MANUAL ON MODERNIZATION OF INLAND WATER TRANSPORT FOR INTEGRATION WITHIN A MULTIMODAL TRANSPORT SYSTEM
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I. INTRODUCTION

A. Definitions

The basic feature of multimodal transport is that at least two modes of transport are used.

The definition jointly given by the United Nations Economic Commission for Europe (ECE), the European Conference of Ministers of Transport (ECMT) and the European Commission (EC) is “Multimodal transport: carriage of goods by two or more modes of transport.”

Sometimes, multimodal transport is connected to the international transport of containers and the need for transport facilitation. It derives its name from the United Nations Convention on International Multimodal Transport of Goods of 1980. The definition of the term “international multimodal transport” is provided in article 1 of the Convention, which reads as follows:

“International multimodal transport” means the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country at which the goods are taken in charge by the multimodal transport operator to a place designated for delivery situated in a different country.

It has evolved, however, to have various meanings closely related to multimodal transport, and these various definitions will be reviewed in turn.

- The most common is that the goods are carried from door to door in the same intermodal transport unit (ITU), usually a container, but it can be also swap bodies or piggyback trailers. This is called intermodal transport by ECE, ECMT and the EC, as well as the International Container and Intermodal Transport Bureau (ICB) and the International Chamber of Commerce (ICC). The definition jointly given by ECE, ECMT and the EC in Terminology on Combined Transport\(^7\) is:

1.1 **INTERMODAL TRANSPORT:**

The movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes.

By extension, the term **intermodality** has been used to describe a system of transport whereby two or more modes of transport are used to transport the same loading unit or truck in an integrated manner, without loading or unloading, in a [door to door] transport chain.

Intermodal transport is also defined as the use of at least two different modes of transport in an integrated manner in a door-to-door transport chain.²

- A related term is combined transport. “Combined transport” is defined as intermodal transport where the major part of the European journey is by rail, inland waterways or sea and any initial or final legs carried out by road are as short as possible. This term is used by ECE, ECMT and the EC to cover environment-friendly intermodal transport, involving as little road transport as possible, and supported by financial incentives. The definition by the European Union (EU) is even more precise, as follows:³

  *For the purposes of this Directive, 'combined transport' means the transport of goods between Member States where the lorry, trailer, semi-trailer, with or without tractor unit, swap body or container of 20 feet or more uses the road on the initial or final leg of the journey and, on the other leg, rail or inland waterway or maritime services where this section exceeds 100 km as the crow flies and make the initial or final road transport leg of the journey;*
  
  - between the point where the goods are loaded and the nearest suitable rail loading station for the initial leg, and between the nearest suitable rail unloading station and the point where the goods are unloaded for the final leg, or;
  
  *within a radius not exceeding 150 km as the crow flies from the inland waterway port or seaport of loading or unloading.*

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At the root, however, the multimodal/intermodal concept is all encompassing to the point that it applies to passenger transport as well. For example, carefully planning a network of public transport combining buses, rail and metro (or skytrain) is a multimodal/intermodal exercise, involving also pedestrian access routes, bicycle lanes, car parks at hubs, appropriate access roads, etc.

In the United States of America, an Office of Intermodalism was set up in 1992 within the Department of Transportation. It states the following:\(^4\)

_The concepts of "intermodalism" have been applied by the freight industry for many years to provide the shipper with the most efficient movement of goods for the best value. The same concepts that work for freight have broad applications to all types of transportation._

_In its simplest terms, "intermodalism" covers all of the issues and activities, which may affect or involve more than one mode of transportation. It has several aspects:_

**Connections:** the convenient, rapid, efficient, and safe transfer of people or goods from one mode to another (including end-point pick-up and delivery) during a single journey to provide the highest quality and most comprehensive transportation service for its cost.

**Choices:** the provision of transportation options through the fair and healthy competition for transportation business between different modes, independently or in combination.

**Coordination and Cooperation:** collaboration among transportation organizations for the purpose of improving transportation services, quality, safety, and economy for all modes or combinations of modes in an environmentally sound manner.

This shows that multimodalism/intermodalism is not limited to freight transport. It is the opposite of unimodalism.

Going unimodal is a comfortable way of thinking, but is either impractical (like inland water transport (IWT) in deserts), expensive (like overland trucking) or not environmentally friendly (like single car occupancy in cities).

\(^4\) [http://www.dot.gov/intermodal/about_us.html](http://www.dot.gov/intermodal/about_us.html)
Multimodal transport implies also related items, such as carefully arranged connections, in sites preferably tri- or quadri-modal, and a layout of connecting sites which encourages multimodality. It thus relates to ports, freight villages, hubs, interfaces, etc. Without such interfaces, a transport cannot be multimodal.

B. History

The “multimodal transport” concept is not new. In the seventeenth century, a famed French writer described how his horse-drawn carriage boarded a barge and went down the Rhone River for 400 km, to avoid the bumpy ride on the underdeveloped road network of the times. This was a precursor of roll-on/roll-off (Ro-Ro). Modern multimodal transport, however, was born with railways. On the very first railways in 1830 (figure I.1), horse-drawn carriages were detached from their wheels and loaded onto flat wagons or attached to bogies, to save travelers the trouble of changing from carts to wagons. It might have been a way to win acceptance for this new mode of transport in order to show how similar it was to the accepted means of passenger transport. This system, however, disappeared quickly because of fierce opposition by some cities.

As far as cargo transport is concerned, container transport or unitization started on railways even before the First World War. In France, these “cadres” were some 2 x 2 x 2 m. strong wooden boxes (figure I.2), reusable, and carrying goods, mainly removals, from door to door. Some can be seen in the French Transport Museum.

An early road-rail-sea trimodal combined transport service between Paris and London operated through Calais and Dover just before the First World War. In 1933, these
international ventures led to the establishment of the International Container Bureau\(^5\) by ICC, both bodies being located in Paris, in order to sensitize the business community to the development of international and thus intermodal transport and its practical aspects.

A specific French domestic company, CNC, was established in 1948, with a fleet of steel “cadres” and a through bill of lading, exporting to all French-connected countries (figure I.3).

The real multimodal revolution, however, originated when a road transport operator, Malcolm MacLean, wanted to overcome the hurdles of the varying legislation concerning trucks in the fifty states of the United States. The interstate trucks needed as many license plates as states they crossed, and the authorized dimensions and specifications varied. Using a system of tractor-trailers helped to cross state borders without handling the goods, but not everywhere. At the beginning of the 1950s, some road operators put their trailers piggyback on railway flat cars to avoid these barriers.\(^6\) Malcolm MacLean, reminded of his frustration in the 1930s at the time lost by his trucks during port operations, gave this some thought. Putting them on a ship without unloading would save time, and sailing along the coast could avoid the barriers. However, he soon found that the wheels and undercarriage of the trailers were an unnecessary burden on board. He devised a chassis on which to bolt a container\(^7\) equivalent to a trailer of the maximum size then allowed on American roads (35’ x 8’ x 8’), and started the first real multimodal, domestic transport from New Jersey to Texas on 26 April 1956, on board deck of a transformed tanker. As a final touch to his invention, his next ships had on-board container gantries as well as cells in the holds, where the containers could be stacked one on top of the other and could nest safely in bad weather.

\(^5\) In 1948, the International Container Bureau was renamed the International Container and Intermodal Transport Bureau.

\(^6\) Some states, imposing a lower overall gross weight for the trucks, were called “barrier states”.

\(^7\) The first container on record, according to the *UNCTAD Report on Unitization of Cargo*, 1970, dates back to 1906. It was a 18’ x 8’ x 8’ steel box, but it was not stackable.
Others seized upon the idea. The first Pacific crossing, though still domestic, took place in 1958, from San Francisco to Hawaii, the year when the authorized trailer length was increased to 40 feet. The first international multimodal move was initiated in 1960, between the United States and Venezuela. However, the agreed date of the full-scale revolution is April 1966, with the arrival in Rotterdam of the first full cellular containership from across the Atlantic, bringing Europe closer to the United States by weeks.

By providing such secure long-distance transportation chains, containerization aided by facilitation created what is known today as multimodal transport.

**C. Multimodal mode?**

Multimodal transport has since evolved as a transport mode of its own, trying to carve its own laws, modelled around the container and its seamless transport. Some even speak of multimodalism, and UNCTAD fully supported this move in the United Nations Convention on International Multimodal Transport of Goods and UNCTAD/ICC Rules for Multimodal Transport.

As mentioned earlier, however, transport can be multimodal simply by carefully planning transport through a succession of at least two modes, for example carrying bulk goods.

This is one area where IWT can fit in, especially in Asia, where bulk transport will always have a role. IWT can easily fit into the multimodal transport system, and this is especially true for Asia, where bulk transport has a strong presence. For instance, in China, it has been a regular policy to organize coordinated shipments of coal by rail, north-south, and then by river, west-east, towards the consuming centres of the lower Yangtze, or for export. Two important reasons are the tremendous capacity reserve of river transport and railway capacity constraints. This is also a very environmentally friendly solution.
II. REVIEW OF MULTIMODAL IWT IN THE ESCAP REGION

The integration of IWT into the multimodal transport system is in its initial stage in most countries of the ESCAP region. Many countries in this region have no container transport on inland waterways. However, it has been observed that container traffic on large rivers in China has grown rapidly in connection with seaports situated on lower sections of the rivers. Other countries have shown great potential for development of multimodal transport along their inland waterways. The multimodal IWT for some countries of the ESCAP region is as follows.

A. Bangladesh

Bangladesh is a riverine country. Its IWT caters mainly for the needs of rural communities.

There is a pending project for a private BOT (build-operate-transfer) dual container terminal investment, one in Chittagong for liner shipping, the other in Dhaka along the Buriganga River, with a barge service between the two terminals. There have been some delays in implementing this project, mainly due to labour movements in Chittagong. The project, however, appears to have been well studied, as may be seen in figure II.1. The prospective operator also runs a terminal at the port of Portland, United States.

At the other seaport, Mongla, a multimodal IWT project was suggested by ESCAP in the 1980s to solve the problem of carrying containers from Mongla Port up to the railhead at Khulna. It involved using redundant rail ferry barges over some

![Figure II.1 Proposed container terminals](By courtesy of SSA Bangladesh Ltd.)
50 km to save the cost and environmental damage of building a railway line up to Mongla, which lies in the Sunderbands marshy mangrove forest. Containers would have been directly handled to and from container wagons on the barge, which would then be pushed to the railhead. However, it seems no follow-up action has been taken.

**B. China**

China began IWT ISO containerization in the 1980s, on the Yangtze and the Pearl River Delta. It also has a long experience of smaller steel containers for domestic trade. Figure II.2, in 1984, shows a number of small IWT containers, of some 3 to 6 tonnes of capacity, usually carried on fast passenger liners, and some 10-foot ISO containers of some 8 to 9 tonnes of capacity.

It did not take long for China to use full size containers, partly because it became the main producer of maritime containers in the world.

A precise assessment of the growth of container carriage over IWT is difficult because statistics cover also a number of coastal routes, and trans-shipment at ports also covers international routes. However, as early as 1994, one of the main Chinese shipping lines reported that it carried 70,000 TEUs by IWT.

Official statistics from the Ministry of Communications are shown in figure II.3. The curve is very dynamic, even if it does not take into account the containers handled by numerous smaller ports of the Pearl River Delta, which could nearly double the figures.

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8 Ministry of Communications, 2000, *China’s Inland River Shipping towards the 21st Century* (Beijing).
Two main areas witness container traffic, the Yangtze and the Pearl River Delta.

1. Yangtze River

It was estimated that in 1995, 1,940,000 million TEUs were handled by the Yangtze River ports: 25,000 TEUs were handled in Hubei, mostly at Wuhan; 4,000 in Jiangxi; 12,000 in Anhui, mostly at Wuhu; 377,000 in Jiangsu, at Nanjing, Zhangjiagang and Nantong; and the rest, 1,530,000 TEUs in Shanghai.

As regards Shanghai, of the 1.53 million TEUs in 1995, only 687,000 were brought from other provinces. Since 18 per cent of the transport to and from the hinterland was carried by IWT, the IWT figure was some 130,000 TEUs handled in Shanghai. Consequently, the real seaborne traffic of Shanghai in that year was some 1.4 million TEUs, be it coastal or deep sea.

As regards Jiangsu, the main ports were also seaports trading abroad or with domestic coastal areas. The actual IWT exchanged within the Jiangsu boundaries was not deemed to be more than 34,000 TEUs, plus some 16,000 exchanged with upstream areas. Moreover, a

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large part of the Jiangsu river traffic, estimated at around 101,000 TEUs, actually went to Shanghai for final export. Seaborne traffic was thus 225,000 TEUs.

Growth since 1995 has been phenomenal, in line with the growth of Shanghai’s traffic, which broke all records despite the Asian economic crisis. In 2000, Shanghai handled more than 5.6 million TEUs. Anticipated figures were at the most 4 million TEUs, therefore real traffic was 40 per cent above projections. In 2001, Shanghai ranked fifth in the league of world container ports, with more than 6.3 million TEUs, a growth of 13 per cent.

Estimates are not available on IWT containers in recent years, but the web sites of the main foreign container lines indicate that their preferred mode of transport to and from places as far as Chongqing (2,400 km inland) is by barge, and operations have been in place since 1993. A number of reliable IWT container services are working, and have evolved in line with the growth of Shanghai itself.

This growth is expected to continue, since a third World Bank inland waterways project in China aims, inter alia, at developing a container line between Hunan Province and Shanghai.

2. Pearl River Delta

The Pearl River Delta experienced ISO container traffic early on, due to the existence within this delta of the Kwai Chung container terminals in Hong Kong, China, and its emergence as the premier container port in the world. According to some reports, the port of Huangpu in Guangzhou was the first port in Guangdong Province to handle containers in 1980. In the first year, it only handled some 7,000 TEUs, but by 1985 numerous container barges could be seen in the delta waters.

Container handling in the Pearl River Delta presents the particularity, unmatched in any other container region, where a large part of the handling is not done by gantry cranes at a berth, but by self-discharging barges, even in small ports. It is not known how many of these containers are reported in the total statistics in figure II.3, as only large ports are shown. It is only recently that a number of ungeared, self-propelled barges are plying the delta waters.
River trade is fuelled by the 186 ports of the Pearl River Delta, of which 36 are large. Container services are operated from a great number of these.

The issue is complicated by the emergence of Shenzhen as a major container port, eighth ranked in the world, which itself attracts some of the trade and has shuttles to and from the Kwai Chung container terminals in Hong Kong, China. IWT figures for Shenzhen are not known, and in any case Shenzhen ports were scarce before 1995. However, the present figure is well above 1 million TEUs.

Various views of midstream operations are presented in figures II.4 and II.5, a solution of relevance in many emerging countries, with their geared barges, either towed or self-propelled, sometimes one towing the other.

Figure II.4. A geared barge, empty, towing another, loaded with five layers of containers (92 TEUs)  
Figure II.5. A geared barge towed by a tug

C. Hong Kong, China

In Hong Kong, China, container handling began at Kowloon wharf in the 1970s, but soon thereafter a dedicated container terminal was built in Kwai Chung. However, since a number of containers began to arrive from mainland China by geared barge, another system of handling between barge and ship evolved in midstream (figure II.6). As early as 1985, 394,000 TEUs were handled in this manner, a large part of which was to and from Guangdong Province. This particular type of handling grew tremendously to reach 780,000 in 1987, 1.15 million in 1989 and 1.65 million in 1991.
A clearer picture is available since 1992, when statistics started separating seaborne trade from river trade. In that year, of the 7.97 million TEUs handled in Hong Kong, China, 5.1 million were handled at the Kwai Chung container terminals, 2.5 million were ocean midstream operations, partly with Guangdong Province and 0.4 million were river trade with Guangdong Province.

An even clearer picture is available as from 1993 (table II.1), which shows the growing traffic involving river trade at container terminals.

However, part of the total amount is short distance, in-port movements, in particular since the inception of the River Trade Terminal. For instance, midstream or container terminal handling can involve containers coming directly from Guangdong Province, or reloaded from public cargo working areas or the River Trade Terminal.
Table II.1. Waterborne containerized cargo in Hong Kong, China, by type of trade
(Thousands of TEUs)

<table>
<thead>
<tr>
<th>Year</th>
<th>Handled at container terminals</th>
<th>Handled outside container terminals</th>
<th>Total</th>
<th>Of which:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sea</td>
<td>River(^a)</td>
<td>Sea</td>
<td>River</td>
</tr>
<tr>
<td>1993</td>
<td>5,740</td>
<td>57</td>
<td>2,797</td>
<td>610</td>
</tr>
<tr>
<td>1994</td>
<td>7,155</td>
<td>123</td>
<td>2,839</td>
<td>933</td>
</tr>
<tr>
<td>1995</td>
<td>8,039</td>
<td>217</td>
<td>2,930</td>
<td>1,364</td>
</tr>
<tr>
<td>1996</td>
<td>8,218</td>
<td>468</td>
<td>3,045</td>
<td>1,729</td>
</tr>
<tr>
<td>1997</td>
<td>8,975</td>
<td>515</td>
<td>3,156</td>
<td>1,922</td>
</tr>
<tr>
<td>1998</td>
<td>8,869</td>
<td>686</td>
<td>2,641</td>
<td>2,386</td>
</tr>
<tr>
<td>1999</td>
<td>9,511</td>
<td>784</td>
<td>2,838</td>
<td>3,077</td>
</tr>
<tr>
<td>2000</td>
<td>10,664</td>
<td>938</td>
<td>3,033</td>
<td>3,462</td>
</tr>
<tr>
<td>2001</td>
<td>10,154</td>
<td>1,131</td>
<td>3,011</td>
<td>3,531</td>
</tr>
<tr>
<td>2002(^b)</td>
<td>4,815</td>
<td>626</td>
<td>1,541</td>
<td>1,841</td>
</tr>
</tbody>
</table>

Sources: Marine Department of Hong Kong, China.
\(^a\) At container terminals, some 30-river berths are available.
\(^b\) First half.

This increased presence can be seen in figure II. 7, which shows part of the main container terminals.

Table II.1 also shows the rising river trade with Guangdong Province. This has led to the building of 60 berths at the River Trade Terminal, some distance from Kwai Chung container terminals, with derricks on shore (figure II.8), able to service non-gear-barges, usually self-propelled.

