Type	Germany		Netherlands		France	
	1994	2000	1994	2000	1994	2000
Self-prop dry cargo	47.3	51.4	45.4	44.9	41.1	43.6
Self-prop tankers	28.2	30.8	28.2	29.1	33.2	21.0

Dry cargo fleet: Of the EU dry cargo fleet, about 71 percent of units are self-propelled while 29 percent are dumb (unpowered) units. The average capacity/unit is about 1,031 tonnes. The average power rating/powered unit is about 456 Kw. Over the five years since 2000, the dry bulk fleet declined by about 8 percent in terms of number of units and by about 4 percent in terms of tonneage. The average tonneage/unit has increased by about 4 percent over the five years.

Tanker fleet: For the tanker fleet about 91 percent of units are self-propelled while 9 percent are dumb units. The average capacity/unit is about 1,345 DWT. The average power rating/powered unit is about 579 Kw. Over the five years since 2000, the number of tanker units remained about constant, but the average tonneage/unit and aggregate fleet tonneage increased by about 12 percent.

Tug fleet: Of the 1,836 tugs about two-thirds are pusher-tugs for which the average power rating is 452 Kw, while the puller-tugs have an average power rating of 198 Kw. Over the five years since 2000, the number of tugs declined by about 1 percent with average power rating unchanged.

Table 5.10 shows the distribution of EU barge sizes by barge type (haulage units only) in 2005.

Unpowered dry cargo barges: Some 43 percent of the fleet is over 1,000 tonnes and 33 percent is over 2,000 tonnes. One type of barge train combination available in the Netherlands IWT system is a six barge train pushed by a tug, with a capacity of up to 14,000 tonnes. However, a fifth of all units remain less than 250 tonnes, but these tend to be older barges, used on smaller canals and waterways, and their proportion in the fleet is reducing.

Table 5.10: Distribution of Barge Sizes by Barge Type, 2005

Range	Dumb Dry Cargo Barges	Self-prop. Dry Cargo Barges	Sub-total	Dumb Tank-barges	Self-propelled Tankers	Sub-total
Up to 249 t	21%	2%	7%	3%	19%	18%
250-399t	9%	22%	19%	2%	4%	4%
400-649t	16%	15%	15%	19%	7%	8%
650-999t	11%	20%	18%	24%	7%	8%
1000-1499t	6%	23%	19%	8%	24%	22%
1500-1999t	5%	8%	7%	9%	12%	11%
2000-2499t	7%	4%	5%	18%	12%	12%
2500-2999t	19%	3%	7%	13%	8%	9%
3000t plus	7%	2%	3%	4%	8%	7%
Total	100%	100%	100%	100%	100%	100%

Source: CCNR Market Observatory 2006

Powered dry cargo barges**:** Some 40 percent of the fleet is over 1,000 tonnes and 9 percent is over 2,000 tonnes. The bigger barges are used on the Rhine, Danube and other wide-gauge waterways. Operating on a 24-hour basis, they usually have a minimum crew of four persons. Amongst these vessels are many specialist carriers including container vessels of between 32 and 470 TEU capacity, car carriers for up to 600 vehicles, Ro-Ro vehicles for up to 72 truck trailers, and cement carriers.

Unpowered tank barges: There are not many of these in total, but 52 percent are over a 1,000 tonnes and 35 percent over 2,000 tonnes.

Powered tank barges: 64 percent of powered tankers are over 1,000 tonnes, while 28 percent are over 2,000 tonnes. The larger barges are mainly double-hulled, chiefly used on the Rhine where they operate 24 hours with a crew of four. There are specialized tankers for hazardous cargo. Some river tankers also handle consumer goods such as mineral water and sunflower oil.[21]

Ports

China: In 2006, there were 1,300 IWT ports in China and 30,900 working berths, including 187 berths capable of handling vessels of 10,000 DWT. The IWT ports lie mainly on the Yangtze River (760 ports and 15,200 berths), Pearl River, Grand Canal and Huaihe River areas. MOT defines 28 ports as main IWT ports of national significance. Table 5.11 shows these 28 ports (which exclude those seaports such as Shanghai and Nanjing that also have substantial IWT feeder operations). Most of IWT ports in China have poor or no connections with the railway system and depend mainly on road transport, often through dense urban areas. Moreover, some of the seaports not shown in Table 5.11 could be improved in their interface with IWT feeder services, which sometimes lack dedicated facilities leading to lower priority in access and/or additional transshipment costs.

Many of the other ports are small, provincially or locally owned and run, with low standard equipment. Many of their berths are simply a mooring at the riverbank with manual loading and unloading via gangplanks.

[21] A more detailed guide to European barge types is at http://www.bureauvoorlichtingbinnenvaart.nl/

Table 5.11: China's Main Ports and Their Railway Connections

Port by River System	Traffic Tonnes in 2006 (millions)	Railway Connection
Pearl River		
Nanning	0.88	YES
Guigang	15.38	YES
Wuzhou	5.28	NO
Zhaoqing	1.75	NO
Foshan	N/A	N/A
Yangtze River		
Luzhou	10.00	NO
Chongqing	10.73	YES
Yichang	5.18	YES
Jingzhou	1.70	NO
Wuhan	50.34	YES
Huangshi	11.95	NO
Changsha	10.56	NO
Yueyang	20.03	YES
Nanchang	7.21	NO
Jiujiang	7.60	YES
Wuhu	39.34	YES
Anqing	28.39	NO
Maanshan	23.93	NO
Hefei	NA	NA
Huzhou	46.07	YES
Jiaxing Inland Water	7.96	NO
Grand Canal And Huai River		
Jining	NA	NA
Xuzhou	15.24	YES
Wuxi	4.94	NO
Hangzhou	52.21	NO
Bengbo	NA	NA
Heilong And Songliao River		
Heilongjiang	0.79	YES
Jiamusi	0.43	YES
'National' ports total	**204.00**	

Before the 1980s, ownership of China's ports was highly concentrated and centralized. At the beginning of 1980s, China carried out the first port reforms. The port and shipping enterprises were separated and became independent legal entities. In the later 1980s, the 25 major ports which had previously been managed by the Central Government were directly decentralized to the provincial/municipal governments. A system of so-called 'dual leadership by regional and central government, with regional government dominant' was set up. The remaining IWT ports were all decentralized to lower level governments.

In 2004, under the ***Port Law,*** all ports were decentralized to regional governments. Each established different administrative systems according to their own actual situation but ports are typically corporatized. Provincial/municipal governments and port enterprises dominate the investment funding sources while the Central Government provides some subsidy to important projects. In 2006, IWT ports made a total investment of nearly CNY 6 billion, with Central Government investment representing less than 4 percent. The funds from ports and other enterprises covered 55.6 percent, funds-raised by local governments equaled 13.3 percent, while the remainder came from domestic loans (See Table 5.12).

Table 5.12 Sources of Finance for Ports in China (2006)

Sources of Finance	Investment (CNY millions)	Proportion
National budget	0.02	0.0%
MOT specialized funds	194.86	3.3%
Domestic loans	1264.29	21.1%
Foreign investment/loans	25.9	0.4%
Local government	798.08	13.3%
Enterprises (mainly ports)	3326.91	55.6%
Other	375.42	6.3%
Total	5985.48	100.0%

USA: There are well over a hundred regular ports, and many hundreds of other commercially significant wharves and jetties serving the US IWT system. Many are privately-owned facilities serving particular companies and traffic types. In addition, there are many common user ports in the larger cities. These are generally owned by a public port authority or commission established by the local authority. Such authorities often act as 'landlords', leasing out areas for individual private terminal operations.

Table 5.13: Domestic Freight Handled at Major Ports in USA (2005)

Port	Domestic Tonnes (millions)
South Louisiana	106.8
New Orleans	29.7
Baton Rouge	33.5
Pittsburgh	39.5
St Louis	27.5
Memphis	15.5
Cincinnati	13.2
Louisville	7.7
Mount Vernon	5.3
Decatur	4.5
St Paul	4.5
Nashville	4.1
Vicksburg	3.7
Kansas City	3.0
Catoosa	2.0
Chattanooga	2.4
Guntersville	1.6
La Crosse	1.1
Helena	1.2

The larger ports have a very wide range of handling facilities and also stress their inter-modal connections for a range of traffic types. However, as noted, the quantum of inter-modal container traffic is very low.

Table 5.13 summarizes some of the main ports on the Mississippi River system (generally handling more than 1.0 million domestic tonnes annually).

EU: There are 334 ports identified in the European Agreement on Main Inland Waterway Ports (1998), excluding Russia and the Ukraine. The 334 ports are the more significant common user ports (though some are very small) and exclude very small regional ports and individual private industrial jetties. About 150 of the ports, nearly half the total, are located on the Rhine River and its tributaries. More than twenty of these common-user Rhine ports handle more than 0.5 million tonnes/year and are shown in Table 5.14.

In nearly all cases their ports have been corporatized and are run by joint-stock companies according to corporate law and commercial principles. They prepare published annual accounts in accordance with internationally recognized financial accounting standards.

Table 5.14: IWT Traffic at Major Rhine System Ports (2002)

System Ports	Discharged Tonnes (mil.)	Loaded Tonnes (mil.)	Total Tonnes (mil.)
Rhine River Ports			
Basel	7.4	0.9	8.3
Mulhausen	2.8	3.0	5.8
Strasbourg	1.8	7.5	9.3
Wörth	0.4	0.5	0.9
Germensheim	0.8	1.1	2.0
Ludwigshafen	5.5	1.7	7.2
Mannheim	5.5	1.8	1.3
Mainz-Weisbaden	2.4	1.0	3.4
Karlsruhe	3.5	2.9	6.4
Wesseling	0.3	2.2	2.4
Bonn	0.2	0.3	0.5
Cologne	5.5	6.6	12.1
Andernach	0.8	1.4	2.2
Krefeld	2.4	0.8	3.3
Duisburg	34.0	6.3	40.5
Homberg	0.5	0.3	0.8
Neuss	2.7	1.5	4.2
Düsseldorf	1.7	0.7	2.4
Emmerich	0.5	0.5	1.0
Walsum	0.4	1.8	2.2
Leverkusen	1.3	0.4	1.7
Seaports*			
Antwerp	31.2	43.1	74.3
Rotterdam	14.6	86.0	100.6
Amsterdam	4.6	20.5	25.1

Source: CCNR Statistics 2002

*Only includes IWT traffic at these seaports

The shares in EU port companies are typically owned either by national governments, city governments or regional governments, or a combination of each. The port of Rotterdam is, for example, a corporation of the Netherlands Government. The Port of Amsterdam is owned by the Municipality of Amsterdam. The Port of Düsseldorf is jointly owned by the Municipalities of Neuss and Düsseldorf. The Port of Duisburg is owned jointly by the Federal Government of Germany, the provincial government of North Rhine Westphalia and the City of Duisburg. The Port of Cologne is owned by the City's Utility company, the Municipality of Cologne and the district of Erft. Other ports have similar types of ownerships.

Most of the larger ports are so-called 'landlord ports' in which the public port company is the owner and developer of the basic port infrastructure, responsible for engineering and property management, environmental compliance, and management of the common areas, and access roads and other utilities. Some or all of the cargo handling areas and operations (and other activities like port security, container storage, maintenance, towage, etc.) are then contracted, concessioned or leased to the private sector. In the smaller ports, the port company itself usually carries out a wider range of the cargo handling functions[22].

Inter-modal transport and wider logistics services are promoted by nearly all ports on the Rhine River system. These services are typically organized by a wide range of private freight forwarding and logistics companies. As noted above, the great majority of barge enterprises are very small. They do not have the financial resources or skills to offer sophisticated inter-modal freight forwarding service or logistics services such as warehousing. Instead they act as transport sub-contractors in the supply chain.

In addition, the Rhine system ports are all very close to the national and international motorway networks and nearly all also have road and railway access direct into the port itself.

The largest of the inland Rhine ports is Duisburg, which can accept sea-river vessels[23]. It is the most important hinterland hub of the Ports of Antwerp, Rotterdam and Amsterdam and is one of the largest logistics centers in Europe. It is helped in this role, not only because it is a natural hub for sea-river vessels, but because of an extensive industrial hinterland and excellent interchange facilities with the IWT system, roads and railways. Some 250 private companies, mainly specialized in transport and logistics, offer their services in the port.

The EU's NAIADES program (discussed in Chapter 4) is attempting to promote new logistics concepts on EU waterways, including the Rhine. It anticipates possible markets for loading units such as 'continental containers', swap-bodies, and refrigerated containers as well as new markets in areas such as waste products, dangerous goods, heavy-lift cargo and river-sea shipping.

5.2 Assessment of International Experience - Industry and Market Development

Application of cabotage policy to IWT operations

The USA operates a strict policy of cabotage in IWT. In contrast, the main EU waterways are by their nature international waterways by both geography and treaty, with freedom of access, and the national waterways of all EU member states are open to barging companies of other EU member states.

[22] Individual port website addresses at www.transportguiderotterdam.com/port%20authorities/

[23] More information on Duisburg is available at http://www.duisport.de

Like the USA, China has a strict policy of cabotage in IWT operations (though unlike the USA, it does not extend to shipbuilding), but China is trying actively to encourage international investment and participation in inland port industries. In terms of logistics services, over twenty international shipping companies have established partnering or joint-venture arrangements with local companies operating in the container industry. For example, one of the key companies in the development of container and motor car shipping in the upper Yangtze, Chang'an Minsheng Logistics (CMAL), is a joint venture of Chang'an, Ford, APL Logistics and China Minsheng.

China will continue to benefit from a policy of encouraging international investment and expertise into the country's IWT industry, through ports and logistics, even if the underlying policy of cabotage is maintained, as seems likely for the foreseeable future.

Ownership of vessel fleet

Both the USA and the EU have an almost wholly privately-owned fleet, whereas at least 20 percent of China's fleet tonneage is still publicly-owned, either in the form of barge transport companies owned by central or provincial governments, or barges that are operated by other publicly-owned industries for their own transport needs.

There has been little empirical research into the relative efficiencies of public and private barging companies. But international research in other transport sectors provides reasonably convincing evidence that, when other factors are equal, transport service companies that are privately-owned usually achieve higher levels of operating efficiency than those that are publicly-owned.

However, publicly-owned enterprises tend to be most efficient when two conditions are in place. The first condition is that there should be separation of the policy and regulatory functions of the government owner from the operational and commercial functions of business managers. The second is that there should be competition in the supply of transport services, which keeps all service providers (whether publicly or privately-owned) responsive to customers and the market. The situation in China's barging market appears to conform to these conditions: the publicly-owned companies are managed with a high degree of independence and autonomy from their 'public' owners; and the barging transport industry in China is highly competitive. Given these conditions, and the evident high rates of growth and innovation in China's barging industry, the case for active policies to reduce public ownership of barging companies does not appear compelling.

Nevertheless, the proportion of private ownership of vessel fleets has been increasing, and is likely to continue under the pressure of market forces, and may be expected to lead to some gains in economic efficiency.

Fleet structure

While it is instructive, to a certain extent, to compare the fleet structure in each of the three regions, it is important to recognize the limits of transferability of this experience from one region to another. The fleet structure is determined by both the physical parameters permitted by the waterway channels and by the nature of the commodity in transport markets. For example, the overwhelming preference for use of barge tows in the USA is encouraged by the proliferation of wide waterways that encourage this configuration as the most efficient way available of carrying the traffic. On most of the EU's waterways, a 15 barge configuration is simply not feasible and the economic preference is therefore for self-propelled

vessels. However, multiple barge tows are used on wider reaches of the Danube and the lower Rhine where they are feasible and are the most economic solution for particular traffic movements.

China has a much more heterogeneous fleet than either the EU or USA. In China both self-propulsion and barge tows are employed. While self-propelled vessels predominate in China, multiple barge tows are used widely where navigation permits. For example, barge tows of 30,000 tonnes are used for some movements in the lower reaches of the Yangtze, while 5,000 tonnes tows operate as far upstream as Chongqing, more than 2,000 km inland. Moreover, though only one in five of Chinese IWT vessels are dumb barges, in absolute terms this adds up to around 37,000 units, more than in the USA.

The main lesson to be learned from the international experience is not that a particular fleet structure might be transferred from one region to another, but that free markets will create different fleets to match different circumstances. For China, there appear to be two relevant lessons. The first is to rely mainly on markets mechanisms for the economic organization of shipping services in IWT while using regulations mainly to meet environmental and safety standards. The second is to ensure that infrastructure programs take account of the effects of infrastructure specifications on vessel operating costs so that infrastructure investments have the most cost-effective impact not only on capacity but on the competitiveness of shipping services.

Vessel sizes

The difference in average vessels sizes in the three regions is striking, with China's by far the smallest. However, China's average masks very large variations between regions and different classes of waterway. For example, the average vessel size passing through the Three Gorges locks, which is 1,500 km upstream from Shanghai on the Yangtze River, is now over 1,600 DWT. This is 50 percent higher than the average barge size operating on the Rhine. The completion of navigation projects in the 11th Five Year Plan will allow self-propelled vessels of 10,000 DWT to Chongqing.

Given the big economies that can be gained through larger vessels the barging industry itself will seek to invest in bigger barges, or to operate barge-tow configurations, where the navigation infrastructure to handle such barges exists or is planned. However, China has also taken supporting policy measures to encourage larger and standardized vessels (the Program was described in Chapter 4). The barge modernization program, combined with underlying market trends, appears to be successful with the average barge size in China increasing by over 300 percent since the year 2000.

As discussed in Chapter 1 of the Report, there are economies of scale in vessel sizes, with generally lower costs/traffic unit for larger vessels. However, China's IWT system and markets are more varied than in the USA or EU. Big barges and small barges do not necessarily all serve the same sub-markets. Smaller barges in China can penetrate economically to many regions and cities of great resources and activity that are located along Class IV and V waterways. They can be used at ports and landing stages that do not have the capacity to handle larger vessels, or the facilities to store/transfer higher freight volumes. Small barges can achieve high utilization, and low costs, in small markets, serving smaller customers who have smaller consignments. They can also be economical for short-distance movements.

A fleet containing a range of vessel types and sizes is therefore likely to match China's IWT transport market more efficiently and effectively at this stage in the country's economic development than a fleet of only a few types of large vessels. The vessel standardization policy should therefore not be aimed at size per se, but remain primarily aimed at penalizing vessels that create damage to the system, create disproportionate costs to their users, or do not meet environmental or safety standards.

It is therefore important to ensure that regulations and charging systems that have an impact on fleets support market mechanisms. For example, charges for use of congested channels and locks that reflect the costs of using scarce capacity will tend to give incentives to well-loaded vessels of all sizes, but particularly to larger vessels that can attain a higher freight throughput from the infrastructure capacity used. Restricting the use of congested locks by small vessels at peak times and prohibiting the use of very small freight vessels on those classified waterways where locks or other facilities may be congested may also be justified, but will in general not be as economically efficient as charging systems.

It is also important to avoid creating unnecessary hardship to the smaller barge operators in the industry. Apart from larger scale commercial barging on the main waterways, smaller inland waterways in China are often the first link in the transport chains faced by poor riparian communities. Large numbers of smaller barges and country boats in upper reaches and tributaries of the main waterways are crucial to these communities, and are often well matched to smaller consignment sizes over relatively short distances, to and from rudimentary landing stages. It would be unfortunate if measures to encourage barge enlargement for the main congested waterways unnecessarily penalize the livelihoods of thousands of small family barge owner-operators, and the important local transport services that they offer, on the many thousands of kilometers of smaller waterways that have ample capacity to handle them.

Vessel designs

There are not many countries internationally in which IWT is a significant industry, so skills and techniques in IWT vessel research and development are globally scarce. The countries that have significant IWT industries can therefore gain by learning from each other. Vessel design, including vessel loading/unloading methods, is expected to be a fruitful area for China to utilize international experience, particularly in newer, more specialized vessel types. In studying such experience, it is important to consider the extent to which minimum crew-size regulations in China, which often lead to crews which are substantially larger than equivalent vessels in the EU or USA, may be constraining the optimization of vessel design and efficiency.

High labor costs in the USA and the EU have given these regions more incentive to develop higher productivity vessels. High environmental and safety standards have created incentives to develop vessels that are both less polluting, and more able to carry hazardous goods in safety. In the EU in particular, high fuel taxes and regulations relating to emissions have provided incentives for more energy-efficient vessels and engines with lower carbon emissions. It is anticipated that China's shipbuilders are already benefiting from selective study and transfer of international skills and experience in vessel design.

Given China's adoption of increasingly stringent environmental regulations, it is possible that the carriage of dangerous goods would be an especially productive area of international co-operation. For example, on the Yangtze River there are over 2,700 oil tankers, nearly 1,700 specialized chemical carriers and 11 gas carriers. It is possible that many would not meet the safety and environmental standards required in the EU or USA. Improving vessels design and safety in these fleets is important to boosting public and shippers' confidence in IWT as a modern and efficient mode of transport.

Ports policies

China's port reforms since the 1980's have seen a major decentralization, corporatization and commercialization of the ports function. There remains a high degree of public ownership of common user ports at lower levels of government, just as in the USA and the EU, but many of China's larger ports

have leased areas for separate and sometimes private operators and a partial 'landlord' type port model is emerging. China is therefore already well developed toward implementing international practice in terms of port administration and institutions.

Given the financing requirements for ports to meet traffic growth and vessel fleet development there is a case for following up further opportunities to encourage more private participation in terminal operations and, where feasible, greater competition between and within ports. Similarly, reducing the ownership of both ports and shipping companies by provincial and local governments would help assure non-discriminatory access of service providers to facilities and could improve utilization of capacity.

Supporting the development of new markets

Comparison of the three regions shows that, for the most part, the sorts of commodities served by IWT are very similar. This is not surprising given the nature and economics of barge transport compared to other transport modes.

In terms of bulk cargo, China's barging industry has demonstrated success in attracting and retaining traffic, where the relevant navigation facilities exist. For example, in terms of serving cities and enterprises located along the Yangtze River, the barging industry is estimated to carry nearly all the sand and gravel, around 80 percent of the iron ore, 72 percent of the crude oil and 83 percent of the coal. China's successful experiences in serving transport demand and continuing high rates of growth have demonstrated that bulk freight shippers in China are entirely cognizant of the cost advantages of IWT. Similarly, China's barging industry has shown itself to be responsive to the market demands.

Moreover, the industry has shown itself able to respond rapidly to new market opportunities. For example, in 2002, prior to the opening of the Three Gorges Dam, that section of the river handled 18 million tonnes of IWT freight. By 2006, with the increase in capacity afforded by the dam and locks, the traffic has increased to nearly 50 million tonnes, a volume that had originally been expected only by 2020.

Another example is specifically in regard to inter-modal container traffic. In relatively few years, twenty-seven Yangtze ports have acquired container handling capability. Dedicated container terminals are operating in Luzhou, Chongqing, Fuling, Yichang, Wuhan, Jiujang, Wuhu, Nanjing, Zhenjiang, Yangzhou, Suzhou and Nantong. The opening of the Three Gorges Dam and locks has now facilitated a rapid growth in container movements to Chongqing.