Overall, river trade growth has been extraordinary, reaching 4.7 million TEUs in 2001, while midstream operations stabilized. The IWT share of hinterland container...
transport is thus 35 per cent in Hong Kong, China, even reaching 40 per cent in the first half of 2002. This also reflects a shift in midstream operations, where the portion in direct transit to Guangdong Province appears to be diminishing. To feed this exchange with the Pearl River Delta, the main terminal operators and some big shipping lines have established their own dedicated feeder system. A few more pictures of midstream handling are provided for reference in figures II.9, II.10, II.11 and II.12.

Figure II.9. A geared barge at work at the Kwai Chung terminals

Figure II.10. A geared barge handling ungeared barges

Figure II.11. A barge on direct loading from a sea vessel with self gear

Figure II.12. Handling of a 103 TEUs self-propelled barge at the River Trade Terminal, with one 45-foot container across
D. India

India has declared three of its waterways as national waterways, and others are proposed. The better-organized movement of goods by IWT can be found in Goa, where IWT directly connects with sea transport.

Trading is mainly in iron ore and amounts to some 15 million tonnes, and transport involves a combination of modes on land and water. The chain IWT–trans-shipper–ship (figure II.13) makes it an original system, which probably has been in use since the 1960s. Ships of up to 300,000 dwt are loaded this way, fed by geared 30,000 to 60,000 dwt trans-ship vessels or loading platforms, serviced by a fleet of some 80 IWT barges between 500 and 1,000 dwt.

Maharashtra has no national waterway, but presents an excellent case for multimodal IWT, in particular due to ISO containers shuttled across the Bay of Bombay between the nearby ports of Mumbai (400,000 TEUs in 2001) and Jawaharlal Nehru – Nhava Sheva (1.5 million TEUs in 2001). This system could be quite similar to the one in the Pearl River Delta. A start has been made, with some 8,000 TEUs exchanged in 2001 between the two sides of the Bay by 80 TEU barges. It could easily be amplified, since Mumbai city is a very large traffic-generating area, and inland container depots (ICDs) by the waterside would help alleviate congestion on the main roads leading onto the island and would enable transport between the two ports to be six times shorter than by road or rail.

There is great potential for the development of an IWT container route on the Ganga–Bhagirathi–Hooghly river system, National Waterway No. 1, at least up to Pataliputra, about 1,000 km inland. Due to the difficult navigability of the river, this has yet to take place. Some trials have been made to carry containers between the terminal at Haldia, at the mouth of the Hooghly River, which handles some 150,000 TEUs, and Kolkata city, over a length of some 90 km. No multimodal transport has been recorded on National Waterway No. 2, the Brahmaputra River.
E. Malaysia

Malaysia is reported to use container barges in Sarawak. There are more than 30,000 TEUs per year handled in river ports, most of them by coasters. The actual quantity of IWT carriage of containers is not known, because most of these moves are in coastal navigation.

F. Myanmar

There is no reported container transport by IWT in Myanmar. The sole BOT deep-sea container terminal, which handled some 40,000 TEUs in 2000, is expecting 1 million TEUs in a final stage. At that time, a need for IWT traffic shall certainly develop.

G. Nepal

A number of container freight stations (CFSs) are being built in this country, to be leased out to well-known logistics companies. Two are road-based near the border with India, and the third is rail-based to be linked with the broad gauge Indian railway system at Raxaul. Thus multimodal transport will soon begin in Nepal.

Although rivers do flow out of Nepal into the Ganges, they are not easy to navigate. The navigability of three rivers has been explored for transit transport.

H. Pakistan

Pakistan does not have a link between its main waterway, the Indus, and the sea. There is thus little appeal for multimodal IWT traffic. However, there may be a need for a barge shuttle between the two container terminals of Karachi and Port Qasim, which are only 40 km apart. Both handle some 200,000 TEUs per year, with the added advantage of serving east wharves of Karachi. Further, containers may avoid certain excise taxes if they do not transit through Karachi city by road. However, no such traffic is recorded at present.

I. Sri Lanka

Sri Lanka has experienced fast development of the Colombo Container Hub, approaching 2 million TEUs in 2002. Except some lighterage within the port, no container movement on barges is recorded at present. A second container trans-shipment port is proposed further south. The distance between the two ports would not be too great, some 80 km, but the route is in open sea, and thus it is unlikely that an IWT service could work.
Vessels of the river-sea type, or river-coasters, may be sufficient, and designs up to 400 TEUs are available. Normal coasters may also be sufficient, since no draught problems are anticipated at either end.

There is, however, a possibility of using IWT on the short distance out of the port towards Beira Lake. Port land is scarce in Colombo, and Beira Lake could serve again, as it has in the past, as an annex of the port for handling containers. The prospect of reviving ancient canals for transportation was studied several times, but unfortunately it appears that it would be expensive to rebuild the abandoned canals. It is still reported to be within the port’s jurisdiction, and there is a possibility that private CFSs could be established there. Designs of 16-TEU barges are available, allowing for lock size and headroom constraints.

**J. Thailand**

The Laem Chabang container port is situated more than 100 km away from Bangkok by road and railway, but only 60 km by water. A number of shuttles started operation as early as 1989. Some 7,000 TEUs per year were carried in this manner, either across the bay or from Bangkok upstream, avoiding the longer route by road, thus alleviating road congestion. The practice was abandoned due to the low clearance of some bridges, but the Port Authority of Thailand is willing to revive it, and studies to that effect began in September 2002.

Studies are also under way for carrying either trucks or containers across the Gulf of Thailand, from the Southern part of the country (Surat Thani Province), to Laem Chabang, avoiding the long road journey and the passage through Bangkok. This kind of long distance ferry would practically be IWT, because it would permanently be very close to a shore, enabling IWT barges with estuary scantlings\(^\text{10}\) to run there.

**K. Viet Nam**

Container transport by barge in Viet Nam is in the development stage. A World Bank project to support the development of IWT started in 1999, and a few thousand TEUs are carried, mainly in the Mekong delta. A new CFS by the side of the Saigon River, where 1,000 dwt barges can be handled, was inaugurated in September 2002. Further, an international service between Ho Chi Minh City and Phnom Penh is contemplated.

\(^{10}\) Similar to the bay-crossing vessel in Bangladesh or the Pearl River Delta container barges in China.
III. EXPERIENCES OF IWT MULTIMODAL TRANSPORT IN EUROPE AND THE UNITED STATES

A. Europe

Multimodal container transport has grown tremendously in Europe over recent years. Thanks to an adapted infrastructure and adequate facilitation, traffic has been able to grow, often at a two-digit rate, throughout the last two decades.

1. Infrastructure

To permit this growth, a number of infrastructure elements have been created.

(a) Numerous container terminals

The first batch of container gantries was installed on the Rhine as far back as 1968, only two years after the first fully cellular ship arrived in Europe. However, in this new trade, which seemed to be vying for speed, it took some time for the deep-sea operators to consider the IWT option, which was purported to be slow. A number of container lines failed for lack of response by the market.

However, in the early 1980s, the cost savings brought about by fully dedicated river containerships was recognized, and local interests started building new container terminals, the farthest inland at Basel, Switzerland, 870 km from the sea. Today, there are some 40 container terminals along the banks of the Rhine. They serve the container transport on the Rhine and its seaports in the delta, mainly Rotterdam in the Netherlands and Antwerp in Belgium.

Similarly, on the Rhone and Seine rivers in France, services started in the 1990s, with eight inland terminals. In Germany also, some terminals were built in other river basins, such as the Danube, Elbe and Weser. Each of these smaller basins serves a large seaport, such as Le Havre, Dunkirk and Marseille in France, and Hamburg and Bremen in Germany. Finally, in Belgium and the Netherlands, there are some 20 terminals servicing their respective seaports, Antwerp and Rotterdam.
(b) Suitable waterway network

This container transport, however, is limited to routes where the necessary gauge can be found.

A great facility in Western Europe is the free-flowing Rhine, unimpeded by locks and with ample vertical clearance under bridges, allowing four layers of containers up to Strasbourg in France, 700 km inland. It is on this river that major development has taken place, with more than 1 million containers crossing, for instance, the border between Germany and the Netherlands.

Canalized waterways, with so-called “European Gauge” locks (12 m wide and more than 110 m long), are also used for container traffic. The vertical clearance has often been critical, and most of the successful container services plying waterways allow three layers of containers. Some canals are even larger than the European Gauge, for instance the Scheldt-Rhine Canal between Rotterdam and Antwerp, where the locks are 24 m wide and the use of barges with four layers of containers is sometimes possible. The traffic on this particular waterway is of the same magnitude as on the Rhine, which shows the benefit that two close ports can derive from a strong waterway connection. However, there are examples of services plying with only two layers of containers, for instance in the northern part of France or in the Netherlands.

As is the case for vertical restrictions, there are instances where services are profitable even in narrower waterways, for instance in France and the Netherlands. There is a plan to develop the use of so-called Neo Kemp, which can squeeze a maximum number of containers in smaller canals. In addition, there are talks in France of developing a “Freycinet 2000”, plying in the smaller network with only one layer of containers and a capacity of 10 TEUs.

The reason behind these investment proposals is that the cost of barging is only a fraction of the total door-to-door transport cost, and that by bringing the containers closer to the market, the savings on the road leg are expected to be far greater than any augmentation of IWT cost.

Road transport, hampered by road congestion and overcrowded access to terminals, cannot guarantee delivery time in all cases. However, inland waterways are free from traffic congestion.
(c) Adapted vessels

In Europe, the main concern is the vertical clearance under bridges. Accordingly, all European designs but one are using hopper barges, in which the containers are lowered much in the same way as in a ship.

All started with normal bulk barges, which accommodated only three rows of containers, because of slanted sides, and three layers only, owing to stability considerations. A Europa II pushed barge, 11.4-m wide, could in that way accommodate 90 to 99 TEUs. The pusher had to use a telescopic wheelhouse (figure III.1) to be able to see above and in front of this high barge.

Soon self-propelled barges were introduced, mainly by owner-operators. Quickly, it was found possible to squeeze in the hold of an 11.4-m wide barge four rows of containers, giving the possibility to stack four to five layers and increase capacity up to 220 TEUs. Barges were further lengthened up to 110 m, thus carrying up to 280 TEUs (in five layers). Combined with a pushed barge like the one shown in figure III.1, such a unit loads up to 480 TEUs with five layers.

Finally, wider barges have been used, some of which are also cellular vessels (figure III.2). These vessels carry up to 480 TEUs.

There is also the Neo Kemp, mentioned earlier, as seen in figure III.3. Like some Pearl River Delta barges, it stacks barges across, and has its own crane. It holds 40 TEUs and can squeeze into a fine network of smaller waterways, bringing it closer to the clients.
On the larger waterways, pushed convoys of four barges can move up to 800 TEUs at the same time. Figure III.4 shows a barge convoy carrying 447 TEUs in a pushed three-barge convoy, with a total capacity of 607 TEUs, more than many sea-going feeder ships.

There appears to be no limit to what IWT can offer, such as the river shuttles between Antwerp and Rotterdam, which carry in a coordinated manner 650,000 TEUs per year, on behalf of four different barge operators.

2. Facilitation

There have been a number of areas in which container trade has obtained concessions not available to other goods carriage.

(a) No tonnage limitation

One of the strong points for IWT has been that, from the start, container traffic on European rivers has been exempt from limitations, imposed by governments or the profession, regarding the tonnage of barges. This has been specifically noticeable in France and in the Netherlands, where there are controls on size and overall capacity of fleet.

All European countries have load limitations for trucks to protect road pavement and the environment. The legislation passed by the EU restricts the maximum weight of tractor-trailers to 40 gross tonnes, except for combined transport operations and some multimodal transport operations in the vicinity of seaports. This load limitation is 28 tonnes in Switzerland.

The maximum payload on a normal 40-tonne European trailer is 26 to 28 tonnes, depending on the number of axles and the weight of the trailer. Assuming two containers are carried on the same trailer, on the same route to or from the same address, each container then can be 13 to 14 tonnes.
However, the same road trailer can load up to 44 tonnes if in combined transport, which means more or less 2 tonnes more weight for each container. Combined transport, and not only by IWT, thus has a niche market with the 15 to 16 gross tonnes of payload, because it reduces the cost of the road leg, which normally accounts for about half of the total cost of a combined transport.

(b) Free rates

Another point is that the rates are also free, providing an added incentive for barge owners. Not that they necessarily have very good rates, but at least they are free to decide whether to run at these prices or not. On all other trades, official freight rates are imposed, and very often this translates into prices too high to attract customers, who then choose other modes of transport.

(c) ICD status

The trade really picks up when river terminals are given ICD status by the sea operators, allowing customers to pick up or return empty containers inland, instead of being obliged to do so at the seaport, thus saving one leg of the route. This also ensures flexibility in obtaining containers at short notice, and customers are therefore easily attracted to this system, which is less cumbersome and far cheaper than road operations.

This ICD status is neither a right nor a favour; it is actually brought about by the market itself as soon as an area has shown to be a good traffic area. Then, operators find it more convenient to leave the empty containers where they are, rather than bringing them back to the port, and shifting them back later to the same inland location to meet the demand.

(d) Expeditious customs clearance

Another positive point is the possibility to complete customs formalities inland. Thanks to a general movement in favour of facilitation this has been made easier every year and the number of inland customs outlets is rising everywhere. IWT has not been the only beneficiary, but often, inland ports have been the forerunners in attracting these bureaus. Lately, it has been agreed on the Seine River that all customs documentation remaining in the seaport can be done while the barge is under way, which transforms the barge into a moving warehouse, similar to, for example, the “virtual gate” seen in Hong Kong, China. Passage of
the containers in the ports is thus very fast and easy, a further guarantee that operations will be smooth.

(e) Legislation in favour of intermodal transport

The road legs are normally kept to a minimum in combined transport, fixed by law in some countries, to less than 150 km from the terminal.

Thus, within 150 km of each combined transport terminal, including IWT terminals, heavy containers carried by road could be carried two on a chassis, while in direct transport they would have to be a standalone. The intricacy of this system will be used in the case study (see chapter VII).

Some European countries limit the time at which trucks can be used on main roads. They have also placed other restrictions on trucking. Germany has decided to charge tax for use of its roads. Switzerland will place an embargo on trucks in transit through the country from 2004. These measures force traditional road users to seek alternatives, such as inland waterways, rail and intermodal transport.

(f) Financial measures in favour of combined transport

Governments and the EU have consistently provided financial support to combined transport, especially since the United Nations Conference on Environment and Development, held at Rio de Janeiro, Brazil, from 3 to 14 June 1992, and the ensuing engagements to limit the greenhouse effect.

This support is aimed at directing traffic to rail and inland waterways instead of long-distance road transport, which is congestion-prone and less environment-friendly.

This has entailed grants for building combined transport terminals, especially tri-modal terminals (rail, water, road). Up to 50 per cent of the cost of studies and up to 25 per cent of final infrastructure costs could be provided in this manner.

The new Marco Polo Programme proposal continues in the same vein, with added emphasis on supporting the start-up of services. As reported in the EC document
COM (2002)54 final,\textsuperscript{11} “The PACT Programme has provided evidence that setting up new intermodal freight services in Europe is fraught with risk. Community funding for start-up of new operations seems therefore still appropriate... Today, if market actors’ willingness to take risks is not stimulated beyond the traditional commercial incentives, traffic will stay on road”. Details of the current Marco Polo aid proposal are found in annex I.

This aid on a European scale is complemented on a national basis, such as the French or Netherlands programmes to that effect, covering up to 25 per cent of infrastructure, with a ceiling of around US$ 2 million.

Moreover, to facilitate the shift from long-distance operations by truck into combined transport operations, the dedicated trucks are exempt, or rather reimbursed, from a number of road taxes, representing up to a US$ 1,000 saving per year and per truck.

3. Resulting traffic

A detailed review of IWT container traffic in Europe has been published by AFTM,\textsuperscript{12} stating that, according to one of the scenarios prepared by the Rotterdam Port, container share in its global IWT traffic would treble before 2020. It estimates that 7 million TEUs, nearly 80 million tonnes of manufactured products, would then be carried on West European waterways.

Yet, this first comprehensive review of Western Europe container traffic also shows that the 1998 figure of 2.4 million TEUs was already equal to the “low” prognosis announced by the Rotterdam Port for 2010 only years ago. Then, 7 million TEUs in 2020 appeared to be a bare minimum.

Updates of this series confirm this trend: figures for 2001 showed that, despite problems brought about by recession and floods, IWT container traffic had reached 3.3 million TEUs in Western Europe.

\textsuperscript{11} European Commission, 2002, COM(2002)54 final, on the granting of community financial assistance to improve the environmental performance of the freight transport system (Brussels).

### Table III.1. West European IWT container traffic

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Rhine traffic</th>
<th>Total Delta traffic</th>
<th>Non-Rhine French traffic</th>
<th>Non-Rhine German traffic</th>
<th>Grand total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>327,766</td>
<td>229,000</td>
<td>–</td>
<td>12,000</td>
<td>568,766</td>
</tr>
<tr>
<td>1988</td>
<td>383,641</td>
<td>325,000</td>
<td>–</td>
<td>30,000</td>
<td>738,641</td>
</tr>
<tr>
<td>1989</td>
<td>372,275</td>
<td>444,000</td>
<td>–</td>
<td>44,673</td>
<td>860,948</td>
</tr>
<tr>
<td>1990</td>
<td>446,296</td>
<td>433,000</td>
<td>–</td>
<td>53,556</td>
<td>932,852</td>
</tr>
<tr>
<td>1991</td>
<td>498,227</td>
<td>523,000</td>
<td>–</td>
<td>59,787</td>
<td>1,081,014</td>
</tr>
<tr>
<td>1992</td>
<td>458,057</td>
<td>570,000</td>
<td>–</td>
<td>54,967</td>
<td>1,083,024</td>
</tr>
<tr>
<td>1993</td>
<td>546,431</td>
<td>657,500</td>
<td>–</td>
<td>65,572</td>
<td>1,269,503</td>
</tr>
<tr>
<td>1994</td>
<td>607,748</td>
<td>746,000</td>
<td>1,700</td>
<td>72,930</td>
<td>1,428,378</td>
</tr>
<tr>
<td>1995</td>
<td>795,454</td>
<td>802,000</td>
<td>10,122</td>
<td>73,000</td>
<td>1,680,576</td>
</tr>
<tr>
<td>1996</td>
<td>936,634</td>
<td>975,000</td>
<td>17,733</td>
<td>100,000</td>
<td>2,029,367</td>
</tr>
<tr>
<td>1997</td>
<td>982,891</td>
<td>1,093,000</td>
<td>21,323</td>
<td>89,000</td>
<td>2,186,214</td>
</tr>
<tr>
<td>1998</td>
<td>1,028,283</td>
<td>1,265,000</td>
<td>21,441</td>
<td>66,000</td>
<td>2,380,724</td>
</tr>
<tr>
<td>1999</td>
<td>1,084,359</td>
<td>1,507,000</td>
<td>36,628</td>
<td>84,000</td>
<td>2,711,987</td>
</tr>
<tr>
<td>2000</td>
<td>1,260,081</td>
<td>1,679,500</td>
<td>58,273</td>
<td>105,000</td>
<td>3,102,854</td>
</tr>
<tr>
<td>2001</td>
<td>1,300,992</td>
<td>1,771,000</td>
<td>71,308</td>
<td>139,000</td>
<td>3,282,300</td>
</tr>
</tbody>
</table>

*Sources: AFTM estimates from information obtained from Rotterdam and Antwerp ports, DeStatis, VNF and AVV Transport Research Centre.*

The corresponding curve (figure III.5) is even more striking, and demonstrates the ability of IWT to adjust to this new business, specially since this growth took place during the recession of the 1990s.