China's transport markets in the IWT sector therefore appear to be working well, delivering successful growth, and can be expected to yield continuing increase in the efficiency and effectiveness of IWT transport services. The lessons on market development that China may take from other regions are therefore limited. China's IWT industry appears to have little need for an IWT market image and promotion campaign such as contained in the NAIADES Action Program in the EU that would '*increase the general public and shipper awareness and knowledge of the potential of IWT in terms of quality and reliability* . Nor is there an obvious case for adopting something like MARAD's plan in the USA to '*partner with industry, state, and local governments, and other Federal agencies to identify new business opportunities for US (IWT and other) maritime industries'*.

However, a key factor to note is that, given their stage of development, bulk cargo markets are simply not growing in EU and USA as they are in China. However, the success of some EU member states, such as the Netherlands and Germany to develop new specialist shipping markets (such as containers and

chemicals) will be of interest to China, and suggest that with appropriate policies China can both grow and diversify its IWT markets.

China's most pressing challenge is not how to create growth in IWT markets, but how to accommodate it and create the conditions that will sustain it. China's approach of concentrating public sector involvement on improving the standards and quality of the public waterway infrastructure network, while encouraging a diverse and competitive market in the IWT service providers that use it, is fundamentally sound. However, there is a case for attempting to extend the market reach of IWT through better interfaces with seaports, and also greater policy attention to inter-modal infrastructure. This is discussed in the context of logistics industry below.

Development of a supporting logistics industry

Good overall logistics are increasingly important to modern transport systems. In relation to IWT, it is useful to distinguish three main issues:

- quality of inter-modal connections;
- development of logistics supply markets;
- improvements in trade facilitation.

Inter-modal connections: Better inter-modal connections can improve the scope and 'reach' of commodity markets in which IWT might participate. Otherwise, IWT will always be confined to customers and traffics that are located in the immediate vicinity of rivers and canals. Although some inland waterway ports in China are close to railway terminals, the overall degree of integration of railway and waterway modes is not high. The two sectors are quite separately administered, railways by the Ministry of Railways and waterways by the Ministry of Transport. And ports are mainly administered by individual provinces and cities. There is no obligation on infrastructure planners of different modes to provide good inter-modal connections. Indeed there is no obligation for them even to consult with each other. At the industry operating level, the regional railway enterprises and navigation authorities sometimes perceive each other as competitors. Although it is true that railway transport and IWT are potential competitors for most existing traffic, it is likely that in the long-term traffic on both modes would gain advantage over road transport by better connections. In both the USA and the EU, there are generally not only better port/railway connections than in China but specific national (and in the case of the EU, trans-national) policies and programs for encouraging inter-modal traffic. This appears to be an area where international experience is relevant to China.

Development of logistics supply industry: The IWT industry in the EU in particular has close links with wider logistics service suppliers such as freight forwarding and storage functions. Moreover there are specific policies (both at EU level and within member States) to encourage a higher level of co-modality (such as between IWT and rail transport). These links are important if IWT is not to be confined only to the lowest-valued sections of the transport market. In China, investments in infrastructure, greater competitiveness, the entry of foreign firms and the adoption of the latest logistics technology by Chinese firms, have all contributed towards the rapid growth of the logistics supply industry. However, most good logistics services are regionally concentrated in China's east coast conurbations, where there are many world class logistics companies and good integration between the transport networks, warehousing and distribution facilities. At some inland ports, logistics operations are often hampered by poor quality infrastructure, outdated warehousing and a slow uptake of technology. Most of the ports that exist or are being developed on China's IWT system are operated by cities and provinces that may not have the requisite skills and experience in providing a full range of modern logistics services. Some would benefit

from adopting the international model of a 'landlord' port, where the port authority remains in overall control of the basic infrastructure but rents or leases land to a wide range of specialized private transport operators, including logistics companies.

Improvements in trade facilitation: Although improving rapidly, China still trails the USA and the EU on most measures of trade facilitation. As part of its annual international business competitiveness study (www.doingbusiness.org), the World Bank assessed China's cross border trade. The costs and procedures involved in importing and exporting a standardized shipment of goods—starting from the final contractual agreement between the two parties, and ending with the delivery of the goods—were established. China ranked 38th out of 175 countries. The comparisons are based on average performance, and it is likely that international shipments that are on-forwarded via IWT perform less well than the average, which includes shipments directly to/from the east coast cities. Areas for possible improvement include standardized customs procedures at inland ports and a 'through bill of lading' requiring a single customs clearance at the inland port. At present, consignments may be subject to inspection both at the ultimate inland origin/destination and at the seaport.

Industry and market monitoring

Both of the USA and to a lesser extent the EU have more comprehensive and more accessible data on IWT than is available in China.

The USA data is most comprehensive and is underpinned by statutory reporting responsibilities on vessel operators and others involved in the industry. It also reflects the centralized and integrated nature of administration of IWT through the USACE. Detailed traffic statistics are available from the Waterborne Commerce Statistics Center. Details of waterborne commerce, fleet and vessel characteristics, port facilities, dredging, lock characteristics and lock performance are also provided on-line with periodic reports on specialist statistics and indicators.

In Europe, despite the institutional fragmentation of responsibilities, great improvements in market monitoring statistics have been made in recent years by co-operation between the European Commission, individual countries and the River Commissions. In particular, the Central Commission for Rhine navigation has now established an EU-wide 'Market Observatory' in which it publishes twice-yearly EU-wide information on IWT traffic, transport supply, fleet data, navigation conditions and some, albeit limited, economic data. The Market Observatory Reports can be easily accessed at the CCRN website or at the EU's IWT website.

The data on IWT in China tends to be based on administrative processes rather than planning or market need. Most national statistics are simply an aggregation of provincial totals. Disaggregated national statistics of traffic and vessel flows by commodity group and by waterway are not routinely available to MOT officials, still less accessible to other industry stakeholders or the general public. IWT infrastructure utilization and performance is known mainly at provincial levels, and is incomplete. Traffic origins and destinations have not been surveyed for more than 10 years.

Chapter 6. Inland Waterway Transport and Sustainability

6.1 Introduction

Chapters 2-5 have examined the international experience of IWT in the EU, USA and China in terms of institutions and administration, policies and programs and industry and market development. The Report has attempted to take from comparative experience those aspects that appear to hold useful lessons for China's future strategies in the sector. Chapter 6 will focus on a framework for developing a sustainable IWT strategy in China.

There are two questions of sustainability that are relevant to public policy on IWT:

- what role should IWT have in a transport system that is sustainable overall?
- how can the IWT system itself be developed in a way that can be sustained?

In the following sections, each level of sustainability is discussed. The greater attention is given to the second question, which is the focus of the Study. But the first question is very significant because, in the long-term, it is unlikely that the IWT sector will be financially sustainable without public investment in improving navigation infrastructure and it is the sustainability of the transport system as a whole that may provide part of the justification for such use of public resources in the IWT sector, rather than in other transport networks.

6.2 The role of IWT Within a Sustainable Transport System

There has not yet been a comprehensive study in China that compares the environmental and social costs of different modes of transport on a consistent basis. However, research from the USA and the EU indicates that an efficiently run IWT system has some environmental and social benefits over other modes of freight transport, particularly road transport. Utilization of waterways for transport can, for each tonne-km carried, help minimize agricultural land-take, reduce congestion on roads and railways, reduce transport accident costs, reduce the average energy consumption of freight transport, and reduce the greenhouse gases (GHG) that are contributing to climate change.

USA research on social and environmental benefits of IWT

Aggregate USA Transport Statistics show that total water transport accounts for around 5 percent of all freight transport CO_2 emissions in the USA[24]. IWT on its own would account for about 2.3 percent, based on IWT share of tonne-km in total waterborne transport. This indicates that a tonne-km by IWT generates about one third of the GHG compared to the average tonne-km of freight in the USA.

In 1994, MARAD published a report called 'Environmental Advantages of Inland Barge Transport'[25]. Based on this work, the USACE literature[26] presents a comparison of the energy efficiency in the USA of a standard (23.5 tonne) road truck, a 100-wagon unit train carrying around 9,000 tonnes, and a typical 15-barge tow (a group of un-powered barges lashed together and pushed by a tug) each carrying around 20,400 tonnes.

[24] http://www.bts.gov/publications/transportation_statistics_annual_report/2006/

[25] The Report can be downloaded from http://www.port.pittsburgh.pa.us/docs/eaibt.pdf

[26] USACE: Inland Waterway Navigation: Value to the Nation, 2000

It argues that one liter of fuel can carry one tonne of freight 25 km by road truck, 86 km by railway and 218 km by barge. Since transport GHG emissions are generally proportional to fuel usage, although also dependent on fuel quality, this implies that the big barge tows used in the USA are more than two and a half times more energy and emission-efficient than very large freight trains, and nearly nine-times more efficient than road trucks. The same source notes that the single barge-tow could carry 870 individual road trucks. Assuming 46 meters between road trucks driving on a highway, one such barge-tow would be equivalent to freeing up 55 km of road lane.

The 1994 Study was recently updated and published in December 2007. The updated Report was prepared by the Center for Ports and Waterways of the Texas Transportation Institute. Its full title is 'Waterways Working for America: a Modal Comparison of Domestic Freight Transportation Effects on the General Public (December 2007)'[27] (referred to below as the Texas Report). The Texas Report updated the following variables:

- cargo capacity;
- road congestion impact;
- emissions;
- energy efficiency;
- safety impacts;
- infrastructure impacts.

The Texas Report estimated the impacts if all IWT were to divert either to road haulage, or to rail haulage (it did not attempt to estimate proportions of modal diversion). Various working assumptions needed to be made in order to derive quantified estimates, so the overall results should be considered indicative rather than definitive. In the summary below, the consultant has converted the estimates in the Texas Report into the metric units used in China.

Cargo capacity: Table 6.1 summarizes the average carrying capacity of the standard configuration of vehicles used for dry cargo in the main transport corridors where IWT operates in the USA. The Texas Report notes that if the traffic carried by IWT were to be loaded into the other modes in the unit vehicles set out in Table 6.1, and set end-to-end, the row of trains would be 97,000 km long and the row of trucks would be 533,000 km long, the equivalent of stretching 13 times round the equator.

Table 6.1: Unit Cargo Carrying Comparisons by IWT, Railway and Road Haulage

Vehicle/Vessel	Description	Length (Meters)	Capacity (Tonnes)
Barge tow	15-barge tow (5X3)	327	23,800
Railway train unit	108 cars, 3 locomotives	1,845	10,800
Road truck	Tractor plus 16.2m trailer	21.3	23

Source: Texas Transportation Institute

Road congestion: The Texas Report estimates that if all IWT were to be diverted to road haulage, it would almost double the level of combination trucks[28] on rural interstate highways on average and considerably more in the vicinity of waterway corridors themselves. Alternatively, if carried by railways it would add about 25 percent to the tonneage carried by railways. The main burden would be on the

[27] The Report can be downloaded in full, or as an Executive Summary at the US Maritime Administration's website: http://www.marad.dot.gov

[28] Combination trucks are also known variously as articulated lorries and semi-trailers.

eastern parts of the railway network, which are relatively congested and not on the west where there exists spare capacity on many lines.

Vehicle emissions: Table 6.2 shows the vehicle emissions by the different modes as estimated by the Texas Report. It indicates the environmental advantages of IWT in the USA on all measures of emissions. However, at a national level it was found that if all IWT were carried by other modes the overall increase in emissions would be relatively modest because of the high base levels of emission and those from non-transport sources. Again, the impact in the corridors where IWT operates would be more significant.

Table 6.2: Estimated Emissions by Mode of Transport in USA, 2005 (Grams/tonne-km)

Mode	Hydro-carbons	Carbon Monoxide	Nitrogen Oxides	Particulate Matter
IWT	0.012	0.032	0.321	0.008
Railway freight	0.016	0.044	0.447	0.011
Road haulage	0.014	0.093	0.501	0.012

Source: Texas Transportation Institute

(rate per short ton-mile converted to metric units by factor of 0.685)

It should be stressed that such estimates cannot be directly transferred to China where relative unit vehicle capacities, engine and fuel standards differ from those in the USA. Moreover, for the railway mode, a much higher proportion of China's rail freight is carried by electric traction which is dependent on coal-fired power generation, whereas in the USA, the great majority of rail freight is carried by diesel fuel traction.

Energy efficiency: The Texas Report always calculated the fuel efficiency of different modes in the USA, based on both empirical and modeled data. The results are shown in Table 6.3. The USA energy efficiency figures cannot be directly transferred to China because of the differences previously noted, but are likely to be of the same order, with perhaps a smaller difference between IWT and rail freight, and a larger difference between IWT and road freight.

Table 6.3: Estimated Fuel Efficiency of Different Modes in USA, 2005

Mode	Tonne-kms/litre
Inland Waterway Transport (IWT)	222
Railway freight	159
Road haulage	60

Source: Texas Transportation Institute

(rate of short-ton miles/gallon converted to metric by factor of 0.385)

Safety impacts: Table 6.4 summarizes the estimated relative safety performance of IWT, freight railways and road haulage in the USA, based on four year averages of total deaths and injuries including both to employees (e.g. truck drivers) and to the general public.

The Texas Report also assessed the rate of hazardous materials spills by the three modes, although the data is rather limited at present and based on self-reporting. Table 6.5 shows the estimates made for the USA on the basis of a four year average 2001-2004, measuring the total volume of hazardous materials spilled.

Table 6.4: Deaths and Injuries Per Freight Mode, 4-Year Average in USA

Mode	Deaths/billion tonne-km	Injuries/billion tonne-km
IWT	0.019	0.031
Railway freight	0.445	3.982
Road haulage	2.980	67.84

Source: Texas Transportation Institute

(rate per short-ton mile converted to metric by factor of 0.685)

Table 6.5: Estimated Spills of Hazardous Materials in USA, 2005

Mode	Liters of Spills/mil. tonne-km
IWT	9.3
Railway freight	10.0
Road haulage	15.7

Source: Texas Transportation Institute

(rate of gallons/million tonne-mile converted to metric by factor of 2.593)

Infrastructure: The Texas Report estimated that if all IWT traffic were diverted to highways then it would require the addition of about 5 cm of asphalt to 203,000 lane-kms of rural interstate highways (on average) because of the higher truck loadings over a twenty year period. There would also be additional capital and maintenance costs. No cost estimates are given for the impact if all IWT traffic were to transfer to railways, but an estimate for coal traffic using the Ohio River was made and it was found that the capital costs of additional railway capacity and train sets would be around USD 580 million.

EU research on social and environmental benefits of IWT

In the EU, there are many studies that compare the environmental costs of road and railway transport, and many that specifically look at environmental costs of particular modes, such as aviation. There are rather fewer that look comprehensively across all modes, including IWT. But taking into account the range of evidence over all modes, the European Environment Agency[29] concluded that the external costs of transport are large in absolute terms and represent a substantial problem for EU countries.

Table 6.6 summarizes estimates made by Prognos Consultants, of the safety, emissions and other environmental costs of the three main modes of inland freight transport in the EU. It also shows the long-run marginal costs of construction and maintenance of infrastructure. The estimates indicate that, in terms of safety, social and environmental impact, the costs of road transport in the EU are about 19 times as high as those of IWT, while the costs for rail transport are about 4 times as high. Even when the costs of building and maintaining transport infrastructure are included, the costs of road freight transport are estimated to be 2.7 times as high as IWT while the costs for rail transport are 2.5 times as high.

In terms specifically of GHG emissions, there is clear evidence in EU of the comparative efficiency of IWT over road transport. The major EU study in this field[30] estimated that CO_2 emissions per tonne-km in EU freight transport are 672 grams for airfreight, 86.3 grams for road freight (in 40 tonne-trucks), 34.4 grams for inland waterways vessels, and 29.4 grams for railways.

[29] The Agency's data can be accessed at http://dataservice.eea.europa.eu/atlas/viewdata/

[30] Institut für Energie und Umweltforschung Heidelberg GmbH *2006. TREMOD: Transport Emission Model - Energy Consumption and Emissions of Transport in Germany 1960-203-0.* Final Report.

Table 6.6: EU Estimates of External Costs of Transport (EUR/100 tonne-km)

Mode of Transport	Construction and Maintenance Costs	Safety, Social and Environmental Costs	Total External Costs (Excluding Operating Costs)
Roads	0.51	1.94	2.45
Railways	1.86	0.43	2.29
IWT	0.82	0.10	0.92

Source: Prognos Consultants, estimates for the European Commission

The EU has recently published a landmark report, bringing together previous evidence and estimates, to assist Member States to assess the external costs of transport, including social and environmental costs. It can be used by member states to assess the level of external costs of IWT, and of other modes of transport, though direct comparisons are typically restricted to road versus railway transport. However, it indicates the comparatively low level of external costs such as congestion, noise, pollution and climate change costs of IWT. The 'Handbook on External Costs' can be downloaded from the internet.[31]

Policy implications

The social and environmental benefits of IWT, across a range of impacts, are partly the driving force behind the policies of the USA and the EU to attempt to increase the role of IWT. Of all these benefits, the potential contribution to reducing GHG is gaining increasing public and policy interest internationally. There is a close relationship between the volume of transport activity, the amount of energy used for that activity by a particular mode and the generation of GHG. More than 95 percent of global transport energy use consists of oil-based fuels used in internal combustion engines. And emissions from private road transport at a global level accounts for around 70 percent of emissions. Therefore, policies to reduce transport-related GHG emissions would therefore require most countries to pay particular attention to limiting this output.

Sustainable transport policies in any particular country may therefore need, among other measures, to consider whether and how to alter the modal distribution of transport to mitigate the social and environmental costs of other forms of transport, as well as to reduce aggregate carbon intensity. This may imply trying to enhance the role and scale of IWT within national transport strategies that have an IWT network.

However, as has been noted, China does not have a comprehensive or integrated national transport strategy, aimed at influencing modal shares, but instead has programs within all modes to attain maximum affordable increments to system capacity and quality. In this situation, public investment in IWT has been, and is likely to remain disproportionately low compared to other modes, in particular road transport.

However, if sustainable transport policies in China are developed in due course, there may be implications for the role and scale of IWT within national transport strategies and for the manner in which the sector is administered and managed. This is particularly important to the possibility of increased public funding for IWT infrastructure versus other modes of transport.

[31] At http://ec.europa.eu/transport/costs/handbook/index_en.htm

6.3 Sustaining China's IWT Industry: Five Dimensions

The second question of sustainability is what the impediments are to the sustainable development of the IWT sector and how these can be overcome.

The most immediate constraints are, of course, physical ones. The most serious constraint, because of its impact on market development, is the very limited reach of the high class (Class III and better) system. On parts of this system, bridge heights create some constraints on use of very large vessels. For example, the 24 meter clearance of the Nanjing Yangtze River Bridge means that bulk sea-going vessels beyond 10,000 DWT can only travel upstream to Nanjing port and are unable to use the 213 km of deep waterway from Nanjing to Tongling. Other physical constraints, particularly on navigable but unclassified waterways, include barriers created by the infrastructure of other departments. In recent years, the cooperation required for integrated management of water resource has been greatly enhanced and the needs of IWT are considered when new hydropower and irrigation facilities are built. But there is a legacy of restrictive or very old structures from the past. For example, in 2006, there were 4,142 dams on China's rivers of which nearly 44 percent are un-navigable by IWT. In addition, only 69 percent of navigable locks and 43 percent of ship-lifts were actually working.

Still, the physical constraints on China's IWT system are being tackled through the recently agreed NIWPP2020 and via a series of provincial navigation plans that have been developed to complement the central plan. Naturally these plans will not remove all constraints on all waterways in China. There are not and will never be the financial resources to achieve this, so priorities have been determined in these plans. Correctly, precedence will be given to the extension of the Class III core network and its ports, and to the busiest inter-provincial and provincial waterways that connect with the high class network. This strategy will have enduring benefits for the widest array of users.

Given that prioritized plans to improve infrastructure have been agreed the question then is what the necessary supporting measures are that will help ensure that the infrastructure plans can be realized and that they will produce enduring benefits for IWT users and the economy. In short, what is necessary to make the IWT system as a whole sustainable?

The World Bank's Transport Strategy[32] defines sustainability in transport systems as having economic, financial, operational, environmental and social dimensions. When applied to China's IWT industry, these dimensions may be interpreted as follows:

- **Economic sustainability:** This depends on the availability and utilization of *economic resources* to meet freight market needs in a way that provides positive economic value to society as a whole. Economic resources in the sector include adequate and reliable water resources (taking account of other water users), navigation channels that can handle efficient vessels and are free of impediments, effective engineering structures such as locks and ship-lifts, general and specialized ports and an effective vessel fleet, etc.
- **Financial sustainability:** This requires that the IWT sector obtains sufficient and reliable income to enable it to pay for the construction, maintenance and operations necessary to meet the market needs. For transport service operators, financial sustainability depends mainly on commercial revenue from freight customers. For infrastructure providers, it depends on a mix of commercial revenue from infrastructure users and funding from governments (at various levels).

[32] The World Bank, Transport Business Strategy: Safe, Clean and Affordable Transport for Development. (2008)

- **Operational sustainability:** This means the management, technical and technological capability to construct IWT infrastructure, and operate and maintain an increasingly busy and sophisticated IWT transport system more safely, efficiently and reliably.
- **Environmental sustainability:** This requires that the IWT industry should meet ever-increasing public and political expectations of environmental performance, including energy efficiency and low carbon generation, as well as more stringent environmental regulations;
- **Social sustainability:** This means trying to ensure that the IWT industry develops as a good neighbor with communities who live alongside waterways and that IWT policies try to take account of livelihoods of barging families who live and work on the waterways.

These dimensions are interdependent. If IWT policy neglects any one of these dimensions it may have an adverse impact on other dimensions. For example, unless the industry is financially sustainable, it will not be able to afford adequate environmental standards. Similarly, if it is not sustainable environmentally, then it will not be able to meet its full commercial potential to handle environmentally hazardous cargo. If it neglects the social impact of change on the community of barging families who live and work on China's rivers it will ignore valuable economic resources and provoke resistance to otherwise beneficial structural changes in the industry. IWT policies need to address all the dimensions of sustainability, and not just the needs of physical infrastructure.

6.4 Sustaining China's IWT Industry: the Key Issues

The five dimensions framework is used to identify the main issues found by the Study to constitute actual or potential impediments to the sustainable development of the IWT industry in China. Taking into account both relevant international experience and China's contexts, the main issues that have been found by the Study to be particularly important to the long-term sustainability of IWT in China are summarized in Table 6.7. They are divided into those chiefly concerned with navigation infrastructure (consisting of channels, locks, ship-lifts, navigation aids etc), those concerned with ports, and those concerned with the transport services (barging) industry itself. Economic and financial sustainability are clearly related, and are treated together.