**(a) Container transport in the Rhine delta**

One of the most interesting elements of this evolution has been the dramatic increase of container transport in the Rhine Delta, be it domestic transport in the Netherlands or exchange between Belgium, France and the Netherlands. It equaled Rhine traffic around 1989, and surpassed it largely in 1997.

For instance, the short distance domestic transport in the Netherlands has bloomed, and now reaches every corner of the country. There are even exchanges from terminal to terminal, without touching any seaport. Most striking, however, has been the emergence of the traffic in and out of Antwerp, most of it interchange traffic between the two major container ports. The traffic over the Scheldt-Rhine Canal is now of the same order as the cross-border traffic on the Rhine. Thanks to the cooperation of the Dutch (AVV) Transport
Research Centre and the port of Antwerp, an updated calculation reconciling various sources has been possible.

(i) Antwerp

The Antwerp document series comprises on the one hand the part of Antwerp activity to and from the Rhine, and on the other the traffic exchanged with Rotterdam, which is not included in Rhine statistics. There is also some intraport activity, as well as transport from Antwerp towards the rest of Belgium and the northern part of France.
The curve in figure III.6 is extremely dynamic, and the port of Antwerp anticipates that it will remain so for the years to come, expecting that IWT might eventually replace road transport as the main hinterland carrier. The prognosis is for IWT to achieve this by the year 2010, with some 3.6 million TEUs.

![Figure III.6. IWT container traffic in Antwerp](image)

*Source:* AFTM estimates, based on data by the AVV Transport Research Centre and the port of Antwerp.

The growing strength of IWT in container transport in Antwerp and the modal split has evolved as shown in table III.2.

**Table III.2. Port of Antwerp modal split of hinterland distribution of containers**

(Without sea-sea trans-shipment, in percentage)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>22.7</td>
<td>24.3</td>
<td>27.1</td>
<td>27.6</td>
<td>27.9</td>
<td>29.3</td>
<td>29.9</td>
<td>+7.2</td>
</tr>
<tr>
<td>Rail</td>
<td>5.2</td>
<td>6.2</td>
<td>7.1</td>
<td>7.8</td>
<td>9.3</td>
<td>10.1</td>
<td>8.8</td>
<td>+3.6</td>
</tr>
<tr>
<td>Road</td>
<td>72.1</td>
<td>69.5</td>
<td>65.8</td>
<td>64.6</td>
<td>62.8</td>
<td>60.6</td>
<td>61.3</td>
<td>-10.8</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>–</td>
</tr>
</tbody>
</table>

It can be observed that the strength of IWT container traffic between Antwerp and Rotterdam casts a different light on the respective roles of these two as transit ports for containerized goods, Antwerp attracts containers from its hinterland as well as from Germany, while Rotterdam sends these overseas.

(ii) **Delta series**

Actually, to ensure that the traffic from Antwerp to the Rhine is not counted twice, another series is reported and is shown in figure III.5 and table III.1. It is necessary to consolidate all containers moving in the delta that are not included in the Rhine traffic, taken as the traffic upstream of the German border. This Delta series comprises the Rotterdam-Antwerp interchange, Rotterdam to Belgium or Northern France, Antwerp to the same destinations, and internal Netherlands traffic, including from Rotterdam.

**Table III.3. Delta IWT container traffic**

<table>
<thead>
<tr>
<th>Year</th>
<th>Antwerp-Rotterdam traffic</th>
<th>Netherlands domestic traffic</th>
<th>Intraport traffic</th>
<th>Belgium-North-Pas-de-Calais</th>
<th>Total delta traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987</td>
<td>125,000</td>
<td>40,000</td>
<td>60,000</td>
<td>4,000</td>
<td>229,000</td>
</tr>
<tr>
<td>1988</td>
<td>170,000</td>
<td>60,000</td>
<td>80,000</td>
<td>15,000</td>
<td>325,000</td>
</tr>
<tr>
<td>1989</td>
<td>195,000</td>
<td>130,000</td>
<td>100,000</td>
<td>19,000</td>
<td>444,000</td>
</tr>
<tr>
<td>1990</td>
<td>190,000</td>
<td>120,000</td>
<td>100,000</td>
<td>23,000</td>
<td>433,000</td>
</tr>
<tr>
<td>1991</td>
<td>275,000</td>
<td>120,000</td>
<td>100,000</td>
<td>28,000</td>
<td>523,000</td>
</tr>
<tr>
<td>1992</td>
<td>330,000</td>
<td>130,000</td>
<td>80,000</td>
<td>30,000</td>
<td>570,000</td>
</tr>
<tr>
<td>1993</td>
<td>400,000</td>
<td>140,000</td>
<td>85,000</td>
<td>32,500</td>
<td>657,500</td>
</tr>
<tr>
<td>1994</td>
<td>431,000</td>
<td>195,000</td>
<td>85,000</td>
<td>35,000</td>
<td>746,000</td>
</tr>
<tr>
<td>1995</td>
<td>451,000</td>
<td>210,000</td>
<td>85,000</td>
<td>56,000</td>
<td>802,000</td>
</tr>
<tr>
<td>1996</td>
<td>550,000</td>
<td>280,000</td>
<td>85,000</td>
<td>60,000</td>
<td>975,000</td>
</tr>
<tr>
<td>1997</td>
<td>602,000</td>
<td>320,000</td>
<td>83,000</td>
<td>88,000</td>
<td>1,093,000</td>
</tr>
<tr>
<td>1998</td>
<td>680,000</td>
<td>316,000</td>
<td>162,000</td>
<td>107,000</td>
<td>1,265,000</td>
</tr>
<tr>
<td>1999</td>
<td>647,000</td>
<td>526,000</td>
<td>209,000</td>
<td>125,000</td>
<td>1,507,000</td>
</tr>
<tr>
<td>2000</td>
<td>713,500</td>
<td>551,000</td>
<td>241,500</td>
<td>173,500</td>
<td>1,679,500</td>
</tr>
<tr>
<td>2001</td>
<td>707,000</td>
<td>576,000</td>
<td>283,000</td>
<td>205,000</td>
<td>1,771,000</td>
</tr>
</tbody>
</table>

**Sources:** For 1993 and 1996, Brolsma, AVV Transport Research Centre, PIANC Bulletin, June 1997; for other years, AFTM estimates based on data from AVV Transport Research Centre and port of Antwerp.

(b) **Container transport on the Rhine**

Another interesting item to observe is the passage at the German-Netherlands border, as shown in figure III.7 (Emmerich-Lobith). An estimate in TEU is available.
since 1994. After a faltering start, its growth has been sustained, and now reaches nearly 1.3 million TEUs.

The so-called “Rhine Traffic” includes some other flows, internal to the Rhine basin, and thus the figures vary slightly from those at the border.

(c) Non-Rhine German traffic

Figures for this are less well documented and refer to the Weser, Elbe, Ems and Danube basins, once figures for traffic related to the Rhine delta are taken out. Before 1996, they were counted as 12 per cent of Rhine traffic.

(d) Non-Rhine French traffic

Traffic on the Rhone started at the end of the 1970s, but volumes rarely surpassed 6,000 TEUs. Since, services have been suspended two or three times, statistics in table III.4 show only figures available since the reopening of the Deltabox line in 1994.

On the Seine, traffic actually began only at the end of 1994 with LOGISEINE, a provider of river-road transport services on the Seine although earlier attempts were made in the 1980s.

In the North-Pas-de-Calais region, a service linking Dunkirk with its hinterland started in 1999. That same year, a domestic container service, carrying urban waste to a disposal ground, started on a strong footing. The other services out of the region are counted as Rhine Delta traffic, since they connect with the two main seaports there. The non-Rhine French traffic series is shown in table III.4.

### Table III.4. Non-Rhine French traffic

<table>
<thead>
<tr>
<th>Year</th>
<th>Seine</th>
<th>Rhone</th>
<th>Dunkirk-Lille-Valenciennes</th>
<th>Non-maritime containers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>500</td>
<td>1,200</td>
<td>–</td>
<td>–</td>
<td>1,700</td>
</tr>
<tr>
<td>1995</td>
<td>5,811</td>
<td>4,311</td>
<td>–</td>
<td>–</td>
<td>10,122</td>
</tr>
<tr>
<td>1996</td>
<td>11,433</td>
<td>6,300</td>
<td>–</td>
<td>–</td>
<td>17,733</td>
</tr>
<tr>
<td>1997</td>
<td>16,598</td>
<td>4,725</td>
<td>–</td>
<td>–</td>
<td>21,323</td>
</tr>
<tr>
<td>1998</td>
<td>14,927</td>
<td>6,514</td>
<td>–</td>
<td>–</td>
<td>21,441</td>
</tr>
<tr>
<td>1999</td>
<td>21,000</td>
<td>3,388</td>
<td>1,240</td>
<td>9,298</td>
<td>36,628</td>
</tr>
<tr>
<td>2000</td>
<td>32,700</td>
<td>2,987</td>
<td>3,515</td>
<td>19,071</td>
<td>58,273</td>
</tr>
<tr>
<td>2001</td>
<td>38,400</td>
<td>8,635</td>
<td>5,725</td>
<td>18,548</td>
<td>71,308</td>
</tr>
</tbody>
</table>

*Source: AFTM estimates based on companies’ data and VNF statistics.*

The rate of growth in 2001 was 22 per cent and was expected to continue.

---

(e) Danube

Non-German Danube traffic represents thousands of TEUs. No reliable series are available. Figures of 100,000 TEUs in 1990 and 160,000 TEUs in 1993 are proposed, but seem to include all modes of transport. For lack of more precise indications, Danube traffic will not be included in the West European total.

B. United States

Very little container traffic is found on main inland waterways although overall IWT traffic is quite high in the United States.

Due to the general orientation of the river network, which is north-south, and which therefore does not coincide with the container movements, generally going east-west, no stable container traffic has developed on the Mississippi River. Furthermore, rail with its double stack trains, has become strong competition.

However, since July 2002, the port of Baton Rouge on the Mississippi River has been operating a weekly regular line between Louisiana and Texas, which has the advantage of running in an east-west rather than the dominant north-south direction. Traffic was expected to reach 40,000 TEUs in 2002.

One place where a regular container line has been able to truly prosper is the Columbia-Snake Waterway, 700 km long, linking from East to West the State of Idaho to the sea in Portland, Oregon. It has even initiated traffic in some very specific commodities for exports, such as frozen french fries or cubes of compressed hay. Traffic started in 1977 at a rather low level (7,000 TEUs), because Portland is a somewhat small container port (less than 300,000 TEUs). Traffic reached a peak of 91,000 TEUs in 2000. Worth mentioning is that during 2000 and 2001, intermodal transport carried more than 60 per cent of the containers at the port of Portland, with 31 per cent of total container traffic by IWT. This is a percentage unrivalled anywhere in the world, except in the inland port of Basel, Switzerland.
The types of barges used are either deck barges as shown in figure III.8 or hopper barges to better protect the containers.

The two systems coexist. In figure III.9, an 80-TEU hopper reefer barge can be seen, with a 40-foot reefer container being handled, which started operations in 1991. Of the containers carried, 75 per cent are 40-foot containers.

Further, most barges in the United States are pushed barges, figure III.10 shows a barge being pushed across a reservoir.

Hay, a very cheap commodity and as such very transport cost-sensitive, is carried over a long distance, 600 km. Barging costs are typically 20 to 50 per cent lower than rail or trucking. There is little doubt that, had this less expensive alternative not been available, this never would have materialized.

Interesting to note is that IWT increases the hinterland of the port of Portland, faced with competition from the far bigger ports of Seattle and Tacoma. Similarly, as explained below, IWT service increases the hinterland of ports in Europe, such as Le Havre, faced with competition from Antwerp.

In all zones where parity exists between Seattle and Portland trucking, the superior sea-service frequency of Seattle should normally weigh heavily in its favour. Instead, the 20 to 50 per cent cost reduction of barging compared with trucking secures the loads to Portland. A gain of up to US$ 350 per TEU is reported in some cases, compared with trucking to Seattle.

The service provided by the barge operators has been tailored to the timing of the sea liner calls. There are two services per week and per river operator, each reaching the port in
time for the weekly call of a specific sea liner. Most calls are on Mondays and Fridays, and on those days barges line up to wait for the sea-going vessels (figure III.11), providing some 250 TEUs per ship call.

In 2000, barging rates were around US$ 0.17 per TEU-km, and US$ 0.24 per 40-foot container per km. To this must be added inland port handling charges, and the occasional trucking. These costs are quite similar to those found in Europe.

Recently, the US Department of Transportation funded studies on container-on-barge transport in the Mississippi River basin, notably a feasibility assessment of truck-barge intermodal freight transport and empty container management for container-on-board transport. This is one of the key issues in order to break new ground and demonstrate the relevance of IWT for the transport of containers, even in a highly competitive environment.

The port of New York has also come up with the concept of a port inland distribution network (PIDN), and envisions a network of inland container terminals, linked to the port by dedicated rail, barge or tandem trailer-truck shuttle services. The PIDN is expected to reduce congestion, improve efficiency and reduce the cost of inland transport by 20 per cent.

It is hoped that these studies will lead to new container-on-barge developments taking place in the United States.
IV. INTEGRATING IWT WITH OTHER TRANSPORT MODES

Obtaining a sound integration of IWT within the multimodal transport system requires that:

- the adequate infrastructure is in place;
- the latest technology is used and constantly updated;
- the regulations facilitate this interchange.

A. Infrastructure planning of IWT for multimodal operations

IWT requires two basic elements of infrastructure: waterway and terminals. A third element, although super-structural rather than infrastructural, is the vessel. At times, however, it is recognized as part of the infrastructure, when it offers a solution to passing through a bottleneck or overcoming a missing link.

1. Waterway requirements for multimodal operations

Standard requirements for the carriage of containers or other ITUs focus on the width of locks and fairways, and on the vertical clearance under bridges. Vessels adapt themselves ingeniously to the existing conditions of each route, and will be described in relation to the specific route.

For navigation to be possible, locks must be provided at every dam or barrage, as well as links between already developed waterways, in order to create a network adapted to multimodal transport.

(a) Width

The sufficient width of locks or between bridge piers provides extra beam for the vessel, making it more stable, thus providing operational flexibility for positioning containers of various weight.

For instance, although not impossible, it would be extremely difficult to operate in the French Freycinet network with two lines and two layers of containers. The locks are 5.2 m in width, while the vessel is 5.05 m wide at 1.8 m below the waterline,14 and the top of the

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14 The maximum draught on these canals is 1.8 m.
second layer of containers, 4.88 m wide at 3.5 m above the waterline, would touch the lock walls with only 2 degrees of heeling. It is probably one of the reasons why the Freycinet 2000 project concentrates on a single layer of containers, requiring less draught.

In Europe, the inter-European Gauge provides for locks at least 12 m wide, which is just enough for four lines of containers. However, they would enable a heeling of 7.5 degrees with three layers, somewhat easier to manage than on the Freycinet network. Furthermore, due to the double hull, it is easy to ballast and in this way compensate for some of the heeling. Finally, four lines make it more likely, even with random positioning, to have a balanced cargo.

In Asia, there are some 40-foot wide locks, providing an extra 18 cm. of width compared with the European locks. Vessels plying there should use it to the full, and be wider than the European barges, to offer wider passageway to the crew and to benefit from less costly design. There are also many 20-foot wide locks, which are wider by 0.85 m than the Freycinet locks and could accommodate two lines of containers, with some ballast and possibly with a double hull.

As mentioned earlier, the emphasis in Europe has been on introducing container transport in intermediate canals, with locks 7 to 8 m wide (such as the Kempenaar-Campinois network, 1,500 km long), in which it is easy to provide a ballasting system on barges with two lines of containers.

Another option has been to place the containers across, rather than lengthwise, with a higher TEU capacity, although less ballast, such as on the Neo Kemp (figure III.3). The only drawback is that these vessels cannot accommodate 40-foot containers.

For future multimodal planning in Asia, a minimal lock width of 12.6 m is recommended, provided the vessels authorized to transit these locks\(^{15}\) have a beam of 11.8 or 12 m. The extra beam provides for a cheaper design, better crew safety and the ability to carry stackable swap-bodies as well, which might be 2.55 m wide according to an EC proposal or 2.6 m according to American proposals.

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\(^{15}\) In Europe, the tendency is to promote a lock width of 12.5 m, but retaining the same 11.4 m vessel beam. With proper guiding walls, there is no objection to keeping the width at 12 m to save lockage water.
Wider locks are also recommended. For instance, an 18 m lock enables six lines of ISO containers or swap bodies in a vessel 17 m wide. Such bigger locks can be found in China and India, and the corresponding wide vessels, with beams up to 20 m, are numerous in the Pearl River Delta, as will be seen.

(b) Vertical clearance

The other important factor for any network is the available height, limited by the vertical clearance under bridges.

This is of paramount importance in view of the competition with other modes because an increase in the number of layers on the vessel increases its capacity and reduces the cost to be charged for each container. This is often the case along the lower valley of large rivers, such as the Yangtze, Pearl, Ganges, Ayeyarwady and Mekong rivers. In such cases, bridges are very long, and there is not much difficulty in providing ample space below the spans of the bridges, as the ensuing slope is not too steep.

Good clearance on smaller rivers is generally easy to obtain, but there are cases where improper planning or weak guidelines have been a hindrance.

On the Rhine, for example, a river not bigger than many Asian tributaries, the standards applied in 1958 when the “Bridge of Europe” in Strasbourg was built were not in line with the standards applied to those further downstream. This bridge is now a hindrance, to the point that a new terminal is being built just downstream of the bridge to receive vessels with four layers of containers, instead of three upstream the bridge.

Part of the problem is that building a dam downstream permanently raises the river level up to the flood level in 10 years’ time, transforming what was a seasonal problem into a daily occurrence.

In those days containers had not yet been envisaged, and the importance of good clearance was not an issue. The Europe Class waterways had a minimum clearance of only 5.25 m, and it was an achievement in France to raise it to 6 m. Today, this minimum clearance has been raised to 7 m, but exceptionally on the Rhine, which is partly in France, criteria should have been provided in French regulations for a 9.15-m clearance, in line with what the countries downstream had provided.
According to stability calculations and statistical analysis of actual movements, a clearance of 9.15 m appears sufficient to enable passage of four layers of containers. Either with ballast, or with a sufficient number of laden containers, a draught of 3 m provides the necessary clearance (figures IV.1, IV.2 and IV.3). The double bottom is usually only 0.5 m thick, which ensures a safety margin of 0.25 m above the containers.

Stability considerations make it unsound to use more than three layers of containers on barges carrying only three lines or rows of containers, except if the fourth layer is empty. In such cases, the last layer should be secured tightly to counteract any wind-induced movement.

This is the rule in Europe, and in Hong Kong, China, where the old container barges are only 23.8 x 8.53 x 2.82 m, operating at a draught of 2.44 m. Tests have been done in winds up to 40 knots, proving that no dangerous heeling develops with 24 loaded TEUs (three layers) and 32 empty TEUs (four layers).

In wider barges, more layers can be accepted. In Europe, four loaded layers with four rows of containers are allowed, and up to five layers if the topmost containers are empty. In Hong Kong, China, tests were conducted with container barges, proving that a 30 x 11.58
x 3.5 m barge, such as the one on the left of figure II.6, operating at 3-m draught remains safe with five layers of empty containers (80 TEUs) even in 40-knot winds. The barges tested were fitted with container derricks, which made them more unstable than ungeared barges. Also, typhoons are frequent in the Pearl River Delta. For these reasons, barges are authorized to carry only three layers of loaded containers (48 TEUs).

Some of the barges, such as those on the right of figure II.6, are even wider, in order to accommodate one 40-foot container across (first vessel on the right), or 3 TEUs across (second vessel from the right, and figure II.11). These barges are some 14 and 20 m wide respectively, and very stable.

The height of the derricks is not known. Some are able even to operate post Panamax ships, with 45-m booms. The clearance of the bridges over the lighters channel (figure IV.4) is only 17 m. It is thus likely that many derricks are shorter than this.

Compared to sea-going vessels, the IWT container vessels are of the open type, and never have hatch covers. In the early days of container transport on the Rhine (1982), some boat owners carried empty containers on the slanting hatch covers of their barges (figure IV.5). This resulted in the most serious accident in Rhine container history, where a barge having lost dozens of containers overboard, blocked the channel for many days. This practice was immediately forbidden and never repeated.

The maximum heeling angle accepted is 5 degrees for Rhine vessels, even in gales, and the metacentric height of vessels carrying containers should not be higher than 0.5 m for fixed containers and 1 m for non-fixed containers.
In Asia, vertical clearances are usually ample, and container barges could be of the pontoon type as on the Columbia-Snake waterway shown in figure III.8. In Bangladesh and India, so-called “flats” are, or can be converted to, deck barges. Bridge clearances are at least 12 m (approximately 40 feet) and, depending on their width, up to four layers of containers can be accommodated with the top layer of empty containers.

Ample vertical clearance enables operating with less draught, so no ballasting is necessary. It is thus recommended that the clearance over shallow waterways be higher than over deep waterways.

Another point is the duration of the clearance. In a free-flowing river, water levels vary throughout the year. The guaranteed clearance is usually obtained at least 350 days (95 per cent of the time). Thus, good clearance is obtained most of the time, and barge operators make use of this. Perception of the restriction brought about by the bridges (or cables in some cases) is rather that of the average clearance, when they do not need to ballast or can have one additional layer.

However, on a canal or a canalized river, clearance is more or less fixed, and the same standard clearance above standard high water level (SHWL) will result in more operational difficulties than for a free-flowing river. While the standard is the same operators have a less favourable perception. A bridge over a lock chamber presents the worst inflexible restriction, and locating a bridge there should be avoided, except if it is built with extra clearance compared with the standard clearance.

Considering the necessary freeboard for pontoon barges, especially for bay crossing, and the growing use of high-cube containers, a vertical clearance of 12.4 m is recommended (figure IV.6), enabling all waterways to carry containers with the highest efficiency, taking into account the foreseeable development of super-high-cube containers.

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16 Operating with pontoon barges, which are built lighter and require also less draught, may also be an option.

17 For instance, the clearance could be in line with that provided on the rest of the waterway during half of the year.
(c) Missing links/bottlenecks

In a network, or on a particular itinerary, there is no point in having good or better-than-expected characteristics even if there is only one spot where permanent below-standard characteristics are found, be it vertical clearance or width.

For instance, in Belgium, locks on the Upper Scheldt are 12.5-m wide, which even exceeds European standards, but there is a historic monument spanning the waterway in Tournai (figure IV.7), unlikely to be removed, which has a width of only 11 m. As a result, no Europe Class vessel is able to maximize the use of this powerful waterway. Rather, another waterway had to be improved to European standards to link West Belgium with France.

Another recently removed bottleneck was situated on the Central Canal in Belgium. Europe Class characteristics were available on the link between Brussels and Liege to France, except at one location, where a drop of 73 m was negotiated using a succession of Freycinet-class shiplifts. A new powerful shiplift, the highest in the world (figure IV.8), compensates for this drop at a single location, away from the historical monuments. It was inaugurated in September 2002. Thus East Belgium is now connected to France, with European characteristics.

The EU has issued a map of the European network, showing all bottlenecks and also missing links.
For instance, there is no possibility of navigating with a Europe Class vessel from most of France onto the Rhine network. Two links are missing: one from the Seine to the Scheldt-Escaut, the other from the Rhone to the Rhine. Within France, another link is missing, from the Seine to the Rhone.

At times, navigation is made impossible because of a single bottleneck point. For example, in Pakistan, the Sukkur barrage spans the Indus River, but it possesses no lock, and is thus preventing any through navigation, even during flood season, when it would otherwise be possible to navigate from the sea to Kalabagh, 2,000 km inland. For many years, the Farakka barrage in India constituted the same problem but this has now been solved by the opening of a large lock.

In China, there used to be no link between the Southern Grand Canal and the Qiantang River, necessitating the use of generators to unload and reload boats. A large lock was provided in the 1980s, paving the way for an extension of the Grand Canal to the seaport of Ningbo, further South.

(d) Insufficient depth

The issue of depth is usually less critical, because containers are of low density and seldom sink the vessel deep enough in the water for it to be fully loaded without ballast. This is not a generalization, however, because there are 20-foot containers weighing 24 tonnes that would overload a barge, but as a statistical average one TEU weighs a little less than 10 tonnes in European IWT.

As indicated above, where a European barge, constrained by the vertical clearance, has to draw 3 m and requires ballast, an Asian barge does not need more than 2.3 m. If this barge is loaded with only three layers of containers, it will need approximately 1.85 m. If loaded with only two layers, it will draw no more than 1.4 m.
An example of container traffic on a river with insufficient depth can be found on the Elbe in Germany. Container service is operated on this river because on the one hand containers usually require lower draught than general cargo, and on the other, low bridges on the canal portion of the route make it impossible to carry more than two layers of containers. On the Elbe itself, vertical clearance is not a problem during low waters, and the vessel operates at reduced draught (1.3-1.5 m) but full height. Conversely, on the canal portion of the route, full draught is available and the vessel is ballasted to go under the bridges with two layers.

In waterways with fluctuating levels, the solution for the container barge operator is simply to load less. Where depth is permanently less than 1.5 m, another solution could be to use a special lightweight barge, which would permit one layer more than normal designs. Usually, this would require the use of special propulsive units, such as water jets or pump jet, but it would make available a capacity of up to 80 TEUs with 1.2 m of draught.

There is a well-documented case of container transport on a shallow river in China: a container service running from Shaoguan and Qingyuan to Hong Kong, China, using the Beijiang and Lianjiang rivers that are only 1 m deep in the dry season. Thus, there is still some possibility for container transport on shallow rivers.

2. Terminals

The requirements to establish a river container terminal are rather basic and easily obtainable. Good quay aprons, space to stack containers, a crane or a gantry are the basics. Some ports, notably in the Pearl River Delta, operate even without a crane, thanks to geared barges. What is really needed is a hinterland and good connections with it.

(a) Bimodal terminals

A bimodal terminal links river operations to a hinterland served exclusively by road. Here again the Pearl River Delta (figure IV.9) is a case in point. This is also found in types of terminals in Europe, such as in Avelgem\(^\text{18}\) in Belgium and on the Columbia-Snake waterway in the United States.

\(^{18}\) The limited number does not reflect a voluntary decision on the part of the terminal operators, but rather denotes the fact that most existing ports in Europe have been trimodal, with a railway link, since the nineteenth century. Only brand new ports can be bimodal.
This has the advantage of limited investments, and thus a potentially larger intermodal presence in every corner of the waterway network. Some of the container ports in Guangdong Province, China, are in the mountains.

With a greater number of terminals, it is nearly automatic that the goal of using road transport on the shortest distance possible is achieved, thus permitting multimodal transport to be called also intermodal and even combined transport, and be in line with efforts for sustainable development.

\(b\) Trimodal terminals

As a general rule, IWT terminals are trimodal, having rail, water and road access. They can be truly trimodal,\(^\text{19}\) linking in a coordinated manner the three modes, or “double bimodal” if each environment-friendly mode organizes its own connection with road transport, simply making use of a common location or common equipment. The latter does not raise any new problem compared with bimodal terminals, and can be detected in the statistics, the sum of IWT plus rail entries being equal to road output.

However, in ideal trimodal terminals this is not the case, as goods or containers received by one environment-friendly mode are forwarded by the other without the use of road transport.\(^\text{20}\) In this case, multimodal transport may involve not only ITUs but also bulk.

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\(^\text{19}\) Trimodal here implies cooperation between rail and waterway, so that the part of the route covered by environment-friendly modes is at a maximum (up to 80 per cent).

\(^\text{20}\) This translates in the statistics as the sum of rail plus river handling being larger than road input-output. For instance, in Duisburg, Germany, in 2001, road transport was 16.3 million tonnes and river and rail were 20 million tonnes, for a total of 36.3 million tonnes.
Bulk is often transported for own account; that is, the owner acts as a kind of multimodal transport operator (MTO) and subcontracts various parts of the route to different parties while retaining overall responsibility. This is similar to merchant haulage.21

Such a long-standing case was the carriage of coal from the German coal mines, in the Ruhr area, to Lorraine steel mills, using the Mosel River. This was later extended to the Saar River, to feed the Saarland steel mills. This particular movement has lately been reduced due to the gradual closing of German coalmines. It involved an initial move by rail from the mine over 50 km to a port stockpile in Duisburg port, then a 450-km river trip to a port stockpile near Thionville, followed by a final 5 or 10 km by rail. Use was made of the two stockpiles to mitigate all incidents, such as strikes at the mines, labour problems on the railway and possible navigation stoppages caused by ice or flood.

A similar supply chain is used nowadays for feeding iron ore to the German steel mills, from Rotterdam and Antwerp by barge to Duisburg, and further by rail to the mills. It is also increasingly used for imported coal (figure IV.10), as German coalmines gradually close. In German public river ports, this type of combined transport represents 15 per cent of rail traffic.

When the canalized Mosel River opened in 1964, French grain cooperatives used this opportunity to operate a through service from the countryside silos, up to 500 km away, by rail to a relay-silo in one of the Mosel ports, then by barge to their clients in Germany or overseas via

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21 “From a carrier’s perspective, managing the logistic chain from shipper to consignee can be viewed upon in two ways. The term merchant haulage is used when the shipper, freight forwarder or consignee arranges the inland carriage of goods (to-port and/or to-door). The term carrier haulage is used when the shipping line, which carries out the marine transport of the container, or its agent, arranges the inland transport in addition to the marine transport. Inland carriers and freight forwarders can arrange the inland transport on behalf of shippers or consignees and as such play the role of chain manager in the case of merchant haulage”, Baker, Van Ham and Kuipers, e Shipping, NECTAR Conference No 6 European Strategies in the Globalising Markets; Transport Innovations, Competitiveness and Sustainability in the Information Age, 16-18 May 2001, Espoo, Finland.
seaports. This has worked spectacularly well, to such a point that the largest river grain port of Europe is a port in a region better known for its steel mills than for its sparse grain fields.

In China, similar supply chains are operated, based on the Yangtze River, usually to end in Shanghai. Coal trans-shipment berths from rail to river and vice versa are operated at numerous locations along this 2,800-km waterway. Figure IV.11 shows an example of the very large pushed convoys operated there, some up to 36,000 tonnes.

As regards containers, the full trimodal character of most terminals has so far been used infrequently. A few such moves are recorded in German public river ports, only 8,000 TEUs out of Duisburg to Hamm by railway. Proposals are under way to establish a service from the Rhine to Italy, combining Rhine river services with rail shuttle trains through the Alps, in order to divert more truck traffic from the roads. However, these attempts have been stalled due to the high price of rail transport on the first 20 km. Nevertheless, containers carried on railways in and out of Basel for Swiss delivery account for more than half of the total traffic due to strong restrictions imposed on trucking in Switzerland. Basel is thus another example where IWT and rail account for more than 50 per cent of the traffic of a port.

In major ports of the Yangtze, rail transport is available, but mostly no direct trans-shipment takes place between barge and rail at the various container terminals.

The same applies to Guangzhou, China, especially Huangpu, which has a rail link. There, it is very likely that the final leg from the mainland of China to Hong Kong, China, will be by barge and the initial leg by rail, or vice versa.

Road traffic is usually quite significant out of these trimodal terminals, and it is therefore of paramount importance that road access be well planned and away from dense areas. At the same time, however, it should help the economy of the region it serves, and thus not be too far away from its customers. This raises the question of inland hubs.
Trimodal terminals magnify the issue of inland hubs. In broad macroeconomic terms, it seems sensible to concentrate the heavy investments required for such trimodal terminals on a few sites, maximizing the traffic of each hub and thus lowering the unit cost of a move. Such big terminals would be located more than 200 km apart from each other.

However, the gains thus obtained amount to barely 50 per cent of handling cost, i.e. US$ 25 per move at the most. It may also reduce somewhat the IWT cost, but hardly more than US$ 10. On the other hand, it may induce extra road transport with costs ranging between US$ 100 and US$ 200 per container.

It is therefore understandable that such a policy is not worthwhile, and the market also ensures that it is not implemented, simply by proposing ever-cheaper services using ever-closer trans-shipment points.

In the Rhine valley in the early 1980s, there were scarcely more than five terminals. Today, there are 25 such ports in France, Germany and Switzerland, most with sizeable traffic, resulting in one terminal every 35 km. Main areas such as Duisburg, Basel, Dusseldorf, and Koln, may have more than one terminal.

As described by Jean-Pierre Rissoan, the shape of the hinterland of an inland port (figure IV.12) is not a circle, but an oval, lying opposite to the main seaport of the river network, and skewed according to the position of the competing infrastructure. It extends a few kilometres only in the direction of the “wind” of the port, and is much larger “under the wind”. The areas of two contiguous ports may realistically overlap because of the commercial strength of one port team or the other, but theoretically they hardly do.

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In the case of container ports, various phenomena, such as driving time legislations, may provide a deeper hinterland to the container terminals (figure IV.13), however no competition remains profitable beyond the first oval. There are cases of highly increased competitiveness for combined transport once a certain threshold is crossed. In the Paris region, for instance, such a threshold makes that river and road transport can remain competitive for nearly 300 km around Paris “under the wind” of Le Havre, while it meets strong competition in the immediate outskirts of the city, up to some 70 km of the terminal. However, this is no longer an environment-friendly combined transport, since the road leg, as long as the river leg, is over 150 km which is the official limit for combined transport in France. It thus cannot use the incentives provided to support this type of environment-friendly transport.

There is also the issue of the cost of helping so many terminals so close together. Macroeconomists would choose to restrict the help to a certain number of chosen projects, but in Europe the market, local politicians and European rules banning local monopolies make this impossible.

Thus trimodal terminals have expanded all along the waterway network of Europe and are ready to develop fully their trimodal potential, should a better understanding develop with rail operators.

(d) Service and logistics centres

Trimodal terminals are also intended to be “freight villages”. This term is a reminder of the fact that transport is performed by human beings, and that they must be located in a convenient environment.

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23 In screening national aids to terminals, the EC verifies that sufficient competition is available around, and that the terminal being helped does not have, nor would obtain through the help, a monopolistic position. See, for example, EU document No. 617/98 of 22 December 1999.
In this respect, inland ports have a long tradition of good hospitality, and locating a freight village or ICD to an inland port is a sure way to guarantee its success.

They also have had, for a long time now, a network of transport-related services, such as freight forwarders, customs and warehouses.

The port of Duisburg, the largest inland port of Europe, thus built a new trimodal terminal in September 2002, the Duisburg Intermodal Terminal (figure IV.14 and IV.15), aiming at moving cargo from road to waterways and rail in response to today’s environmental concerns. This shift will exploit the potential offered by ports for intelligent intermodal networks and the development of rail and water systems to strengthen the hub function of Duisburg.

Other, though smaller, examples can be found in many places. One of the most typical is the port of Lille in northern France, which in 1990 started from scratch a container terminal in a dying port that led to a rejuvenation of the port. Older bulk activities have been replaced by a booming container terminal, which has increased its volumes up to 75,000 TEU per year. To shoulder this shift, the port has created three barge lines to move containers to and from the neighbouring seaports, to the tune of 14,000 TEUs.

Since the industrial fabric around the terminal was somewhat blocked by expanding urbanization, the port contacted and subcontracted to its neighbours the warehousing and even some processing, including packaging, testing, humidity or temperature controlled godowns, etc., a shift called “outsourcing”. It has been at the forefront of this movement
since the middle of the 1980s, which helped its container traffic to pick up, as there are no additional trucking costs incurred to stuff or destuff the containers.