It should be stressed that the Study has found, as a whole, that the IWT sector in China is of enormous economic importance, has a fundamentally sound institutional framework, a well-defined understanding of the roles of public and private sectors, an ambitious and well-founded infrastructure physical development plan, and a vibrant and dynamic transport services industry that is delivering growth and innovation. The existing problems are how to succeed and the solutions that will build upon and reinforce that success while mitigating adverse side-effects.

In addition, not all of these issues require or are capable of immediate action or resolution. But they emerge as the areas where long-term strategic improvement will strengthen the sustainability of the system overall. Chapter 7 deals with each of these issues in further detail.

Table 6.7: IWT Sustainability in China – Main Issues Identified in Study.

Sustainability Components	(N) Navigation Infrastructure	(P) Ports and Terminals	(T) Barge Transport Industry
Economic & Financial	N1 - Comprehensive and accessible navigation infrastructure planning and performance data. N2 - Navigation infrastructure financing system that will allow NIWWP2020 and provincial plans to be attained and maintained. N3 - Continuing efficiency improvement in navigation authorities needed to ensure most effective management of infrastructure and most productive use of user fees.	P1 - Comprehensive and accessible port system planning and performance data. P2 - Infrastructure improvement in ports to handle growing traffic and bigger and more specialized vessels, together with continuing efficiency improvements to help maintain cost advantages of IWT. P3 - Diversification and market 'reach' of IWT can be increased by improving both the infrastructure and operational interfaces between seaports and IWT, and improving inter-modal connections at ports.	T1 - Comprehensive and accessible industry and transport services market performance and monitoring data. T2 - Continue to facilitate an industry market structure that encourages private firm entry, competition in prices and transport services, specialization and innovation
Operational	N4 - Long-term development of River Information Services. N5 - Good channels of consultation between infrastructure providers and transport service suppliers should continue to be maintained.	N/A	T3 - Better enforcement of vessel and operator technical and safety standards, while allowing flexible market response to shipper needs.
Environmental	N6 - Increasingly demanding interactions between navigation infrastructure managers and other authorities responsible for river environments.	P4 - Increasing need of ports to adapt to more stringent environmental requirements.	T4 - Expectation of more stringent environmental regulations on carriage of hazardous cargo, discharge of materials and waste from vessels, and vessel engine emissions.
Social	N/A	P5 - Minimize adverse impacts of commercial IWT (particularly small port operations) on riparian communities.	T5 - Livelihoods of large number of barging families, living and working on waterways.

Chapter 7. Conclusions, Recommendations and Results Monitoring

7.1 Recommended Areas for Policy-maker's Attention

Based on the existing and potential impediments to sustainability that have been identified in the Study in Table 6.7, this Section summarizes each of the recommended areas for policy-maker's attention. These are primarily aimed to assist MOT to determine its own strategy and actions, but inevitably have implications for other stakeholders in the IWT industry. Subject headings are referenced according to the issues identified in Table 6.7

7.2 Information and Data for Sector Monitoring and Planning (N1/P1/T1)

The IWT industry has now been growing rapidly for nearly a decade and, as indicated in Chapter 2, it is expected by Chinese experts to double its traffic task by 2020. Moreover, while it has been growing, it has also been changing. There has been a rapid increase in average vessel size, greater penetration into inland areas, development of container operations, increasing role of private companies, increasing proportion of higher grade waterways, port expansions, and many other changes. China's IWT sector is bigger, more complex and more technologically advanced than previously and needs more professional and sophisticated approaches to sustain its administration, planning and management. This can only be achieved if China's IWT statistical systems are designed to provide better information on the utilization of the system. This issue is relevant to navigation infrastructure, ports and transport services and is therefore addressed broadly across the sector.

China's IWT data systems provide clear waterway classifications, reasonably good quality throughput statistics for the main ports, and totals of traffic by province. But there is no routine collection or centrally published source of data on the levels of traffic using individual waterway sections (particularly on provincial feeder waterways). Neither is there data available on commodity types by their origin/destination or tonne-kms carried, or numbers of barging movements of different types, or the structure and ownership of the barging industry. Similarly, data is also lacking regarding indices of barging costs or tariffs, or on many important trends that would help in the governance of the industry and the prioritization of capital investments.

China's IWT data is extremely sparse when compared to the kind of system information, traffic patterns and utilization data that is routinely available, for example, to those planning China's railways, which are all supervised by a central ministry. The international comparisons also indicate that China's IWT system data is notably less comprehensive, less reliable and less accessible than the IWT data available to USA and EU waterway planners and policy-makers. The data available in the USA and the EU is also regularly updated and readily accessible to stakeholders and the general public on the internet.

It is therefore recommended that MOT consider establishing a comprehensive central database of China's IWT system, which we refer to below as a China Inland Navigation Database (CIND).

It would be necessary to undertake a feasibility study of how best to structure CIND, but as a starting point, Table 7.1 summarizes the main sort of data that could be targeted for capture in such a database. The table is indicative only and is based solely on freight transport, although the IWT passenger industry data could be included.

Table 7.1: Comprehensive China Inland Navigation Industry Database - Indicative Structure

Data Type	Navigation Infrastructure	Ports and Terminals	Barging Transport Industry*
Location	Digital maps of waterway system showing all classified waterways by classification and length.	Ports located on digital maps with distances from reference point(s).	Number and location of companies and vessels registered for IWT (Province and National).
Ownership Information	Specification of MOT or province administered (and which province).	Port company details, ownership details etc.	Type of ownership (individual, private company, public company)
Physical	Classification of waterways and waterway sections; Standards of major engineering structures (locks and other navigation facilities); Availability statistics (e.g. no of days able to operate at classified standard).	Classification of ports and terminals; Berth nos. and capacity (e.g. DWT) and specialized characteristics (e.g. container berth or oil terminal etc.); Major facilities, inter-modal connections etc.	Vessel classification by: • type of freight vessel, • capacity propulsion or non-propulsion, • power, • age.
Market Utilization	Total traffic flows by province and commodity; Inter-provincial origin-destination flows by commodity; Utilization by major waterway or section by direction and major commodity: • vessel movements; • tonnes/ tonne-km/TEU. Tonne-km by waterway class (total and average/km).	Traffic loaded/unloaded by province, port and commodity: • vessels loaded/discharged, • tonnes and TEU loaded/discharged.	Distribution of commodity tonne-kms by: • vessel type, • company type.

* Framework shown for freight industry, only but can be extended to passenger industry

In terms of scope, although MOT does not have operational responsibility for provincial waterways, it has responsibility for overall governance of the IWT sector. Moreover, the three main IWT systems in China are networks rather than isolated waterway sections. It is therefore important that CIND contains utilization and market information on all classified waterways and, if not practicable, at least down to the Class V waterways. Some of the biggest potential economic benefits can be attained by improvements in Class IV and Class V waterways and elevating them to higher classes. Close co-operation from provincial authorities would be essential. It is in the interests of provinces that MOT has good statistics and information on which to develop national strategies for IWT. MOT could seek such co-operation in return for the contributions that it makes to funding of capital improvements in provincial waterways.

The scope of USACE's Navigation Data Centre, and its methods of data capture, processing and promulgation, has provided a good starting point for examination by China' experts of what may be desirable and possible in China's circumstances. Central to USACE's market and infrastructure utilization data is a statutory obligation of barge operators to submit individual voyage data. China may not be able

to establish the regulations and mechanisms for full data capture all in one stage, but might examine how the various data sought by CIND could be included, and its scope widened, by stages.

Recommendation-1: A feasibility study is undertaken to define the scope of best processes, institutional responsibilities and resource requirements for the implementation of a Comprehensive Inland Navigation Database for China (CIND).

7.3 Navigation Infrastructure Issues (N2/N3/N4/N5/N6)

Long-term financing strategy (N2)

The financial challenge facing the IWT industry in China has two parts: (a) who and how to fund the capital works program; (b) who and how to sustain adequate funding for the long-term maintenance and operation of IWT infrastructure.

Funding of capital works under the NIWPP2020 requires a level of investment in IWT infrastructure that would make it the highest level in China's history. In the half century from 1949 to 2000, only about CNY 30 billion in total was invested in IWT construction in China. During 2000 to 2006, total investment in fixed assets in IWT was CNY 37 billion.

However, even though the 2006 investment reached CNY 9.85 billion for inland navigation and CNY 5.98 billion for the main ports, it is noteworthy that this is significantly less than the current annual expenditure of the EU and its member states on their IWT system, even though the EU has a more technologically mature and less heavily used IWT system.

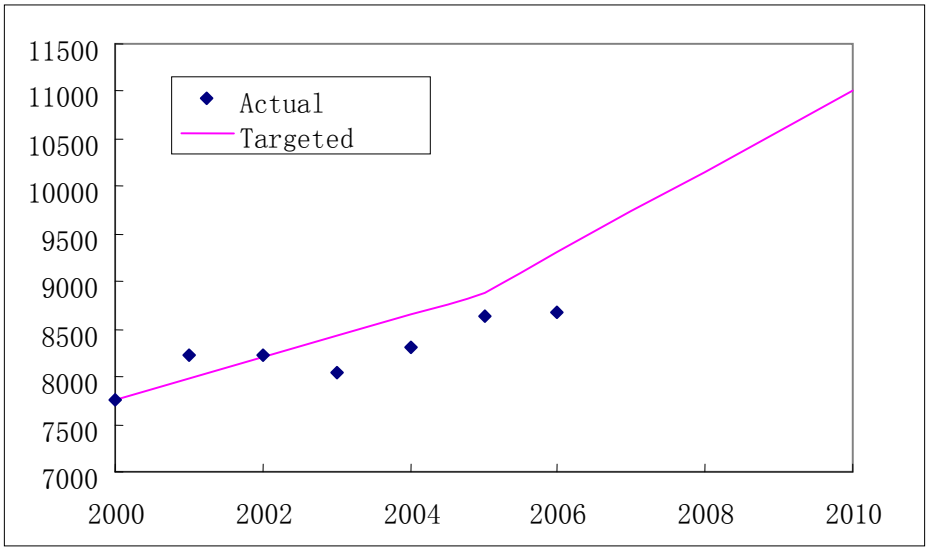
The NIWPP2020 requires that Class III and above waterways should reach 10,600 km by 2010. This implies an addition of 340 km of Class III and above waterway every year between 2006 and 2010. But in practice, the Waterborne Transportation Institute (WTI), the Study consultant, has estimated that the CNY 9.853 billion in 2006 only provided 56 km of improved waterway. It is further estimated that to achieve the 2010 target requires approximately CNY 30 billion per year, or about 4 times the actual investment in 2006. It is not surprising that the actual attainment of physical targets is falling behind the projected target (See Figure 7.1). It seems that there is already a mismatch between the physical targets set out in the NIWPP2020 and the investment resources that are available.

At to the funding of long-term operation and maintenance, it is concluded in Chapter 4, albeit without certainty, that taking account of the fees and other user-related costs, waterway maintenance cost recovery may be in the range 50-70 percent. The majority of the remainder is funded by national and provincial waterway authority budgets.

Taking into account both capital and recurrent costs, including maintenance and operating, it is clear that financing is one of the single biggest constraints to the long-term sustainability of the IWT system, and certainly a constraint to the expansion planned in the NIWPP2020.

The challenge facing funding for operation and maintenance is increasing. According to WTI information, much of the maintenance equipment is very old, the efficiency of maintenance is poor, the maintenance quality is bad, and some waterways are frequently silting. With the length of navigable waterway and costs of maintenance increasing, the problem of maintenance financing is increasing.