A very strong advantage has been that the customs office is located in the port with all freight forwarders nearby, making it a compulsory stop for all international transport. As a result, it has become the third inland port of France.

Early on, a fully-fledged trimodal container gantry was installed, giving the terminal the possibility to respond to additional traffic offers, such as the carriage of containers of urban waste from the city to the disposal site, 61 km away, at volumes of 18,000 TEUs.

It also initiated a regular train shuttle between Lille and Le Havre, a port not yet reachable by Europe Class barges, showing the advantage for a river port to have all modes at its disposal.

(e) Dry ports

Some inland ports that do not yet have a river container terminal have been selected by multimodal operators as the sites for their rail terminals, because of sufficient land and the bi-modal infrastructure available.

An example of this can be found in Germany, in an area of the port of Duisburg away from any waterfront, and in France at the port of Bonneuil on the outskirts of Paris, where a set of 600-m long sidings was made available in order to run the longest trains possible from Paris to Italy, filled with swap bodies. This possibility should be availed of to its fullest extent in Asia.

In order to achieve this, IWT bodies should always propose to responsible authorities that any ICD to be set up inland should at minimum be located by the side of a river, and if possible within an existing river port. These ICDs, often dubbed “dry ports”, would be potential real inland ports with little extra investment.
B. Use of the latest technology to connect IWT with other transport modes

1. Communication revolution

The primary and somewhat revolutionary change is that a vessel can be connected to radio or phone to obtain and exchange information. Previously, exchange of information could only take place at stops.

Today, VHF provides easy contact with the shore and other ships, and is the main means of communications for all safety issues, such as vessel traffic system (VTS).

Also, and more importantly, the growing coverage of cellular mobile phones has made it easier, in Europe at least, to contact those on board boats by phone rather than through VHF. It also means that ships can be logged on to the Internet, and exchange information with their base on a regular basis. Blind spots are few, and increase in coverage is also bound to happen in most countries of Asia. If some areas are not covered, due to scarcity of population or distance from a main thoroughfare, then IWT authorities might consider providing this coverage, which in any case will bring them returns, even from land transport related clients.

Alternate phone operators have also used IWT infrastructure to lay their optical cables, either on the towpaths or in the riverbed. Care should be exercised, however, so that this does not impair the possibility to deepen the waterway.

With these new possibilities for communications, owner-operators in Europe are nowadays able to look for potential clients while under way at the helm of their boat, when previously they were obliged to have recourse to a third party to do so. This has permitted an easy passage from administered marketing, through freight bourses or clearing houses, to liberalized marketing with fixing of prices left to market forces. IWT has been fortunate that this passage took place during a period of strong activity, so that freight levels have remained on the high side, and the IWT industry has become healthier.
2. Positioning and tracing

Another new technology is the Global positioning system (GPS). The accuracy of even the inexpensive systems has been so well proven that nowadays nearly every vessel has one on board. It provides, inter alia, the speed, location and a new innovation, which enables better organization of the traffic. This technology is available worldwide. Even better accuracy is possible with very limited investment, which could enable waterway authorities to dispense with part of the buoyage. Trials in this direction are under way in countries that are developing their IWT potential for the first time. In some cases, it might even be private fleets that take this direction for their own use in undeveloped waterways.

GPS also enables tracking and tracing, which sometimes has been difficult to provide to rail as its vehicles are unstaffed. Tracing has been one of the main requests of container operators and their clients. IWT is at the forefront in this area, owing to the interactive link between mobile and shore, proving how responsive the industry can be to clients’ needs.

3. Reliability and just-in-time delivery

In the past, IWT has not been very strong in this area, with delays caused by fog, night, rain, high water, drought, etc. With the advent of onboard radar and VHF, as well as VTS assistance provided by the authorities, fog, rain and night no longer delay vessels. With increasingly powerful engines, it is less and less likely that the strength of the current is a problem, except when navigation is stopped for safety reasons. Ice is not a foreseeable problem in Asia, except in northern China, Kazakhstan and the Russian Federation. In Western Europe, it poses a problem in canals only, but only for a limited time. In the United States, ice is still interrupting the northern part of the network.

In Europe, low water has been all but suppressed. The last area to experience this problem is Poland, with the Oder and its connecting canals. There is also the Elbe, which has draught problems at times. An aqueduct is being built across to ensure that the Mittelland Canal to Berlin no longer will be subject to the vagaries of this river, which had to be used for a few kilometres.

This reliability has enabled IWT to fully integrate the just-in-time (JIT) processes. What is needed is to deliver on time rather than early, and slow speed is not a problem if it is planned beforehand.
As early in 1964, a French waterway operator could guarantee the car-maker Renault that the spare parts needed daily to assemble the R16 model would be at the assembly line every morning, after 30 hours of transport. Even 15 minutes’ delay would have stopped the line and involved penalties, but these never had to be paid. In contrast, in those days, French rail could not guarantee precise delivery even over short distances.

Reliability has been one of the main advantages of container transport by IWT. Delivering a container by truck from the port on the same day of arrival, but with a margin of uncertainty of two or three hours, may not be ideal for customers who will be obliged to keep their crews on alert most of the day, even beyond working hours at times, and may not be able to use the goods before the next working day. IWT reduces the uncertainty to a strict minimum, usually less than half an hour. The fact that the duration of transport can be up to two days counts little in view of the organizational benefits.

For example, should a container arrive during the weekend in a European seaport, road transport is usually not feasible because consignee premises are closed, and early positioning may not be possible because truck traffic is banned on motorways on Sundays. Port terminals usually open only at 6 a.m. on Mondays, and trucks have to line up to load up, congesting the gates of the terminal. It may take anywhere from one to two hours to leave the terminal, instead of half an hour. In early rush hour it may take more than four hours to reach an inland destination (200 km), so it is very unlikely that the container will be on the customer’s premises before lunchtime on Monday. In comparison, a barge leaving the seaport terminal on Saturday would fully unload in an inland terminal at 6 a.m. on Monday (200 to 300 km), and the containers would be on customer’s premises by 8 a.m., because the road leg is much shorter (usually less than 50 km).
4. EDI and port software

In order to interlink fully with other modes, IWT container lines need to be integrated in the present electronic data interchange (EDI) systems. This has been successfully done in Europe, and owing to onboard computerization, vessels can even be linked to EDI during the trip. Some trucks are linked in this way, but for obvious reasons this is easier to achieve on a roomier vessel. Some vessels have stability software onboard, and manage their ballast during handling operations as well as give instructions to the crane operator on where to put a specific container.

The fact that containers can be cleared by customs while they are on board is also a proof of complete integration within the latest techniques.

The port of Lille was once again at the forefront of this evolution, and in 1990 created its own software, modelled around the same principles as those used by the few seaports that at that time had an integrated EDI.

The use of e-commerce is also beginning in IWT, with some web sites providing a marketplace for shippers and carriers to meet and exchange commercial information, such as quotations. However, the river community is small, and most of the freight is traded by direct contacts or through freight forwarders. On this point IWT will probably follow the general trend in the transport sector, and it remains to be seen if the freight forwarders are doomed, and to be replaced by e-trade.

E-commerce, if properly used, will be an important factor for increasing the visibility of IWT as it could market the IWT option of carrying containers to shippers.

5. Gantries and other handling equipment

Any of the seaport container cranes can handle IWT container vessels. At inland ports, depending on whether there is a noticeable level variation, reachstackers and big mobile cranes can also be used. The main inland container terminals also boast the same state-of-the-art handling machinery, such as 1 over 3 straddle-carriers, road trains and big reachstackers.

Special cranes exist for faster turnaround, however, such as barge gantries (figure IV.16) and trimodal gantries. They are similar to bimodal gantries except that they have a
cantilever on the waterside. Some of them are quite large, the widest on record spanning 123 m over rail tracks, road and water. As they are closer to the ground, the trolleys travel faster and their dimensions are adjusted to the specific work they do.

In Hong Kong, China, the River Trade Terminal is equipped with cheap derricks (see figure II.17), directly derived from those found on geared barges, and may provide even cheaper services.

In seaports such as Rotterdam and Antwerp, there are special IWT terminals fed either by fully automated guided vehicles, 10-TEU road trains or by rail shuttles located some distance away from the main sea terminals. The same system will be used in Port 2000 of Le Havre. The extra cost of bringing containers from deep-sea terminals to these specialized IWT terminals is compensated by the higher traffic concentrated to this location, providing a better load rate to the gantries. In Rotterdam, the river terminal of European Combined Terminals B.V. (ECT) (figure IV.17) started with one river gantry and has increased to three at present, with more to come. The traffic of this terminal is around 500,000 TEUs handled from barges, making it the largest river container terminal in the world.
6. On-board handling equipment

In the Pearl River Delta, local ingenuity has created a handling system that does not need shore support. When normal commercial relations between mainland China and Hong Kong, China, were established at the end of the 1970s, container traffic soon bloomed and these on-board derricks were used to the maximum. Although it may not appear to be the latest technology, it carries more containers than any other system in the world. Either on shore or on-board, some 8 million TEUs will be handled this way in the ports of Hong Kong, China, and maybe 1 million more in the ports of Shenzhen, China.

In Europe, where vertical clearance is a major issue, these big on-board derricks are unthinkable. When on-board handling equipment is proposed, such as on the Neo Kemp seen in figure III.3, it has to be of the collapsible or folding type. Even then, operators prefer to use shore-based equipment because of the weight of this piece of equipment.

7. Unitization

Since 1969, various techniques of integration between IWT and other transport modes have been in use, however with limited expansion.

(a) Barge carrying systems

The oldest and most sophisticated is the barge carrying system. In the early days, it competed with the container system, but lost the fight, and only a handful of these vessels have survived, the others having been converted into full containerships.

It involved middle-sized barges, either 450 tonnes or 800 tonnes, handled by huge cranes (LASH system) or elevators (SEABEE system) or ballasting the mother ship. Designed at a time when port congestion was high, it could beat normal liners but could not compete with the new containerships, with their high turnaround and priority berthing at new terminals. The barges were costly, and a number had to be left in each port to collect cargo for the next call, which could be up to a month’s time. Only these systems remain: one trans-Atlantic LASH line for paper transport, which is used westbound to organize all-water transport between Duisburg and any Mississippi port; a fleet of LASH vessels under Ukrainian and Russian flags is running between Antwerp, the Black Sea and the Far East; and

24 In order to avoid duplicate counting, only the final exporting ports are reported.
an Africa West Coast line, which has larger and deeper barges, essentially detachable 800-tonne holds handled by ballasting the ship. On this run, its capability of not entering congested ports has worked wonders.

From time to time there are talks of inventing a new but similar system, but nothing has materialized as of today.

(b) Roll-on/roll-off

The Roll-on/Roll-off (Ro-Ro) technique has had considerable success in sea transport, but more in niche markets than as an overall solution.

On inland waterways, some use has been made of this technique, integrating IWT and road transport. All cross-river ferries use it, but these are not counted as IWT in the statistics. The first concrete example dates back to the 1940s in the United States when cars were carried by ferry from the producing areas to the consumers or to export. This no longer exists, but this system has been used since 1964 in France by Renault to replace road transport between its various plants, all located along the Seine River. Limited vertical clearance has complicated its success, but is ideal from a logistics point of view. The oldest plant of the company was on an island in the Seine River, making it impossible to expand because of the surrounding urbanization. Thus the newer plants were built away from Paris in the open fields along the banks of the river. A central parking and dispatch area was created at a port on the outskirts of Paris, from which all the Paris clients were served. In a well-planned process, most of the moves were done by water, 500 vehicles at a time.

More astutely, the production line on the island did not send its cars to a parking on shore, but moved them directly to the barge, which thus served as a parking during the day, and moved the cars to the suburbs during the night. The integration of IWT in a complete logistical process was there pushed to its extreme. Millions of cars up to 400,000 units a year were built and moved that way. The plant has closed down, and only suburban and export exchanges remain on water with some 150,000 units.

Ro-Ro is nowadays used on the Rhine, with much higher barges, which also carry trucks and oversized cargo. Some 400,000 vehicles are carried that way every year.
There are also Ro-Ro river-coasters, which have both container capability and Ro-Ro space (figure IV.18). Their dimensions are 95.92 m long, 14.10 m wide and 4.05 m in draft. They have a stern ramp giving access to a trailers’ lane 468 m long (36 trailers), with a clear trailer height of 5.46 m. On deck they can carry 108 TEUs. They have been operating a line between Goole and Duisburg for more than a decade, even though there was a shift towards pure container carriers on this route in 1998, and they now run from Rotterdam only. The advantage is that trucks can be picked up in the heart of one inland industrial region and dropped off at the port of another across the sea. As shown in the figure, continental, pallet wide containers of 2.5 m wide occupy the upper layer.

One of the most interesting uses of IWT in the Ro-Ro sector has been the Ro-Ro vessel Han Asparuth navigating the Danube (figure IV.19). It is a 22-m wide Ro-Ro carrier, designed to be faster than road transport between Germany and Eastern Europe, as it is not held up at the borders. It carries 48 trucks or 56 unaccompanied trailers, and has been a great success for years.

C. Facilitation measures between IWT and other transport modes

On the subject of multimodal transport, a number of steps can be taken to facilitate the smooth interface between IWT and other modes of transport.

1. Including IWT in all multimodal legal instruments

This is not obvious and even in Europe it was overlooked for a decade. The system of incentives, for instance, was largely reserved for rail, and IWT had but a modest share, while it could provide exactly the same services as rail. Today, there are more international containers\(^{25}\) carried out of the main European ports by waterway than by rail.

\(^{25}\) Though this may not be accurate in TEU-km, rail covering usually far longer distances.
Efforts made to coordinate documentation among the modes through simplification, normalization and harmonization should take advantage of IWT. Further, during these negotiations, all modes being present, IWT should make itself known to its partners in the multimodal chain, and gain better visibility within the trade.

This might be needed and useful even if no multimodal transport by IWT exists. In fact, the IWT reputation for being backward is to some extent true, and great benefits could be derived from this exposure to the best procedures in view of a thorough modernization of the sector.

This has happened in Europe, where IWT was for a long time locked into a straightjacket of immobilism by its own workforce. It was the forced exposure of the sector, through international trade, to the facilitation and liberalization process, that opened the eyes of the profession to a necessary change. The same could happen in other regions or countries.

2. Including the needs of multimodal IWT in infrastructure planning and construction

(a) Clearances

When there is no container transport on the waterways, it is common practice to have rather low bridges. Multimodal IWT requires bridges as high as described in section A of this chapter.

To take into account the specific needs of IWT is sometimes a difficult procedure, for it has to obtain the go-ahead of rail and road authorities, which often involves extra cost and entail technical complexity. Fortunately, roads as well as railways need a substantial clearance, and IWT requests of up to 7 m (three layers with ballast) are easily understood. However, to reach 12.4 m of clearance (four layers without ballast) over the major network will require strong negotiation. If waterways are not shallow, as they are not during flooding, 9.15 m seems adequate over major waterways for four layers with ballast, and five layers will be possible during the lean season, for instance to carry empty containers.

This does not apply, on canals or canalized rivers, however, which must have a better clearance, equal to that of the average water level in a river. This will often bring the requirement to 12.4 m.
As regards bridges or navigable spans of barrages, the opening also must be adequate, and bridge piers must be reinforced against occasional shocks by a barge, but multimodal IWT does not require additional specification for that.

The width of locks is entirely within the control of the waterway authorities, but sometimes they are not the owners of the infrastructure, and the owners (electricity boards, irrigation departments, etc.) will have to comply with the recommended width of 12.6 m or more, which is fortunately a small increase.

(b) Missing links and bottlenecks

- Missing structures

The problem arises each time an irrigation barrage or a power dam is built across a waterway. Who should pay for the lock? The logic followed by many national laws is to compensate whoever is damaged by a new structure. In this case, the lock itself would be compensation, and the builder of the barrage or dam would have to pay for it. Builders, however, intend to spend as little as possible, and are reluctant to provide costly infrastructure that might be little used. They claim this investment is not useful and provide cost-benefit analysis to prove it.

However, the issue is different, it is about freedom of movement. No one can predict what will happen 100 years hence, but the barrage or dam will still be there — the older barrages are well over 2,000 years old — and potential could be lost if navigation is impossible. Who would have thought of the development of container transport on the waterways 50 years ago? To preserve that potential, many laws have incorporated very strong protection in favour of navigation, making it compulsory to provide a means to cross any obstruction across a waterway. This is only natural: in addition to drinking and fishing from the bank, water transport is the oldest use of any waterway, and it does not divert any water from it.

Thus a revision of laws in riverine countries to ensure this protection would be welcome. It would solve the theoretical debate on who should pay for through-passage structures, and give a stronger hand to IWT authorities in their negotiations with offenders. It should preferably include provisions to ban the
free withdrawal of water to the point of impeding navigation. On this issue, ecologists fighting for the protection and free passage of fish could side with IWT authorities.

- Bottlenecks

This is a very similar case, except that navigation is possible, only restrained. For improvements, IWT usually has to pay. Therefore, it is important to impose modern design guidelines that prevent the building of structures (locks, bridges, etc.) with dimensions impeding multimodal transport. If this is not done in a timely manner, IWT will have to pay to raise the bridges or widen structures should it be necessary in the future.

- Missing links

The issue of completing missing links is much more costly, sometimes involving billions of US dollars. Cost-benefit analysis is required to prove the viability of a specific link. However, in the economic doctrine, there is limited understanding of network interaction, even within a country. Further, benefits are usually accounted for only at the national level, while they may also occur abroad, when the link is a multinational link or enables to link two basins or two networks, one of which is multinational.

The characteristics required for multimodal operations should be incorporated in the design or the new infrastructure, along the lines proposed above.

3. Coordination at planning stage on location and layout of ICDs

Inland container depots are new structures, often provided by public bodies. It should be brought to the attention of these bodies through a comprehensive coordination checklist that they need not be “dry ports”, but that many successful ICDs are tri- or quadrimodal terminals on the banks of waterways. The examples shown earlier (Duisburg, Basel, Lille) demonstrate the potential offered by this teaming of transport modes.

Layout of these depots must also be carefully revised so as to enable IWT to fully play its role, be it at a future stage. For instance, in the port of Gennevilliers near Paris, a trimodal gantry has been in place since 1970, but did not serve to unload barges on a regular
basis until a container line opened in 1994. During all these years, it handled the occasional short-sea containers and served to handle containers in and out of trucks and wagons. A second gantry was installed, and helped the site to move over 100,000 TEUs in 2000, one third by water.