Figure 7.1: Class III Waterways: Targeted and Actual Length (km)



At the same time, the barging industry complains of the large number of different types of administration and service charges that they pay to government administrative agencies, and the level of these charges. There are about 70 charge items in total. According to a WTI survey, the overall charges account for between 10 and 25 percent of total revenue of shipping operators. However, in some waterways that have many locks, the proportion can reach 35 percent.

Matching resources to expectations does not allow simple or short-term solutions. It will not be fatal to the long-term future of the IWT industry if the NIWPP2020 takes a few more years to implement than was planned, but if it turns out to be wholly un-fundable then a more fundamental re-appraisal would be necessary. Similarly, if there is a widening gap between the maintenance required and the delivered, then the IWT system will progressively deteriorate, even while it is being expanded.

The Study therefore concludes there is an urgency to undertake a detailed financial investigation of the financial needs and funding sources of IWT navigation infrastructure. The financial needs assessment should include both NIWPP2020 and provincial navigation construction plans, and future maintenance and other recurrent costs. The funding sources assessment cannot be solved in isolation from overall affordability, and wider public investment choices between IWT and other transport sector investments. In early 2008, the State Council decided to allocate to MOT, as a new transport super-ministry, responsibility for all transport modes, other than railways and pipeline transport. So MOT should now be in a better position to determine and recommend the resources that should be allocated to IWT at a national level, and at least to influence allocations at provincial level.

In terms of recurrent costs, the international experience is that transport infrastructure, that is made available to users at tariffs that are much lower even than its management and maintenance costs, will tend to be poorly managed and maintained. In addition, any contribution of public funding of these recurrent costs, when it occurs, tends to be fluctuating and minimal, subject to the vicissitudes of budgeting processes. A financial investigation should therefore also look at the amount that the barging industry should and could afford to pay for the use of waterways and their infrastructure. A simpler and more rational set of mechanisms should then be proposed and implemented for this use. The EU advocates the principle that transport users should pay at least for the marginal costs, approximating to the

recurrent costs of infrastructure use. While it may not be attainable immediately, it may be a useful principle to apply to setting aggregate medium-term user cost recovery targets in China.

China officially started implementing the fuel tax in 2009, and accordingly stopped collecting the waterway maintenance fee, passenger and cargo transport surcharge, and waterway transport administrative fee. Specific fund is earmarked for construction and maintenance of waterways. As a tax collected by the central government, the approach to distributing among different regions is yet clarified.

Recommendation-2: Financial experts are commissioned to undertake a detailed financial investigation of the financial needs and funding sources of IWT navigation infrastructure, including both provincial and national uses and sources of funds; quantify the long-term need and case for national and provincial budgetary financial support.

Funding and operations of navigation authorities (N3)

It was concluded in Chapter 3 that the system of decentralized navigation authorities in China is in general logical and appropriate. The Study finds no case that this basic structure should be altered, but that attention should be given to making it work more effectively.

In this regard, there are institutional characteristics of navigation authorities that mean that they have rather limited incentives to ensure that they operate at highest efficiency or responsiveness to users:

- There are no market pressures on the navigation authorities, and they are natural monopolies in their region of responsibility; there are not, and cannot easily be, any real pressures of competition on them;
- Some are self-budgeting organizations who fund themselves from 'levies charged for overhead expenses' and are not subject to normal departmental budgeting. If they are inefficient they are able to pass these inefficiencies on to the barge companies in the province;
- The barge companies pay a range of different fees and charges for using the waterway system but the financial accounts of navigation authorities are not transparent with respect to uses of funds. Therefore, the extent to which the revenue obtained is reinvested in the system is not clear. It is not always evident either on what this revenue is invested, or indeed whether it is in fact spent on maintaining bureaucracies.

The issue of the efficiency of navigation authorities is an important one to the long-term sustainability of the system as a whole. MOT does not have direct control over the provincial navigation authorities, and cannot directly intervene in their efficiency, although it could influence their policies in return for funding grants to upgrade provincial waterways. For example, each province is required to submit a Provincial Navigation Plan to MOT and a semi-annual report about matters such as number and names of shipping enterprises registering etc. It may be possible to require provinces to include a section in their Plans, or from time to time, in their semi-annual reports, specifying what actions they intend to take in the plan period to improve their management efficiency and effectiveness in various areas such as administration, lock management, dredging, and maintenance of navigation aids.

One area in which efficiency improvements have been gained in transport infrastructure management internationally is through competitive procurement of dredging and other maintenance activities. Both highway and railway sectors in China have reaped significant savings from this approach. Waterway maintenance can sometimes be more complex than road maintenance due to constantly changing river conditions, but international experience demonstrates that suitable contracts can be tendered and

administered for activities such as maintenance dredging and care of navigation aids. Therefore it is not necessary, and may not be desirable, for navigation authorities to retain very large numbers of employees to undertake dredging of river channels, maintenance of river banks, and repair and maintenance of navigation aids. It may be possible to divest some of these functions by transforming the groups who do them into separate companies who can then compete for dredging and maintenance contracts let by the navigation authority. This approach can help introduce some competition into, and reduce the costs of, some functions which have historically been monopolized. Contract dredging is more common in coastal areas of China than in IWT.

Moreover, it is possible to attain even greater cost-effectiveness in such contracts by changing the contracts to what is known as a 'performance-based' specification. For example, in a performance-based dredging contract, the winning bidder would be paid not just to excavate a certain number of cubic meters of river-bed in a certain location. Instead the contractor would be paid to achieve and maintain a particular level of access (channel depth and width) for a particular number of days each year. Their payment would therefore be related not to input activity, quantified as an amount of dredging done but would be directly related to the operational performance of the infrastructure - the availability of good navigation channels. Performance-based contracts would provide incentives to contractors to carefully plan and continuously optimize and improve their dredging schedules, rather than just follow a rigid plan that may be rendered sub-optimal by shifting riverbeds.

Recommendation-3: The performance of navigation authorities should be considered a matter of importance to the long-term sustainability of IWT in China; their financial and operational performance records should be gradually improved to enable monitoring and comparisons of value for money in the use of funds; they should be encouraged to undertake pilot programs of competitive maintenance procurement (including both specification-based and/or performance-based dredging and other maintenance contracts).

River information services (N4)

The potential benefits of RIS are well recognized in China as they are in the USA and the EU. Use of technology can enhance the utilization of navigation infrastructure, the productivity of vessels, navigation safety and environmental protection. It can also improve the statistics with which a China's navigation data base could be populated.

Each region is embarking on a major development phase of the river information services project. The detailed functionality and staging of projects will necessarily differ as their purposes are not precisely the same in each jurisdiction. However, it may be of benefit to all three regions to create opportunities for mutual consultation and cross-fertilization of ideas.

Recommendation-4: High priority is to be given to implementing its 2007 RIS project, including continued dialogue with experts involved in similar programs internationally.

Consultation among industry stakeholders (N5/N6)

As described in Chapter 4, the ***Water Law***, the ***Port Law*** *and the* ***Regulation on Administration of Waterways*** all stipulate the legal obligations for those involved in supplying navigation and port infrastructure to consult with a wide variety of other government departments, at national and provincial levels, in reaching their decisions.

There is no legal or regulatory obligation to consult with the users of IWT infrastructure, the barging industry and its customers in China , as in the USA and the EU transport policy and project procedures. However, such consultations do take place through various branches of Trade Associations. For example, the China Ship Owner's Association (Yangtze Branch) acts as a channel of communication between operators on the Yangtze and the government. It assembles and conveys operators' views to relevant authorities and it disseminates new industry laws, regulations and policies to members. The China Ports & Harbor Association (Yangtze Branch) performs a similar function for ports issues on the Yangtze.

Recommendation-5: MOT continues to contribute actively to inter-departmental consultations and planning of water resources to ensure that the interests of IWT are positively and comprehensively represented in decisions, policies and projects that may have an impact on the IWT industry; and similarly that the channels of communication with all stakeholders in the transport services industry, and with major freight shippers, are kept active and harmonious.

7.4 Ports and Terminals (P2/P3/P4/P5)

Upgrading of ports facilities and performance (P2)

Chapter 5 of the Report detailed the port reforms that have occurred over the last thirty years and the success of many of those ports in handling traffic volumes that are substantially growing and diversifying. One of the potential impediments to the sustainable development of the IWT system is that, despite increased investment in some of the main ports, many others are old, lack large and/or specialized berths, and may need more modern handling equipment. The relevant question is how to solve capacity and quality problems in what is now a very decentralized administrative system.

The most compelling finding is that the market-oriented policies that the government has pursued in the IWT sector (ports and shipping) have seen a big increase in traffic and port investment. In this regard the policies have been successful. It is part of that success that average vessel size has increased by a factor of 6 in just 10 years. It is to be expected that heavy infrastructure, such as port construction, cannot adapt to such industry changes immediately.

The logical course is to build upon the previous market-oriented reforms in the IWT sector by encouraging continued commercial policies by provinces and cities with regard to ports as well. More external participation should also be encouraged. This could be implemented by leasing of terminal areas or granting concessions to build and operate new terminals, promoting fair competition between terminal operators within ports where throughput is large enough to sustain it, and encouraging competition between ports where possible. Similarly, reducing the simultaneous ownership of both ports and shipping companies by provincial and local governments would help assure non-discriminatory access of transport service providers to facilities and could improve utilization of capacity.

External participation in ports investment and operation: In many countries, port efficiency and better port services have been promoted through a balanced public and private sector approach rather than just relying on the public sector to build and manage port infrastructure and services.

Internationally, the ports sector has proven to be one of the most fruitful areas in transport for increased private investment. Traditionally, most ports in developing countries were so-called public service ports that tended to be slow to adapt to the growing traffic task and more demanding standards required. These ports also rarely had access to all the capital investment funding necessary fully to respond. Governments

have therefore often looked to the private sector for both capital to meet growing demand and professional operating experience to offer world class services to facilitate trade.

The most prevalent mode of private participation has been what is called the 'landlord' model. In landlord ports, the public sector (national, provincial or city government) is the owner and developer of the basic port infrastructure and manager of the common areas and facilities. Cargo handling operations are then leased, contracted or concessioned to specialized private companies.

Competition in the inland ports sector: International experience suggests that port companies can sometimes have significant market power in their regions of operations. This usually occurs for at least one of four reasons:

- The regional economy and throughput may be too small realistically to support two competing ports.
- There are some economies of scale and scope in port infrastructure which means that once the basic infrastructure of a port has been built (channels, berths, navigation aids, access roads etc.), the marginal costs of increasing throughput may be less than the average costs, particularly during developmental stages. Existing ports therefore may have cost advantages over new ports in expanding capacity.
- Existing ports may have the best location with regard to the industries that IWT serves, which may give them a strong advantage over a new port.
- In cases where the existing ports are owned by government authorities, they may establish planning restrictions that make it difficult for potential competitors to build new port infrastructure.

In areas where IWT ports are operated as local monopolies by large publicly-owned enterprises with excessive market power and few incentives for efficiency, this will be an impediment to the long-term sustainable development of the IWT industry. Creating competition between IWT ports, or within a specific port, is not feasible where traffic flows are very low. However, where the possibility exists, the long-term development of the industry will be better served because competition creates incentives for managers to meet market needs at the lowest possible cost and it encourages them to innovate to obtain market advantage.