4. Setting up customs within inland ports

A simple and effective measure to strengthen multimodal IWT is to offer hosting inland customs offices within the premises of inland ports, for instance through attractive rental rates. This would provide a base for a service node, hosting freight forwarders, road and rail carriers, deep-sea carriers, truck and container repairs, driver hostels, restaurants, etc. For that, the environment must be attractive, and beautification measures should be considered as an integral part of planning a new inland terminal.

5. Evolution of water transport companies towards MTOs

Usually, laws governing transport undertakings are unimodally oriented, and provide a different set of conditions to be met for each mode. Sometimes, an operator in one mode is even barred to work in another. In the case of IWT, this might be a problem because in a combined water-road operation, the cost of the waterway portion is usually less than one third of overall costs.

Being a small stakeholder in the global context, an IWT operation is not in an easy position to market its services, unless it is able to propose a global service, from door to door or at least from seaport to door. The transformation of the status of an IWT operator to that of a multimodal operator should thus be authorized and encouraged by adequate regulations.

6. Introducing IWT in the EDI system and e-commerce

EDI is sometimes organized by Governments, or by the private sector to only one mode or the other. However, IWT needs integral access to any modal EDI in order to be at par with any other mode. For instance, it should be part of national transport or trade facilitation committees.

This of course requires IWT to be ready for it and to fully avail itself of the possibilities offered. It is essential that IWT operators adopt a comprehensive approach when they improve their management systems and that they introduce EDI in its various forms into their design. Only then can IWT become a valid link of a multimodal chain.
The same applies to E-commerce. There are many opportunities for inland shipping operators to jump into business-to-business (B2B) on the Internet. There are two types of clients for IWT container lines: shipping lines and shippers. B2B may expand more towards shippers. This has the advantage of broadening the marketplace at little cost, dispensing with the necessity of physically meeting every small client.

7. Negotiations with port workers

One of the main problems when introducing the carriage of containers inland is the reluctance of seaport workers to accept this.

The best-known example of such a situation is still going on in an Asian country, where every study since 1982 has recommended inland movement of containers by IWT. This has not been possible to date because of fear expressed by the labour unions over losing jobs as stuffing or destuffing would no longer be done in the port. Even railway moves have been on the low side, with only 10 per cent of the traffic.

There have been ways out of this deadlock in other countries, through grants for retirement, offer of jobs at the inland ports, etc. A team of facilitators could be set up to tour the countries on request in order to encourage a shift from road transport to more environment-friendly modes of transport. It is in the best interest of the countries involved because such blockage harms their foreign trade.

8. Acceptance of work over side at moorings or in midstream

Container handling often has been a problem at seaports either due to the inadequate infrastructure in ports or to insufficient capacity. Inland handling is also difficult because of the high cost of investments.

One possibility would be to encourage midstream operations as established in Hong Kong, China. This is done by self-sustaining vessels with container derricks. This type of geared barge could work wonders in ports with small port infrastructure, or which rely on anchorage working, such as Mongla in Bangladesh. The barges could be used either as handling gear only, and remain in port at either end, or as a shuttle between sea and land terminals, such as Chittagong or Mongla to Dhaka in Bangladesh.

26 Usually shipping lines have their own Internet software or EDIs through which the connection is already established with IWT operators.
This shuttle could also be used for short distances, for example:

- shuttling between two terminals in the same area, for instance, Jawaharlal Nehru Port Trust (JNPT)-Nava Sheva-Mumbai in India, or Karachi-Port Qasim in Pakistan;
- between an outer (daughter) port and its river (mother) port, for instance, Mongla and Chalna in Bangladesh or Haldia and Kolkata in India;
- between an outer anchorage and the main port (anywhere, but also between Saugor and Haldia in India). The Laem Chabang-Bangkok shuttle in Thailand could be also included in this category, even though Laem Chabang is a normal port, because the shuttle crosses the Gulf of Thailand.

Shuttles could also supplement overloaded container terminals by operating a ship on both sides to benefit the carriers as well as the port authorities as they would speed up port turnaround. This might be applied in JNPT-Nava Sheva, whose success has made congestion a near reality.

9. Incentives given on the legislative side

Inland transport of containers by environment-friendly modes is becoming a necessity due to growing awareness of the threat posed by global warming.

To promote this, some countries have come up with specific incentives, the latest of which has been the Marco Polo programme (described in annex I). Others have been more on the technical side, for instance the higher load limit for trucks carrying containers in combined transport operations. An example of the influence of this last measure, which also applies to combined water-road transport, is as follows.

- The example assumes transport of two containers from Asia to Reims in France via any port in the northern range. Their gross weight is 15.8 tonnes each.

Combined transport incentives will have an influence on which port of entry in Europe shall be chosen, and increase the hinterland of one when it is served by multimodal IWT.

Direct road transport from either of the ports of Antwerp and Le Havre to Reims is the same at US$ 650 for one TEU. The weight implies that only one container can be carried per trailer.
Terminal handling charges (THC) at the port of Le Havre is US$ 117 per container and US$ 110 at Antwerp.

Freight being equivalent, Antwerp is thus slightly less expensive.
There might nevertheless be ways to use Le Havre at less cost than Antwerp, using combined transport, which in France provides some advantages on the road transport leg.

In this instance, the best way would be to use the multimodal IWT service from Le Havre to Gennevilliers (Paris) because rail does not operate combined transport to Reims.

The port-to-door quotation from Le Havre then is US$ 193 lower than from Antwerp.

This is based on the fact that, provided the road leg of the combined transport is less than 150 km, overall weight of trucks in combined transport in France can be 4 tonnes higher than in unimodal road transport. Thus, they can carry 2 x 15.8-tonne containers, instead of one, on one truck for final delivery, and return them to Le Havre via Gennevilliers and IWT, making it cheaper.

In any case, when the sea carrier is big enough, it has a container depot in Paris, saving the return by barge to Le Havre, which provides an added bonus and is summarized in table IV.1.

Table IV.1. Comparison between different european ports\(^a\) and land transport modes
(Prices in US dollars, for one TEU in a batch of two, with same destination)

<table>
<thead>
<tr>
<th>Transport between Port and Reims</th>
<th>650</th>
<th>650</th>
<th>1300</th>
<th>457</th>
<th>412</th>
</tr>
</thead>
<tbody>
<tr>
<td>THC</td>
<td>110</td>
<td>117</td>
<td>134</td>
<td>117</td>
<td>117</td>
</tr>
<tr>
<td>Freight difference</td>
<td>0</td>
<td>0</td>
<td>125</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>760</td>
<td>767</td>
<td>1559</td>
<td>574</td>
<td>529</td>
</tr>
</tbody>
</table>

\(^a\) Coming from the East, a quotation via Marseille-Fos, a French Mediterranean port, appears sensible. If the freight rate were cheaper at Fos than in the north by some US$ 700, Fos would be selected. In fact, the freight difference is the opposite, Fos being more expensive than Antwerp or Le Havre, in the range of US$ 125 per container. This is broadly based on the hub bias, with no big shipping line only feeders making a direct call to Fos; the extra handling is reflected in the price.

This example shows how much seaports can benefit from a developed IWT serving them.
10. Customs facilitation

The international transport of containers should be done to a greater extent by environment-friendly modes. In this regard, IWT can be used to facilitate international goods movement in two sample areas: Bangladesh and India on the one side, and the Greater Mekong Subregion on the other.

(a) Bangladesh and India

A transit agreement exists between Bangladesh and India, mostly geared for break-bulk movements, and is regularly renegotiated.

This could be upgraded to provide for combined road-river container transport without a break of seal at the borders, and in this way provide either “domestic” transport between West Bengal and either Northern Assam (Gauhati area) or Southern Assam/Manipur (Cachar area), or international transport for export cargoes from Assam, such as tea. Using derrick barges to handle containers in Assam and a road leg would provide door-to-door transportation in a much smoother way than by usual direct “domestic” road transport via Siliguri around the northern tip of Bangladesh. Export cargoes could stop directly at Haldia. For faster dispatch, customs inspection for export could be done in Assam. On the basis of mutual benefits and agreement, cargoes can be exported at Bangladesh port(s).

The fact that the Cachar waterway is shallow is not really a hindrance as containers are unlikely to request much draught. Designs are available of extra shallow self-propelled barges, drawing only 1.3 m with 80 TEU capacity, and still carrying 40 TEUs at 0.9 m. Existing vessels could even serve the purpose.

Although bilateral in nature, such an agreement concerns transit, and could fruitfully draw on the experience of the Customs Convention on the International Transport of Goods under Cover of TIR Carnets (TIR Convention) in 1975, presently being introduced in a number of countries in Asia. Although dealing with road transport, it has devised many procedures, which are regularly throughout the world, and could find some application here, should its provisions be more beneficial to the development of trade than the existing ones.

(b) Greater Mekong Subregion

The fact that containers, once on board, are very difficult to tamper with, gives customs authorities the assurance that seals will be well protected in multimodal IWT
operations. This is of prime importance when there are many border crossings or when operating in insecure areas. In the Upper Mekong, in order to reach Luang Prabang in the Lao People’s Democratic Republic from China, four border crossings in a rather exposed zone are involved. A river container line thus would be the safest way to carry goods between the countries of this route.

In the delta area, road infrastructure is insufficient and rail is non-existent. Container transport between Cambodia and Viet Nam is thus an adequate response to a growing need. With the expected economic development of Cambodia, such a line would find a good market. The fact that larger feeder containerships can reach Saigon port rather than Phnom Penh would enable the creation of a viable combined sea-river route from Singapore to Phnom Penh via a Vietnamese port.

Long-distance ferries, such the one used on the Danube (figure IV.19), may also be a solution to supplement the insufficient road network.

11. Night navigation

Although apparently of a technical nature, the issue of night navigation is in fact linked to facilitation.

It must be stressed that night navigation should be permitted only when channels are cleared and without much natural dangers, such as strong eddies and reefs, and only when appropriate lighted aids to navigation are installed.

Nowadays, radars and the requested software are normally available on board and extra GPS stations are placed on shore. The placing of these GPS shore stations, required for improved accuracy, is also part of facilitation since it is likely that international traffic will be the one using this system most.

Night navigation also needs improved security to ensure that piracy does not occur under the cover of darkness. These measures fall under the security authorities rather than IWT authorities.

In a number of countries, night navigation is forbidden. This limitation should be removed through the improvement of waterways and installation of night navigation aids or more advanced radars and GPS.
V. PROMOTION OF IWT IN THE MULTIMODAL TRANSPORT WORLD

A country’s ability to transport is equivalent to its ability to prosper: most national development plans recognize the strategic role of transport in providing the inter-sectoral linkages of the economy.

In many countries, IWT has been one of the big reasons for their prosperity. It is striking that even where IWT enjoys favourable conditions, investments are markedly lower than its market share.

This is mainly due to the perception of policy makers, planners and developers of this mode of transport as slow, old-fashioned and outdated. Thus, promotion of IWT in the context of intermodal competition and multimodal cooperation may start by showing “problems-that-are-not”, enabling a complete rethinking about this, in fact, very lively mode of transport, and laying the ground for adequate communication with the public.

A. IWT is not slow and delivers cargo “just-in-time”

Multimodal transport requires delivery on scheduled time. International goods orders are sometimes placed months in advance, and a break in the supply chain could be disastrous. Thus it is essential that every mode “delivers” at its own pace on time. IWT is able to do that with the advantage that it meets no congestion. Its combination of speed and reliability is at par with other inland modes.

This is especially true for Asia, where the average speed of a railway freight wagon is often lower than the service speed of a number of mechanized vessels. Further, in actual service, railways in some parts of Asia have a very bad record, and total delivery time of a well-managed water transport can be far shorter than the present railway performance.

The other competitor, road, proudly advertises “Karachi-Lahore in four days” which, should the Indus and its tributaries be navigable, would not be out of reach of a modern vessel running 24 hours a day. On the Yangtze in China, fast inland container services achieve a comparable feat on a 2,400 km stretch, and normal international containers travel 400 km/day on the same route.

In Europe also, where borders are many, IWT performs well in comparison to both rail and road. On the Danube, a Ro-Ro vessel carries trailers across six countries at a faster pace than a prime mover. On the Rhine, container traffic rises on average at a double-digit
figure per year, guaranteeing delivery times very close to what the other modes can ensure: in Europe, the average speed of international freight trains is only 18 km/hour from station to station.

A stronger presence of IWT will bring benefits to the industry, which will get a better service; consumers, who may get a cheaper product; railways, which will eventually achieve much needed improvements under the pressure of IWT competition; and road, which is likely to see an increase in traffic linked to IWT intermodalism.

A strong advantage of IWT is that is congestion-free. Multimodal supply chains require delivery on scheduled time according to the just-in-time (JIT) concept, rather than rapid delivery. Many supply chains incorporate a sea voyage in their organization. Then, global delivery time ranges in weeks rather than days, and adding one day more using IWT on the inland transport side would not have a negative impact. Also, thanks to its reliability, it provides the consignee with a guaranteed estimated time of arrival (ETA), while road transport may miss its ETA due to traffic congestion either on roads or at terminal gates, or due to time restrictions on the use of trucks.

B. IWT is location-specific but linked to seaports and banks

Especially in developing countries with great rivers and underdeveloped transport networks, the other modes of transport are obliged to bridge the rivers at great cost, while IWT can reach both banks of a river with the same ease.

In addition, since water transport has often been the only means of transport for centuries, many big cities are located on the banks of rivers or estuaries.

There are places where this feature is still put to full use: in China, the Yangtze is still the main artery of trade in and out of the nine provinces and two municipalities. The fate of Shanghai, Kolkata, Bangkok, New Orleans or Rotterdam would have been very different had they not been endowed with a riverine hinterland. Even the birth and development of Paris was much linked to river transport.

There are therefore great market opportunities due to the fact that rivers or canals run past or through big cities. Building materials can reach the centre of town without choking the surrounding streets, and city waste can be processed outside of the cities, with only a short move on water, either in bulk (like London or Geneva) or in containers (like The
Hague or Lille). In the same manner, IWT can easily link complementary industries that have settled on riverbanks without congesting the few crossings on which enough traffic is already squeezing.

In the case of new canal developments, there are techniques to locate a water route where it would not have been thought possible, resulting in a clear opportunity to reach traffic sources in the hills or on plateaux. In comparison to ropeways and belt conveyors for distances above 15 km, IWT can be even cheaper with the advantage of not being limited to carrying only one type of commodity: if one type of traffic disappears, another may surge; or additional traffic could materialize and complement that which was originally envisioned.

IWT thus enjoys more flexibility than is usually thought. Intermodalism, mainly through exchanges with road transport, definitely broadens its hinterland.

C. IWT is not doomed where it does not carry bulk cargoes or operate over large distances

As regards the IWT length of haul, in Europe the average lead is around 150 km; thus, long distance is not a must. On the contrary, many lucrative offers are for short-distance shuttling, when congestion of roads and railways, or topographical considerations, makes it a sensible alternative. In Goa in India and in the Netherlands, for instance, many container routes are no more than 50 km long, and IWT is also a very good alternative to transport in deltaic areas, where roads are difficult to build and maintain. Rural transport or country boat transport is also bound to short distances, and may amount to a fairly high tonnage. In Bangladesh, country boat traffic provides good service in most areas, while it does not appear in the statistics. It may amount to 15 million tonnes, three times the amount of middle-distance mechanized traffic.

As regards transportation of goods, it is usually believed that bulk transport is the only type, which can support a strong IWT. Ro-Ro and container transports, however, are spreading rapidly, and they carry manufactured goods in these ITUs. Besides, there are cases where IWT bulk transport is not competitive on medium and long distances due to drastically low railways rates for bulk, but where it has a good niche is in the traffic of finished goods, break bulk cargoes, packaged goods, etc. for which railway rates are high, and this is where IWT can compete with both the railways and roads on quality of service and on cost.

27 Where rates are based on commodity nature.
Of course, a strong flow of bulk trade on a waterway network is not detrimental to IWT, but there may be other ways to run a profitable trade. In Asia, it may sometimes be difficult for IWT to obtain much bulk traffic on a purely "tariff" approach, while it may win in quality of service: a reduction of pilferage and losses, by 2 per cent as documented in a number of cases, will go a long way to put IWT on a competitive footing with other modes. Multimodal transport, which better protects goods, including manufactured goods, in its ITUs, may be a solution, and on this type of traffic IWT has a strong role to play. Container transport is very well suited to shallow rivers with its high volume/weight ratio and a full complement of containers could transit towards land-locked countries on ultra-shallow barges not deeper than country boats.

D. IWT is not an outdated technique, nor is it receding

Historical curves for containers in Europe show that growth has been very consistent, without having been affected by various recessions in the developed economies. Continuation of an overall steady growth in the world is more than likely, while forecasts show an explosive growth in the multimodal field.

The type of goods carried and the logistics chains smoothly organized are more diverse every day, especially those using containers, even on short distances. The Netherlands is a case in point, with nearly half a million TEUs carrying butter, beer, milk, etc., that never touch a seaport.

In the first decades of the twentieth century, competition from road and rail virtually destroyed the water transport industry in the United States. In 1924, the federal Government established the Inland Waterways Corporation to revitalize commercial transportation on inland waterways and present a viable alternative to the railways. It had a pioneering role, since at that time there was no common carrier left on the rivers, and only a handful of private bulk carriers. It experimented considerably with tugs, pushers and barges, methods of propulsion and fuels, and it also maintained unprofitable routes as a service to the public. Later, expenses of this nature were shown separately in its accounts to demonstrate the profitability of operating commercial routes. It also built or operated terminals.

When its tasks were considered fulfilled, the Corporation was sold to private parties and became the Federal Barge Lines in 1953. During the lifespan of the corporation, IWT

28 From 1984 to 2000, IWT in the United States grew from 568 to 656 million tonnes, and from 356 to 444 billion tonnes-km.
traffic had grown from less than 50 million tonnes in 1924 to 297 million tonnes in 1953. Traffic stood at about 656 million tonnes in 2000, the highest figure ever recorded.

E. **IWT should not be considered in isolation: it is also one of the facets of water resources, and often part of the industrial or commercial fabric as well**

The link to water resources is well known, but seldom incorporated in comprehensive analysis. However, the development of the Tennessee, the Rhone, the upper Rhine and the Volga are proof that excellent results can be achieved at low cost for the countries involved, by the simultaneous development of a river for power, flood control, navigation, irrigation, industrial/urban uses, beautification and recreation.