The development of China's IWT industry will therefore be supported by policies that:

- discourage local governments who own ports from protecting their own ports by unreasonable restrictions on companies who wish to invest in new ports and terminals;
- encourage state, provincial and city-owned ports to constitute their port companies as commercial enterprises with transparent and consistent accounting and reporting systems that can underpin fair competition between them;
- encourage competition between terminals within a port if the level of traffic makes this feasible;
- where exclusive operation of a particular type of terminal may be justified, consider the possibility of a concession structure and encourage periodic competition for the concession through a competitive and transparent bidding process.

Such policies are closely connected with the ideas that underpin the 'landlord' port concept identified above. More details of the concepts of making ports more competitive and efficient, the international experience and the tools for implementing new policies are available in a World Bank Toolkit.[33]

[33] World Bank. 2006. *Port Reform Toolkit: Second Edition.* World Bank and PPIAF, Washington, DC. http://www.worldbank.org/transport/ports/toolkit_update/toolkit.html

There is however always a risk with such policies that there may arise some duplication of port services and facilities. However, demand is increasing rapidly in China and the more immediate danger is that there may be insufficient port capacity of the right type and quality rather than too much.

Recommendation-6: The port reform policies that have been adopted should be continued and built upon to continue encouraging more diverse participation and investment, and higher private participation in specific terminals and competition in port services where feasible.

Expand market reach of IWT (P3)

One of the strengths of the China's IWT system is the fact that the system is physically linked to many of China's most important international seaports. A strategy for the industry should give detailed attention to how the infrastructure and operational interfaces between IWT and international shipping in these ports can be strengthened to maximize the opportunities for onward collection/distribution of international cargo by IWT.

There is also a scope to expand market reach through better inter-modal connections at ports. These are not always very good for most traffic types, particularly rail/port connections and this inherently limits the market reach and penetration of IWT. As shown in Chapter 5, even of the main 28 ports, only around half are linked to a railway line and some of these connections either do not have modern and efficient inter-modal design and equipment, or do not offer onward train services. Moreover, even in the container business, only two of the container terminals, according to the railway network plan of Ministry of Railways (MOR), will be built close to IWT ports (at Wuhan and Chongqing).

Big improvements in seaport/IWT interfaces and inter-modal connections are unlikely to emerge through simple workings of the market alone. They need to be given specific policy and project focus in national and regional transport plans.

Better inter-modal connections between railway and IWT will help make both modes of transport more competitive with highway transport, for a range of freight movements. But IWT has most to gain through these connections because the waterway network is static and its markets are inherently limited without connections to other modes. Moreover, the MOR is an enormous national organization, whereas most individual inland waterway ports are by comparison very small. Therefore, there is a case for MOT to take the initiative in liaising positively with MOR to promote, and possibly to help finance, rail connections in the vicinity of ports, including provincial ports.

Recommendation-7: MOT investigates how the market reach of IWT can be expanded by improving the infrastructure and operational interfaces between seaports and IWT and by improving inter-modal access at river ports, where such connections may be shown to be economically desirable.

Environmental and social impact of IWT activity and ports (P4/P5)

There is a very large number of small and medium-sized ports on China's waterways where IWT activities, including loading/unloading and storage, exist in close proximity to residential and other built-up areas. Unless this activity is carried out in a disciplined way which is sensitive to local concerns, it may be environmentally intrusive or physically dangerous to local communities. Environmental

expectations and standards in China are likely to continue to increase as economic development progresses and incomes rise. This could prove to be a significant constraint on the sustainable development of the IWT unless it adapts to these rising expectations.

Recommendation-8: MOT prepares and disseminates guidance to IWT ports and operators about the importance of harmonious relationships with local communities, the need for compliance with prevailing environmental standards, and practical measures that can be taken for IWT activities to become a better 'neighbor' to others who live and work alongside China's rivers.

7.5 Barge Transport Industry (T2/T3/T4/T5)

Keep transport services markets competitive (T2)

The IWT industry depends on a successful partnership between public infrastructure and private transport services. The central role of national and provincial governments in the provision and operation of navigation and port infrastructure is essential and cannot realistically be replaced. But the ultimate sustainability of the IWT will depend on how successfully barge transport companies use the infrastructure to deliver transport services to freight customers.

China's experience suggests that the long-term sustainability of the IWT industry will be best promoted by continuing to encourage an open industry structure for barge transport services. An 'open' industry structure is one that avoids unnecessarily restrictive regulations on vessel operators in terms of their ability to enter and exit the industry, the vessels that they use, and the services and prices that they offer.

In terms of industry entry and exit, subject to national cabotage policy and to meeting competence tests, entry into the industry is not artificially restricted. Partly as a result of this 'open' structure, the barging industry in China is very competitive, growing in size, and developing more specialization, such as in shipping of containers or petroleum products. Although there are some large companies on the main routes, the overall industry concentration is not excessive and there are few, if any, parts of the market that are not readily contestable by large numbers of small and medium-sized companies, or by new entrants.

As in all such industry structures, there is likely to be continuous turnover of companies entering and leaving the industry. However, the overall sustainability of the industry does not require that every individual company will be sustained. The IWT industry, as a whole, will be more sustainable if it is dynamic and adaptable. And this will occur when the barging market is open to new investment and new operators who may replace inefficient companies that fail and exit the industry.

In terms of vessels, this is a challenging area because China has such a vast array of vessel types and sizes. There are more than 3,000 types of ship in China. On the Yangtze River alone, there are more than 300 types of ship and 140 types of motor. In the EU, there are 16 basic ship designs used in self-propelled cargo vessels ranging in tonneage from 300 DWT to 4500 DWT and four main kinds of dumb barge. In the USA, there are five main kinds of barge.

There are the following possible reasons for the wide range of vessels in China.

- China is a large and very diverse market containing many different sub-markets and operating circumstances, which is partly reflected by the fleet diversity.

- The execution of legal ship inspections differ between different local ship inspection agencies, though the same standards nominally apply. Lower standard vessels are often approved at the provincial level. This in turn makes it harder for more expensive, but higher standard vessels, to compete.
- Large numbers of individual operators own and live on vessels and as might be expected, they adapt vessels for their own convenience.
- Many waterway construction projects and irrigation projects are carried out constantly, which means vessels must continually be adapted to the changes.

The ship standardization policies applied on the waterways for which MOT is responsible will helpfully lead to fewer high polluting vessels, larger vessels, more modern vessels, and less damage to and higher utilization of congested infrastructure. As a generalization, vessel standardization is better for infrastructure planners and providers, while vessel diversity is more beneficial for markets. In devising measures to standardize and increase barge size, it will be important to strike a balance between the interests of the IWT markets and those of infrastructure providers. Economic mechanisms can help establish this balance more efficiently than regulations alone. For example, the use of many of the more congested locks and waterways in China is either free or charged at a flat rate per tonne of cargo. Charging systems that are based on the utilization of capacity and facilities, rather than just tonnes carried, will have the following three advantages.

- They will tend to favor larger vessels of designs that attain higher throughput for a given use of capacity.
- They will still allow smaller vessels carrying urgent or high value cargo to use the facilities, in contrast to an outright ban, provided they pay the requisite fee for use of capacity.
- They will give a greater incentive to operators to seek ‘back-loads’ to reduce the number of barges that pass locks empty or lightly-laden.

MOT can also encourage barge companies and ship-builders to consult and collaborate with international experts in vessel design to benefit from selective transfer of international skills and experience. Promising areas of collaboration could include specialized vessels, transport of hazardous cargo, energy-efficient engine designs and cleaner fuels.

In studying such experience, it is important to consider the extent to which minimum crew-size regulations in China, which often lead to crews which are substantially larger than equivalent vessels in the EU or USA, may be constraining the optimization of vessel design and efficiency. If so, it might be necessary to review whether the current minimum crew numbers specified are appropriate.

In terms of transport services and prices, if the competitive structure of the barging industry market is maintained, the specific transport services that barge companies offer to freight customers, and the prices that they charge, can be safely left to market forces. The long-term sustainability of the industry will then depend on acting against any pricing cartels that may be established, or any restrictive practices by ports or barging companies that restrict competition. An example of this would be discriminatory port tariffs or volume discounts for particular shipping companies that effectively block-out new operators.

Recommendation-9: Existing market-based policies for the barge transport services industry should be retained in which competition is encouraged, industry capacity quotas and tariff regulations are avoided, and standards-based regulation is retained to ensure navigational competence, safety and environmental performance.

Technical and safety standards (T3/T4)

One of the adverse reasons for a proliferation of unwelcome vessel types, often of low standards, are that different provincial navigation authorities apply different requirements or are sometimes lax in vessel inspections. The national ***Regulations of Ship's Legal Inspection of PRC*** are not always rigorously applied. While it is possible to improve consistency and compliance in the short-term through better policing of the national regulations, one underlying problem is that provinces have a financial incentive in obtaining vessel registrations in their own province than in neighboring provinces. Equally, they have concerns that some of their local carriers may not be able to afford to comply. For the local authorities, they may make themselves a more attractive location for registration by 'turning a blind eye' to certain matters of non-compliance.

However, as the IWT system sees larger and more specialized vessels, with more heavily utilized waterways and becomes dependent on better technology, China's main waterways will have less room for, and necessarily lower tolerance of, vessels that are unsafe or unreliable or heavily polluting. Not only may they create navigation or environmental hazards, but they will undermine fair competition with those individuals and companies who do comply with the rules.

This cannot just be a temporary campaign but a long-term commitment to the agreed standards. It is also important to recognize that those standards will change over time. Existing regulations on hazardous cargo and the discharge of materials and wastes from vessels may be strengthened. Moreover, China does not currently have any vessel engine energy efficiency or emissions regulations, but nonetheless should consider adopting such standards if it wishes to strengthen the case that IWT is the most environmentally friendly transport mode.

Recommendation-10: MOT considers the case for progressive introduction of vessel engine efficiency and emissions standards, while increasing its efforts to ensure by provincial navigation authorities comply with all prevailing national environmental, safety and competence standards for vessels and crews.

Protection of livelihoods of the community of small barge owner-operators (T5)

It is important to the long-term economic sustainability of the IWT industry that it modernizes and progresses. Otherwise, with highway and railway transport developing every year, the IWT will stagnate and then decline. However, IWT policies and strategies should take account of, and try to mitigate, the impact of modernization on the small family operators in the industry.

Around 80,000 individual households, each owning one vessel, operate on China's waterways, many of them living on their barges. If all family members and dependents are included, plus people employed in IWT ship-building and repairs and at all the small ports and minor landing stages, it is likely that at least half a million people belong to or depend for their livelihoods on the operation of the independent barge sector.

The increase in waterway traffic levels in recent years has helped support all barge-owners, including very small ones. This group in particular is vulnerable to the many possible threats to their livelihoods:

- An increasingly competitive market will put pressure on tariffs and directly on their earnings.
- More rigorous vessel standards, including environmental standards, may put their existing vessels out of use on some or all waterways.

- It may be difficult for them to participate in the trend toward larger and more modern vessels as their access to financial resources or loans to buy bigger vessels is likely to be very limited.
- Their lifestyle and mode of working may not make it easy to impart the education and skills necessary for their children to participate fully in a modernized IWT industry.

By the nature of their work, these families tend to be geographically scattered, often in quite remote locations, and they work independently. It is difficult for the small barge community itself to organize to express their collective concerns, even through the operators' associations. It means that they and their problems may have little visibility to policy-makers at both central and provincial levels, and their lifestyle may be seen as a remnant of a by-gone era rather than an integral part in future development.