Such multipurpose developments are also catching up in developing countries, such as the Damodar in India and gigantic works like Itaipu at the Brazilian-Paraguayan border, the Rio São Francisco in Brazil, Gezhouba and the Three Gorges in China.

With increased energy costs, small watercourses with low head turbines are becoming quite profitable and a number of projects are planned, particularly in China on the tributaries of the Yangtze. Container lines are part of these developments.

There are also other concealed functions of IWT, which are seldom brought to the fore: barges are, sometimes unwillingly, used for storage purposes, and armadas of loaded vessels are waiting for ships to call at Bangkok, Chalna or Kolkata. In contrast, French Renault cars built at the original factory rolled directly out of the lines onto barges acting as buffer stock-cum-mode of transport, since the factory was in the heart of a city and could not use its scarce area for storage; daily, the production was moved to a suburban location for dispatch or parking.

These other functions linked to IWT could help its development by lowering the capital or operating costs of this mode of transport. Navigation on irrigation canals is a clear example and is probably one of the most promising opportunities for IWT development in some countries of the region.

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29 The latest World Bank loan for Chinese IWT concentrates on such works on the Xiangjiang River, seen as a way to ease the landlocked position of Hunan Province.

30 This feature does not exist anymore. Faced with city growth and globalization, Renault had to move its factory from Billancourt to other riverine locations.
F. IWT is intermodal and multimodal in essence

The combination of modes originated to help passenger movement overland, and the ferrying function remains even today and extends to road and sometimes rail transport.

Once people ventured farther from their birthplaces, they started to trade and often did half of the trip on rivers, but this nascent IWT had to be supplemented by other modes on the route. IWT was really created with the use of sails to go upstream and downstream, but the complementarity with other modes was never challenged. In the sixteenth century in Europe, horse-drawn coaches were carried over hundreds of kilometres on flattop barges to avoid the rough and insufficient road network, a fully multimodal combination.

Intermodalism emerged with the development of railways, when the latter needed to bridge gaps in their network. This was the case during the nineteenth century in Pakistan, where the Indus flotilla carried the goods over a long distance to link the two isolated railway networks. Once the overland connection was established, the flotilla was disbanded.

During that period, by locating most of their stations away from the waterway front, the victorious railways disrupted the usual interface. A form of "one-modalism" was established, where railways were buying canals and IWT companies to let serve only the trade that they themselves could not profitably carry. At that time road transport was not a serious competitor over long distances.

When trucks started to prosper, intermodalism regained popularity and a number of railway lines were closed and replaced by road services. At the same time a buoyant IWT truly practiced intermodalism, at least at one end, but interfacing with either sea or road transport, while most inland ports also had rail connections.

Today, this intermodal network enables IWT to play its part in the multimodal system and to use containers and Ro-Ro techniques. Being location specific, a majority of its traffic needs to use another mode.

By this intermodalism, IWT brings more traffic to other modes of transport rather than competing with them. Also, with proper planning of terminals and adequate siting of new industries, its role in the intermodal competition in Asia can be tremendous.
G. IWT is not doomed if its vessels are not huge; there is also a market for medium-size consignments

It is true that in accordance with the law of escalating returns, bigger vessels have a cheaper unit price. What if, however, there is no market for such vessels?

It is also true that the existing small vessels are contrary to the general tendency of concentration, and with the ensuing increase in size of the consignments of bulks they are at risk of being chased out of the market. This concentration move exists throughout the industrial chain: a company which needed one 20-tonne truck per day twenty years ago may need five today. This means a 300-tonne barge satisfies three days of its needs, with free storage during its voyage, and fits very well in a supply chain, provided the plant is not too far away from the waterway.

There is thus a growing trade in highly specialized bulks, usually half-products or semi-transformed bulks, shuttling between big seaboard plants to the factories where the final transformation takes place. This is done in medium quantities, and is ideally suited to the medium-size fleet, which has found a very dynamic niche market. This can be true in every country of the world, should this opportunity be known, and should IWT be adequately marketed.

In summary, what IWT needs above all is communication. It needs:

- Visibility in the eyes of the political decision makers, so that they do not forget IWT in their votes or in their programmes.
- Visibility in the eyes of the general public, which still has an image of this mode as being slow and outdated.
- Good marketing of the industry, whose goods already travel by water in containers, be it unknowingly. The number of “niche” markets is astounding: butter, beer, soft drinks, etc. The fact that the Netherlands carries 43 per cent of its goods on water, even on small canals, is not entirely due to geography. It has to do also with profit.

When it becomes known that even a small consignment of only 10 tonnes of goods, or even 3 tonnes of garments on hangers, can be profitably carried by IWT, understanding of this mode will change.
VI. IWT IN THE FRAMEWORK OF INTEGRATED TRANSPORT SYSTEMS

A. Financing of IWT for integration with other transport modes

In developing countries, much of the initial transport infrastructure of various modes is in need of repair, extension or modernization. The growth of internal and international trade was greatly hampered by unsuitable infrastructure development in the twentieth century. To put an end to that situation, large sums have been invested into modernizing networks.

Nevertheless, not all modes of transport have been invested in equally. The amount spent for IWT has often been much smaller than that for the railways, for instance.

Most Governments in Asia prefer to invest in artificial transport modes used by the general public, rather than developing the network of natural waterways.

The World Bank has made efforts to reverse this tendency. IWT as a whole has been strongly supported by the World Bank in Asia. A number of projects financed by the World Bank have been implemented in Bangladesh, China, Thailand and Viet Nam.

One of the strategies to develop a sound transport sector has been to invite private sector financing. Ports in particular have seen a sizeable growth of BOT or BOO projects. The development of international trade and multimodal transport has seen the emergence of a number of big operators. Even during the 1997-1998 Asian economic crisis, many ports continued to grow in the container sector, while their traffic declined in other sectors.

IWT could benefit from this trend and its development could also be supported by private sector involvement in container transport out of the ports, possibly in shuttle traffic between an inland port and a seaport controlled by the same interests. After all, IWT has shown its potential in this sector in many Asian countries. At least one proposal has been made in this direction in a developing country of the region.

Nowhere is this more clearly possible than in the multimodal sector where activity has been driven by shippers’ requests and has been put into the service of the supply chain, ultimately responding to final customer desire.
As regards financing of IWT, a new strategy would be to provide financing of basic infrastructure components, paving the way for increased private financing of waterway infrastructure, ports and operational facilities. Governments could play the role of catalyst by creating a financial and regulatory environment in which private sector capital and operating experience would be attracted in a controlled manner so as not to bring about a monopoly situation.

To that end, Governments could jointly finance transport assets or initiate operations in the public interest, which are unlikely to be run solely by the private sector. Waterway infrastructure, such as locks, channels and bank protection, would also qualify for government financing. Some port infrastructure could also be set up that way, when BOT is not a solution.

Governments could also establish appropriate legal and regulatory framework to ensure fair competition and constrain monopolies.

Finally, they could assist with labour redundancy schemes, which are a burden to the financial viability of any future operation, but are often a requisite to start one. Such labour problems may hamper the initiation of multimodal transport activities, deemed to be less labour-intensive, and thus rejected by seaport workforces. In fact, it has been the IWT part of proposals that has raised the most concerns in ports, which are afraid that they will be bypassed for the labour-intensive operation of stuffing or destuffing of containers. Without a solution, no private financing of any IWT operation under the framework of multimodal transport is likely to take place in several countries of the region.

Another role Governments can play is statutory, dealing with technical or legal rather than financial measures, although, for example, providing free land by the riverside has a cost-reducing function. Accepted re-use of redundant port facilities can also be a source of financing for the private sector.

In the field of financing, governments may facilitate the improvement of institutional capacity to monitor new public/private partnerships, managing transactions between public and private bodies and overseeing private operations without interfering with their financial and commercial activities.

This new approach aims at addressing a variety of challenges.
This approach would help address some of the challenges facing the sector. The long cost-recovery period and low rates of return (usually lower than 12 per cent) still make IWT investment unattractive for potential private operators. However, provided a combination of public and private financing can be arranged, successful privately run schemes could develop in countries of the region.

Governments should also establish pricing and cost-recovery mechanisms. They should aim at attracting investment and guaranteeing adequate maintenance. At the same time, however, they should not deter traffic. Thus governments should assist investors or operators in guaranteeing sufficient returns until traffic is high enough to pay for its expenses at the toll or fee level provided.

In addition, waterways have many functions and their benefits are enjoyed by various parties or communities. It is difficult for the waterways authorities, and even for a private party, to recoup these benefits through a payment, toll or fee.

According to the World Bank, recovery of the costs amounts to 25 per cent in Europe, 30 per cent in the United States and 40 to 50 per cent in China. The boat operators are the main contributors, while flood protection and town development sectors never get called upon to contribute to the costs.

France has found a way to finance IWT. Faced with the problem of deferred maintenance, insufficient investments for modernizing waterways and a European obligation to link its network with the rest of Europe, France had to invest heavily, but could not do so because of budgetary constraints and deficit limitations. To overcome these problems France started taxing some of the users of water.

Of course, vessels normally pay some money to begin a voyage, and also for each tonne-km made (less than US$ 1 per 1,000 tonne-km), but this does not amount to more than US$ 6 million per year. Pleasure craft also pay, roughly providing the same revenue, so users of the waterway pay approximately US$ 10 million. However, this does not even cover the salaries of the lock keepers. The users of the banks of the waterways also pay a certain amount, but amounting to less than US$ 5 million per year.

The main users of water are the thermal power plants located along navigable waterways, which make use of the controlled level of the river ponds to reduce their pumping power and benefit from the reservoirs created by navigation barrages or dams to mitigate the
thermal increase of the water they release back into the river. Without these navigation structures, their expenses would be far higher. They also extract, through evaporation, water that is no longer available for navigation, and which navigation has to replenish. The same applies to drinking water. In summer, the total discharge of the Seine River within Paris would diminish by half owing to drinking water withdrawals, if no reserves were released by navigation.

This is translated into a fee per m³ pumped for cooling or other purposes. It amounts to between US$ 1.5 and US$ 4.6 per thousand m³. Other users are also charged, but they receive a discount of 10 to 30 per cent for industrial purposes, and 90 to 97 per cent for agricultural purposes. Drinking water is also charged, and this tax is passed on to the consumers who find on their domestic bill an entry entitled “VNF tax”.

The VNF tax system is more tailored to the task, and amounts to some US$ 100 million per year. However, the backlog of deferred maintenance of the whole network is such that it would require nearly US$ 3 billion, of which US$ 1 billion is urgent. It will take sometime, but the rehabilitation may ultimately be achieved in a dozen years for essential waterways.

What remains to be financed are new investments, permitting better linkages between networks and enabling multimodal transport on many routes, presently impassable by multimodal barges. This had been provided by a special tax of US$ 9.15 per 1,000 kwh on hydropower produced on navigable waterways, which went into a special fund for land transport and waterways.

Recent developments have suppressed this fund, but the principle of the tax is now used by the general budget. It provides some US$ 150 million per year. Only part of this revenue, approximately US$ 50 million is retrocede to VNF.

Moreover, regions have entered into planning agreements with the state so that they will contribute to rehabilitation or new works on the network located in their territory. This source of financing covers US$ 100 to 150 million per year starting from 2000.

Hydropower produced on the Rhone River is a special case, specifically allocated to finance navigation of this river by a 1932 statute similar to that of the Tennessee Valley

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31 Or released in the case of sanitation plants.
Authority in the United States. The complete development of the river having been achieved, it remains to be decided what to do with this source of financing. It had in a first instance been ascribed to developing a link between the Rhone and the Rhine Rivers, but this was cancelled.

As regards multimodal needs, the raising of bridges has been planned by one French region where the size of the locks was adequate, but there was insufficient vertical clearance. This is a costly exercise (over US$ 150 million).

However, most of the investments for multimodal IWT and its linkages with other modes of transport go to ports. Upgrading of ports or terminals has been facilitated by VNF through special agreements whereby the user has to guarantee a certain amount of traffic in exchange for a subvention for civil works. This system has worked tremendously well and 10 per cent of French traffic has been generated in this way.

As explained in chapter III, special subventions are also obtainable for developing combined transport terminals, either on the national side or on the European side. Total subventions may rise to more than half of the total cost and include specific vessels developed to enable traffic that would not be possible otherwise, for instance ballastable vessels. Although they are not structures, these have been specifically included in the list of elements of the combined transport network because they replace or avoid infrastructure.

For many riverine Asian countries, rivers run through large areas of the countries, such as the Yangtze and Pearl Rivers in China, the Greater Mekong River in six Asian countries, the Ganges in India and the Ayeyarwady River in Myanmar. They can be used as trunk transport corridors for medium- and long-distance transport. When roads or railways are planned or expanded in adjacent areas of those rivers, those rivers can be proposed as alternatives by the IWT sector and evaluated in economic, financial and environmental terms. Mostly, IWT solutions for those river areas should be feasible in appropriate planning with partial planned investments in roads or railways.

Countries may also consider the “polluter pay” approach as adopted by some European countries. Use of roads, in particular for long-distance transportation, causes air pollution and users are obliged to provide compensation so as to contribute to other less polluted modes of transport, such as inland waterways and railways. The funds thus raised are
used to improve inland waterways and railways to reduce overall air pollution produced by all the modes of transport.

B. Policy formulation and government support for IWT

On the issue of multimodal transport, most of the measures related to government support and policy formulation have already been exposed in their respective fields. They can be summarized as follows:

1. Domestic technical measures

- Definition of adequate multimodal standards for waterway design, in particular regarding vertical clearance (12.4 m over main routes) and lock width (12.6 m on main routes). For other waterways, the vertical clearance should be roughly equal to the width of the design vessel. Special attention should be paid to canals, where the clearance should be commensurate with that over the average water level found on the route, rather than over the SHWL.

- Removal of bottlenecks and building of missing links wherever economically feasible.

- Maintaining multimodal waterways, so as to guarantee a standard 1.45 m draught on smaller routes and 2.45 m on main routes. It must be remembered, however, that even the Rhine guarantees only 1.9 m in difficult sections.

- Setting up government-funded ICDs by the side of potentially navigable rivers.

- Locating inland customs offices to riverine multimodal terminals.

- Ensuring GSM and DGPS coverage along waterways.

- Encouraging use of EDI between harbour customs and IWT container operators for advance clearance in order to save time in port and recoup part of the extra time spent inland.

- Organizing River information services (RIS) accessible from onboard ships by EDI, WAP or the Internet.

- To speed up river development, organize daily feedback of depth information from vessels en route, and daily update of RIS. This will cut the amount of
signalling and marking to the strictest minimum without compromising safety, which is essential for the reliability and final success of a container line.

2. Domestic political measures

- Enlist IWT authorities and operators within a national transport or trade facilitation committee.
- Authorize night navigation in order to reduce transit time.
- Authorize IWT operators to become MTOs.
- Negotiate with seaport authorities and port workers in order for environment-friendly river transport to be accepted and encouraged for moving containers inland.
- Authorize and encourage overside handling of containers and their direct waterway connection with the hinterland.
- Encourage IWT shuttles between anchorages or mouths of ports and upstream ICDs, for instance by banning road transit of containers through big cities.
- Encourage combined transport operations, for instance by accepting higher load limits for trucks operating in and out of intermodal container depots.
- Guarantee law and order on waterway route so that reliability of IWT is at its normal level, i.e. higher than rail or road transport and as found in Europe or North America.
- Finance or subsidize capital costs of establishing riverine intermodal container depots.
- Finance or subsidize operating costs of IWT container services on the grounds that they are less harmful to the environment and incur five times less external cost to the community for each container carried.

3. Multilateral agreements

Although multilateral agreements are not always indispensable, such as when countries do not have border rivers or when only domestic rivers are considered, it is usually very useful for a riverine country to understand such agreements due to the technical
knowledge bank accessed by national engineers during the negotiations, and the expertise they develop for further national use.

Work done at the regional level in Europe by the ECE has resulted in a host of conventions for the development of IWT technology and commerce.

Below is a list of ECE legal instruments in force in this field:

- European Code for Inland Waterways (CEVNI), including Signs and Signals on Inland Waterways (SIGNI), regularly updated;
- Budapest Convention on the Contract for the Carriage of Goods by Inland Waterway, 22 June 2001 (new agreement, not enforced);
- European Agreement on Main Inland Waterways of International Importance, 19 January 1996;

The work accomplished and supplemented by that done under guidance of the ECMT since the 1950s, and by the EC/EU since the 1960s, has permitted unification of the way that IWT and the waterways should be devised to be conducive to the best development.

The regime governing navigation on the Rhine is the Convention of Mannheim signed in 1868 by Belgium, France, Germany, the Netherlands, Switzerland and the United Kingdom of Great Britain and Northern Ireland. Under the Convention, the Central Commission for Navigation on the Rhine (CCNR) was established for coordination and cooperation of IWT on the Rhine.

The Rhine countries have implemented uniform rules and regulations for navigation formulated by CCNR, such as Police Regulations for Rhine Navigation, Inspection Regulations for Rhine Vessels, Regulations of Boatmaster’s Licence for the Rhine, Provisions for Carriage of Dangerous Goods on the Rhine, Regulations on Customs Sealing of Rhine Vessels, Regulations Governing Issues of a Diploma about Radar Piloting on the Rhine and Agreement on Bunker Fuel Oil.
Another agreement on river navigation in Europe is the Convention concerning the Regime of Navigation on the Danube signed in 1948 by Bulgaria, Czechoslovakia, Hungary, Romania, USSR, the Ukrainian SSR and Yugoslavia.

There is one convention in the ESCAP region regarding the measurement of vessels employed in inland navigation, signed in 1956 under the auspices of the predecessor of ESCAP, the Economic Commission for Asia and the Far East (ECAFE). ECAFE also adopted a Uniform System of Buoys and Shore Marks for Inland Waterways in Asia and the Far East in 1957.

Under the period 2000 to 2002, ESCAP, in cooperation with the Mekong River Commission (MRC), undertook a study on harmonization of aids to navigation on the Greater Mekong River and recommended the aids to navigation systems for the Greater Mekong River in 2002. The recommended systems are to be installed on the Upper Mekong River through China, the Lao People’s Democratic Republic, Myanmar and Thailand. Cambodia has re-painted some buoys and formulated national standards in accordance with the recommendations. The Viet Nam Inland Waterways Administration has proposed to revise national standards in line with the requirements of the recommended systems.