The principles of social sustainability require that the impact of policies on these families to modernize and professionalize the commercial barging industry should be acknowledged and assessed, and if possible mitigated. Some of the mitigation measures might include policies such as:

- appropriate phasing-in of new vessel standards, including environmental requirements, to allow small owners time to adjust;
- provision of access to locks at affordable prices at non-peak times;
- provision of access of small and medium-sized barging enterprises to financial credits for adaptation of vessels, or new vessels to meet higher regulatory requirements;
- retention of appropriate low-cost infrastructure and facilities at ports to enable the small barges to access, even when new modern berths are provided for large vessels;
- assistance with adjustment into new shore-based jobs for those forced out of the industry.

The foregone list is only indicative. The key point is that, as in many other China's industries, the IWT industry is modernizing and this will inevitably leave many traditional operators behind. The full extent of the problem will not be revealed until there is a stabilization or downturn in traffic levels, but it is prudent to anticipate the adjustments that will be required.

Recommendation-11: Long-term policies for sustainable development of the IWT industry should explicitly contain mitigation measures for those small family barge owners/operators who may be adversely affected by the modernization process.

7.6 Monitoring of Results

Result Areas

The framework for monitoring the sustainable development in the IWT sector should reflect those aspects of the industry that are considered important to policy-makers in the sector. Following earlier discussions with MOT, it is proposed that the framework adopted for analyzing the concept of sustainability should also be adopted for assessing objectively success in the development of the industry. Thus, the framework proposed should try to measure and demonstrate success in the dimensions of economic and financial, operational, environmental and social sustainability. Within each dimension, it is necessary to identify the main areas in which MOT wishes to assess the results of its policies and of IWT industry development more generally. These are defined as Result Areas. The results framework proposed contains 14 'Result Areas', which represent the consultants' interpretation of the 14 most important areas in which MOT is trying to influence the industry, and therefore in which MOT should attempt to assess results.

If there are other Result Areas that MOT considers vital to include, they can be added, though the more that are added the less focused will be the monitoring and the greater the administrative effort required in implementing the framework.

Monitoring Indicators

The monitoring indicators should try to measure the success of the industry in meeting policy-makers' objectives within each of the Result Areas. At this high policy level, the indicators selected should reflect a number of aims:

- the indicators should try to measure results in those areas that policy is trying to influence (defined as Result Areas);
- there should not be too many indicators, because policy-makers need to focus on the essentials;
- the indicators should therefore be high-level, and deal with the progress of the industry in its widest sense;
- the indicators should be based on statistics and information that are both possible and economical to collect and analyze.

Within the 14 Result Areas, the framework proposes 29 high-level performance indicators. Unfortunately, in regard to forth criterion above, the data on China's IWT industry that is held at a central level is rather limited, and certain types of data may not be immediately available. The indicators that are listed reflect this rather limited basic data availability, but only partially. In some areas, the consultants have proposed basic indicators which are too important simply to discount. If the data does not currently exist, it is recommended that over a period of time it be collected as part of the CIND as recommended in the Study.

Overall Results Framework

On this basis, Table 7.2 summarizes the proposed monitoring framework for industry sustainability. More detailed notes are given below the table. As noted the framework is indicative rather than definitive, and it can be adapted by MOT to include or exclude particular result areas, or to modify the performance indicators to be monitored within each result area. It can also be implemented in stages over time, depending on the development of information systems.

Table 7.2: Sustainability of the IWT Industry - High-level Results Framework – (1)

Main Components of Sustainability	Result Areas	Main Performance Monitoring Indicators	Notes
Economic & financial:			
The ability of the IWT industry to offer, maintain and continuously improve competitive transport services to freight customers in accordance with market needs and in a way that is financially viable.	1. Increase and diversify IWT traffic levels.	1.1 Total traffic by tonnes and tonne-km carried 1.2 Traffic carried by major commodities, by tonnes and tonne-km carried 1.3 Traffic carried by each class of waterway	Note 1
	2. Maintain or increase modal share carried by IWT.	2.1 Proportion of total traffic carried by IWT transport, by tonnes and tonne-km carried 2.2 Proportion of international containers delivered to/from major seaports that are handled by IWT	Note 2
	3. Improve competitiveness of shipping services.	3.1 Index of average shipping freight tariffs for a fixed sample of routes and commodities 3.2 Index of port charges for a fixed sample of routes and commodities 3.3 Index of average delivery/collection time of international container by IWT between seaport and final customer for a fixed sample of routes	Note 3
	4. Ensure the financial sustainability of navigation infrastructure.	4.1 Total capital expenditure and sources of funding, including proportion of recovery from users 4.2 Total operational expenditure and sources of funding, including proportion of recovery from users	Note 4

Note 1: MOT wishes to increase and diversify the volume of traffic carried by IWT and the best single indicator of success in this Result Area is the tonne-km carried of each major commodity. Use of 'tonnes handled' is not such a good indicator because (a) traffic may be handled more than once leading to multiple counting of the same traffic, and (b) 'tonnes handled' ignores trip distance and so does not give a full indication of the total traffic performance. Traffic carried by class of waterway (Indicator 1.3) is particularly useful in assessing both the success of the waterway upgrading program, plus traffic trends on the lower rated waterways.

Note 2: China's national statistics already provide estimates of total traffic by different modes of transport (Indicator 2.1). However, the success of the industry in attracting international container traffic is a good measure of its overall adaptability and performance in diversifying into high value markets generally. Indicator 2.2 should be easily supplied by major seaports.

Note 3: The ultimate purpose of MOT and provinces in improving IWT infrastructure and encouraging fleet improvements is to make the IWT industry able to offer better services at lower costs. This is therefore a very important Result Area, and it is suggested that MOT maintain indices of IWT shipping rates and service levels. These can only be limited samples, but if the sample frames are carefully designed, a meaningful time-series should be attainable.

Note 4: The Study has identified the financial sustainability of inland navigation infrastructure as both a major 'unknown factor' (because of data limitation) and a major concern (because of apparent delays in attaining the NIWPP2020 targets). It is therefore very important for policy-makers to monitor the evolving sources and uses of funds in the industry on a comprehensive basis.

Table 7.2: Sustainability of the IWT Industry - High-level Results Framework – (2)

Main Components of Sustainability	Result Areas	Main Performance Monitoring Indicators	Notes
Operational:			
The capability to construct IWT infrastructure and operate an increasingly busy and sophisticated IWT transport system more safely, efficiently and reliably	5. Implement the NIWPP2020 plan and provincial navigation plans	5.1 Total length of waterways of each class operational at the end of each year, in total and compared to plan targets 5.2 Total number of new berths of various types/capacities operational at the end of each year in total (and compared to plan targets if available)	Note 5
	6. Increase the efficiency of administration of navigation	6.1 Indices of productivity for each navigation administration and in total (e.g. cubic meters dredged/dredging employee, or river-kms maintained/maintenance employee)	Note 6
	7. Modernize the barge fleet	7.1 Total fleet numbers by barge type/class 7.2 Average capacity, power rating and age by barge type/class 7.3 Number of new vessel registrations by barge type/class	Note 7
	8. Improve port performance	8.1 Total port and berth numbers by berth type/class 8.2 Average capacity of berths by type/class 8.3 Index of vessel turnaround times for a fixed sample of port terminals 8.4 Number of ports with regular rail service connections	Note 8

Note 5: The NIWPP2020 represents the main physical goal of MOT and is therefore a key Result Area that should be monitored, both in terms of navigation improvements (Indicator 5.1) and ports improvements (Indicator 5.2).

Note 6: Efficiency in the administration of inland waterways should be a key concern of policy-makers and an important Results Area. It is suggested that a number of productivity indices be developed and monitored for navigation authorities. The indices will provide a 'time-series' that will enable policy-makers to assess trends in performance of a single navigation authority. The indices will also provide a 'cross-section' across different navigation authorities that will enable the performance of each one to be benchmarked against the others.

Note 7: MOT has important policies in fleet modernization and so is a key Results Area. It is suggested that DWT, age and power rating are key indicators. It would also be helpful if the statistics could distinguish between dry bulk vessels and tanker vessels, for both self-propelled or un-powered barges.

Note 8: Ports performance is clearly a key Result Area with which MOT is concerned and four main performance indicators are suggested. Indicators 8.1 and 8.2 will measure the overall availability of port infrastructure and the extent to which the higher capacity, specialized berths being sought by MOT, are actually provided. Indicator 8.3 captures the broad operational performance of ports for a given sample of terminal types, while Indicator 8.4 will measure progress in establishing better inter-modal connections (although not how much they are used).

Table 7.2: Sustainability of the IWT Industry - High-level Results Framework – (3)

Main Components of Sustainability	Result Areas	Main Performance Monitoring Indicators	Notes
Environmental:			
The ability of the IWT industry to meet ever-increasing expectations of environmental performance and more stringent environmental regulations	9. Increase energy efficiency	9.1 Average liters fuel used/1,000 tonne-km of freight carried	Note 9
	10. Reduce spillages of dangerous cargo on waterways	10.1 Total number of significant incidents 10.2 Total spillage (1,000 liters)	Note 10
	11. Reduce spillages of dangerous cargo in ports	11.1 Total number of significant incidents 11.2 Total spillage (1,000 liters)	Note 11
	12. Increase industry safety	12.1 Number of significant incidents involving death or serious injury 12.2 Number of deaths and serious injuries to IWT shipping and port workers and to other people caused by IWT	Note 12
Social:			
IWT as a good neighbor and one that considers livelihoods in small boat sector	13. Monitor impact of IWT and ports on waterside communities	13.1 Qualitative assessments	Note 13
	14. Monitor social conditions in small barge sector	14.1 Numbers of individual owner-operators 14.2 Qualitative assessments	Note 14

Note 9: There are national targets for energy efficiency in IWT, so this is a key Results Area to be monitored.

Notes 10/11: One of the main environmental concerns with regard to IWT is spillage of hazardous or dangerous cargo. The suggested performance indicators cover both the number of incidents and an estimate of total volume of materials involved in serious spills. It is suggested that data for navigation and ports incidents be kept separately, as the likely causes of and solutions for such incidents will be different.

Note 12: MOT wishes to see much higher compliance with vessel and crew standards regulations and one of the drivers of this concern is industry safety. It is assumed that China already keeps the two main safety indicators proposed (and more detailed data) so that these can be readily incorporated into the proposed industry monitoring framework.

Note 13: There is no obvious single indicator of how well ports are performing in terms of harmonious relationships with other waterside neighbors. However a qualitative assessment can periodically be made.

Note 14: Total number of owner-operators in the industry can be monitored from registration statistics (Indicator 14.1), though more detailed social surveys would be needed from time to time to really understand the status and problems of small operators. Such surveys could form the basis of a qualitative monitoring of this sub-sector of the industry (Indicator 14.2).

Annex A: Maps and Sources of Data on USA and EU IWT Systems and Standards

A1: USA

The US Navigation Data Centre provides a complete database of maps and supporting information about the whole US waterway System. It is contained in the website Waterway Data, which can be found on:

http://www.ndc.iwr.usace.army.mil/data/data1.htm

Waterway data include the navigable waters in the USA, including inland waterways, off-shore waters, the Great Lakes, and the Saint Lawrence Seaway. Data on commerce, facilities, locks, dredging, imports and exports, and accidents are included along with the geographic waterway network.

The data included are in standard file formats that can be imported into other software tools such as spreadsheets, databases, and Geographic Information Systems (GIS). Software is available to be downloaded to read the GIS systems.

A2: EU

A map showing all the classified waterways in Europe in detail can be seen and downloaded at:

http://www.inlandnavigation.org/documents/Facts%20Figures/Network/Map_Waterways_Europe.jpg

Technical parameters of the main European international waterways can be seen and downloaded at:

http://www.unece.org/trans/doc/finaldocs/sc3/TRANS-SC3-144e.pdf