In 1995, the Governments of Cambodia, the Lao People’s Democratic Republic, Thailand and Viet Nam signed the Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin, which includes an article on navigation as follows:

Article 9. Freedom of Navigation

On the basis of equality of right, freedom of navigation shall be accorded throughout the mainstream of the Mekong River without regard to the territorial boundaries, for transportation and communication to promote regional cooperation and to satisfactorily implement projects under this Agreement. The Mekong River shall be kept free from obstructions, measures, conduct and actions that might directly or indirectly impair navigability, interfere with this right or permanently make it more difficult. Navigational uses are not assured any priority over other uses, but will be incorporated into any mainstream project. Riparian may issue regulations for the portions of the Mekong River within their territories, particularly in sanitary, customs and immigration matters, police and general security.

32 Country names when they signed the Convention.
In 2000, the Governments of China, the Lao People’s Democratic Republic, Myanmar and Thailand signed the Agreement on Commercial Navigation on the Lancang-Mekong River. The Agreement is supplemented by six technical annexes:

- Regulations on Safe Navigation of Vessels on the Lancang-Mekong River;
- Rules on Water Transport Administration on the Lancang-Mekong River;
- Guidelines on Maintenance and Improvement of Navigability of the Lancang-Mekong River;
- Regulations on Investigation and Handling of Waterborne Traffic Accidents on the Lancang-Mekong River;
- Regulations and Management of Search and Rescue, Salvage and Wreck removal on the Lancang-Mekong River;

The most important international standards for multimodal transport are the UNCTAD/ICC Rules on Multimodal Transport. These rules are not prevalent in the Asian IWT sector. Extensive training on these rules seems to be a prerequisite for using multimodal transport with IWT in the ESCAP region.

C. International cooperation for development of IWT within multimodal transport

IWT is still a weak sector in the ESCAP region. ESCAP has exerted great efforts to promote policy support and technological advancement for IWT in the past decades.

In April 1999, ESCAP adopted resolution 55/1 on sustainable development of inland water transport in the Asian and Pacific region (see annex II). The resolution aims at increasing the awareness of the importance of IWT in the transport system and recommends the integration of IWT within intermodal transport systems. It is hoped that this resolution will be able to change the disadvantaged position of IWT in the ESCAP region.

A possible activity in regional cooperation would be the establishment of an integrated trans-Asian transport network. Regional transport networks cover large areas and span long distances. Long-haul transport by road is extremely costly but would be fairly economical by rail or inland waterway. Moreover, heavy road traffic would cause severe air pollution
around the region. However, rail and inland waterways cannot service as many places as roads due to their geographical constraints. The best solution would be to incorporate all modes of transport into an integrated transport network, which would be most efficient, low cost, energy saving and environmentally sound.

The integrated trans-Asian transport network would encompass main roads, rail and inland waterways on the Asian continent. Its major links would be composed of rail and inland waterways servicing as long haul transport corridors, supported by feeder road links for freight distribution from inland ports and railway stations.

ESCAP has studied the Asian Highway and Trans-Asian Railway for over 40 years. Integration of the two networks with the addition of inland waterways would form an integrated trans-Asian transport network. A number of domestic and international large rivers in the region currently used for IWT run long distances in parallel with existing routes of the Asian Highway or the Trans-Asian Railway. There are also other navigable rivers near the existing routes of the Asian Highway or the Trans-Asian Railway which have great physical potential and which it would be economically advantageous to incorporate into the regional transport network.

An integrated trans-Asian transport network in the ESCAP region would be more operational than any unimodal transport networks so could become important alternative international and regional trade routes for traditional maritime transport.

Meanwhile, it would benefit fairly balanced development of various transport means in the region and reinforce the importance of IWT and attract more investment in the sector so as to eventually promote its integration within overall transport systems.

Another priority issue in the regional cooperation for IWT is experience and information sharing, as most riverine countries in the ESCAP region have limited resources in planning, research, management, maintenance, education and training. Resources are also unevenly distributed among different countries. Some countries’ strength is engineering design whereas others’ strength is construction of shallow draft barges. However, there are almost no experience and information exchanges among the institutions for IWT within the region and considerably limited communications outside of the region.

An effective approach to solve this problem is networking of existing institutions active in the IWT sector in the region. Through networking, institutions in the region can be

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interconnected and could share resources, experience and information. Exchange with institutions outside the region could also be organized. With this approach, the resources in different countries can be effectively utilized. The regional capacity would not only be enhanced through this approach, but also quickly upgraded.

Regional organizations should additionally focus on human resources development and advisory services. Human resources development for the IWT sector may be tailored to meet the requirements for integration of IWT within overall transport systems. Some of the issues of human resources development could be policy and strategy for IWT development, planning and financing of IWT systems, legislation of IWT, organization of transmodal transport, and modernization of IWT systems. Human resources development could be attained through seminars, training, publications and audio-visual packages. Human resources development is enhanced by specifically tailored advisory services.

Subregional cooperation is also important in the ESCAP region. There are a number of subregional cooperation organizations in the region which include members with navigable rivers, such as the Association of South-East Asian Nations (ASEAN) and the South Asian Association for Regional Cooperation (SAARC); 80 per cent of the ASEAN members have IWT and 65 per cent of SAARC members have or have the potential to develop IWT. These organizations may play an active role in promoting cooperation among their members.
VII. CASE STUDY

In order to fully explore the intricacies of IWT container logistics, a rather complex example is studied hereafter.

The case study deals with possible container transport between Changsha, a large city in Southern China and Reims (France), Osaka (Japan) and San Francisco (United States), to demonstrate the potential benefits of multimodal IWT and ways to assess the potential.

A. Route description

The possible routes are shown in figure VII.1.

Changsha is the capital city of Hunan Province in the southern part of China. It sits on the banks of the Xiangjiang River, one of main tributaries of the Yangtze River. It is linked to the hub seaport, Shanghai, by inland waterways through the Xiangjiang/Yangtze Rivers, and by railway and highway. It is also linked by railway and highway to the large seaports in the Pearl River Delta, Shenzhen, Guangzhou, and Hong Kong, China. In the delta area, river transport can be transferred by barges.

There is not yet a real river container service from Changsha to Shanghai through the Xiangjiang/Yangtze rivers. At present, containers can be trans-shipped at Wuhan, a central port on the Yangtze River. However, with improvement of the Xiangjiang River, financed by

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33 The case is for example purposes only, and does not correspond to any commercial quotation or known movement of goods.
the World Bank and the Government of China, container transport between Changsha and Shanghai (by inland waterways) will be feasible.

Containers reaching seaports will be forwarded to Osaka, San Francisco or Reims via Le Havre, France.

The first leg would be from Changsha to the coast, the choice being mainly between Shanghai and Hong Kong, China.

There are three options to Shanghai, either by waterway, rail or road, and two to Hong Kong, China, by rail or road with a minor option for barge transport between Guangzhou and Hong Kong, China, since there is no rail connection to the container terminals at Hong Kong, China.

The second leg is by sea transport, and finally there is another land leg in the receiving countries.

B. Assumptions of the case

The case study is based on the transport of four 20-foot containers with custom-made, heavy jade bottles for sparkling beverages that are to be carried from Changsha. Two of these containers are bound for Reims, one for Osaka and the other for San Francisco.

The goods contained, 30,000 x 450 g bottles per container, are valued at US$ 200,000 per container. The gross weight of each container is 15.5 tonnes, including packing and tare weight.

Incoterm is ex-works, assuming the clients will take care of the complete transport chain.

C. Inland portion in Europe

The French buyer, or a representative (freight forwarder, for instance), calculates first the inland portion in Europe, to determine the port of entry in Europe.

The most economical way is to use the multimodal IWT service from Le Havre to Paris. In addition, most sea-carriers have a container depot in Paris, saving the cost of
returning by barge to Le Havre, which provides an added bonus (one-way option). This is summarized in table VII.1.

Table VII.1 Comparison between road transport and river-road transport

<table>
<thead>
<tr>
<th>To Reims from:</th>
<th>Le Havre return by road</th>
<th>Le Havre return via Logiseine</th>
<th>Le Havre one-way via Logiseine</th>
</tr>
</thead>
<tbody>
<tr>
<td>THC</td>
<td>117</td>
<td>117</td>
<td>117</td>
</tr>
<tr>
<td>Total</td>
<td>767</td>
<td>574</td>
<td>529</td>
</tr>
</tbody>
</table>

Notes: 1. On these short routes, rail is not at present competitive with road and IWT.
2. Prices in US dollars, for a 20-foot container, in a batch of two, with the same destination address.

This shows that land transport is quite expensive, at times higher than river transport, and warrants a complete study of the entire transport chain, because the shorter route geographically is seldom the cheaper option due to hub effects.

Further, due to the higher security in IWT compared with road transport, both in matters of accident and theft, insurance is likely to be cheaper. This will be taken into account in the global comparison, including both land transport legs.

D. Inland portion in Japan

In Japan, a port container depot in Osaka is selected as the destination, for destuffing before sending to bottlers.

E. Inland portion in the United States

The only relevant charge is THC at this port (destination delivery charge), which amounts to US$ 740.

F. Inland portion in China

An approach similar to the European portion has to be applied in China, but is far more complex. Here, there would be four possible transit ports, and four inland modes. This results in a number of combinations, some of which have not yet been tried, but nevertheless are distinctly possible. These various options show the flexibility of multimodal transport and display the capacity of IWT to fully integrate the most modern supply chains.
The main options involve a choice between the Pearl River estuary ports (Guangzhou, Shenzhen and Hong Kong, China) and Shanghai as transit ports. Both the Pearl River estuary and Shanghai use IWT, although in a different way.

1. Inland river-deep sea

From Changsha, the only modern waterway to the sea is the Yangtze River and its tributary, the Xiangjiang River.

Lightly loaded 72 TEU container barges\(^{34}\) can sail the Xiangjiang River down to the Yangtze River and to Wuhan. There, either the containers would be transhipped onto the main container service from Wuhan to Shanghai, or the barges would continue, tied for instance to a mainstream 30,000 dwt pushed convoy to the seaport.

Shanghai container traffic has been expanding rapidly (nearly 50 per cent in two years), and ESCAP\(^{35}\) is estimating some 11 million TEUs at this port in 2011, to which should be added a probable 8 million TEUs due to its role as a hub. At that stage, it will have overtaken Hong Kong, China. Thus, the future of this IWT solution seems well established, and might evolve in a similar manner as it has in the Rhine Delta.

IWT’s position would be even stronger if a one-way possibility was offered from river ICDs, where containers to be stuffed would be taken from these ICDs, or containers emptied were brought back there.

2. Land-river-deep sea

This option is specific to Hong Kong, China.

About one third of South China cargo is transported through Hong Kong, China, by river barge. It is estimated that there are over 160 barge companies providing over 320 daily feeder services, linking 60 river ports and terminals in the Pearl River Delta.\(^{36}\)

Thus, another option with rail or road from Changsha to Guangzhou and barge from the port of Guangzhou has been included. For goods originating from the Pearl River Delta, this IWT option has been a strong advantage of Hong Kong, China, in its competition with

\(^{34}\) 75 x 13.75 m, 1,097 tonnes at 2.2 m.


\(^{36}\) Legislative Council Panel on Economic Services, Hong Kong, China, 21 March 2001, *The Freight Container Industry* (Hong Kong, China).
Shenzhen, and it can be easily verified that barging increases the hinterland of Hong Kong, China, versus Shenzhen.

Some 4.8 million TEUs of total throughput are barged into the port from the Pearl River cities, especially those on the western side of the delta. The following costing exercise will show whether this option is still as favourable when considering cargo coming from other provinces.

3. Rail-deep sea

Rail has been the main mode for long-distance transport in China, especially for north-south transport. Changsha is one of the nodal points of the network, located as it is on the Beijing-Guangzhou route, which is one of the main arteries of the Chinese network, although highly congested. It has been working at capacity or overcapacity for at least a decade. Its reliability is thus limited mainly due to priority accorded to passenger trains.

As far as Hong Kong, China is concerned, it has practically no railway link to deep-sea container terminals. Thus, an extra road leg is incurred between Shenzhen and the port, diminishing the competitiveness of this rail option. As well, since it entails a “border” crossing, it is an expensive leg. Due to this, the competitiveness of the Shenzhen ports is enhanced.

As far as rail transport is concerned, Shanghai is not too badly situated with respect to Changsha, thanks to an east-west line. The availability of wagons on this route is poor, however, which makes the IWT options more attractive.

4. Road-deep sea

Road transport has always been a favourite mode for carrying containers due to its speed and point-to-point delivery.

As far as tariffs are concerned, road transport in China is very expensive, nearly three times more than rail and even more over short distances. However, since IWT and rail quotations usually include also a road leg, often hidden in a global price, the final competitiveness of road transport is not as bad as might have been thought.

However, container truck shortages are common and long-distance transport is not that easy. Thus goods are often brought to the seaport by normal trucks and stuffed into a deep-sea container at the port. In the present case, nevertheless, due to the cost of the bottles and their fragility, there is no other option to direct stuffing in Changsha.
It is to be noted that the road to Guangzhou is nearly 120 km longer than rail, while to Shanghai it is some 20 km shorter.

5. Costing of alternatives

After obtaining data from various sources, figures were gathered and are shown in table VII.2.

Table VII.2. Comparison between different Chinese ports and different inland transport modes  
(Price in US dollars, for a 20-foot container, in a batch of two, with same origin)

<table>
<thead>
<tr>
<th>From Changsha to:</th>
<th>Hong Kong, China by rail/road</th>
<th>Shanghai by rail/road</th>
<th>Guangzhou by rail/road</th>
<th>Shanghai return via Wuhan by IWT</th>
<th>Shanghai one-way via Wuhan by IWT</th>
<th>Hong Kong, China via Guangzhou by rail + road/barge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance in km</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By rail</td>
<td>854x2 + 20x2</td>
<td>1,207x2</td>
<td>707x2</td>
<td>-</td>
<td>-</td>
<td>707x2</td>
</tr>
<tr>
<td>By road</td>
<td>947x2</td>
<td>1,189x2</td>
<td>825x2</td>
<td>-</td>
<td>-</td>
<td>122</td>
</tr>
<tr>
<td>By IWT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,125x2 + 423x2</td>
<td>423x2 + 1,125</td>
<td>105</td>
</tr>
<tr>
<td>By rail (SZ) b</td>
<td>256</td>
<td>354</td>
<td>214</td>
<td>-</td>
<td>-</td>
<td>214</td>
</tr>
<tr>
<td>By road</td>
<td>963</td>
<td>1,200</td>
<td>839</td>
<td>-</td>
<td>-</td>
<td>214</td>
</tr>
<tr>
<td>By IWT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>310</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>Cost for round trip from Changsha to port</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By IWT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>310</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>Cost for Guangzhou/Shenzhen-Hong Kong, China</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IWT/rail handling</td>
<td>184</td>
<td>184</td>
<td>184</td>
<td>100</td>
<td>100</td>
<td>184</td>
</tr>
<tr>
<td>THC</td>
<td>180</td>
<td>52</td>
<td>180</td>
<td>52</td>
<td>52</td>
<td>180</td>
</tr>
<tr>
<td>Total cost by rail</td>
<td>944</td>
<td>590</td>
<td>578</td>
<td>-</td>
<td>-</td>
<td>(180)</td>
</tr>
<tr>
<td>Total cost by IWT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>462</td>
<td>362</td>
<td>-</td>
</tr>
<tr>
<td>Total cost by road</td>
<td>1,143</td>
<td>1,252</td>
<td>1,019</td>
<td>-</td>
<td>-</td>
<td>1,035</td>
</tr>
</tbody>
</table>

a A notation such as 854 x 2 + 20 x 2 indicates 20 km of initial transport by road from the container terminal to the limit of Hong Kong, China, 854 km to go from Shenzhen to Changsha, 854 km to come back and 20 km of approach transport by road from the limit of Hong Kong, China, to the container terminal.

b The total cost Changsha-Shenzhen is only US$ 570 by rail due to cheaper THC. If there were no barge option, Shenzhen would beat Hong Kong, China, even in the Pearl River Delta. However, it could well destroy its remote hinterland as well as that of Central China.
It follows that the price of one tonne-km between Guangzhou and Osaka (2,935 km),
compared with one between Hong Kong and Le Havre (17,380 km), would show a ratio of 11
to 1. With 11,000 km on a main route costing the same as 1,000 km on a minor route, it can
be said that the globe is shrinking along the lines of minimal cost.

G. Maritime portion

All four possible ports of transit must be taken into consideration.

Table VII.3. Freight per 20-foot container *(US dollars)*

<table>
<thead>
<tr>
<th>Freight</th>
<th>From:</th>
<th>Hong Kong, China</th>
<th>Shenzhen</th>
<th>Guangzhou</th>
<th>Shanghai</th>
</tr>
</thead>
<tbody>
<tr>
<td>To:</td>
<td>Osaka</td>
<td>620</td>
<td>855</td>
<td>865</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Le Havre</td>
<td>450</td>
<td>500</td>
<td>700</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>San Francisco</td>
<td>590</td>
<td>375</td>
<td>475</td>
<td>390</td>
</tr>
</tbody>
</table>

The distortions produced by the hub bias for the two leading ports, Shanghai and
Hong Kong, China, are clearly seen:

- The distance between Hong Kong, China and Shenzhen is hardly 30 km, while
  the difference may be more than US$ 200;
- Shenzhen is nearly 2,000 km closer to Europe than Shanghai, but they share the
  same freight rate;
- Conversely, in this quotation, Shenzhen is cheaper to San Francisco than
  Shanghai, even though it is farther away.

H. Global view

At this point, a complete depiction can be drawn, as follows.
1. Changsha-Osaka

Table VII.4 summarizes the total costs from Changsha to Osaka. For simplification, no THC at destination is added.

Table VII.4. Total cost from Changsha to Osaka

<table>
<thead>
<tr>
<th>From Changsha to Osaka via:</th>
<th>Hong Kong, China by rail</th>
<th>Hong Kong, China via Guangzhou + IWT</th>
<th>Guangzhou by rail</th>
<th>Shanghai by rail</th>
<th>Shanghai return by IWT</th>
<th>Shanghai one-way by IWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inland transport</td>
<td>944</td>
<td>820</td>
<td>578</td>
<td>590</td>
<td>462</td>
<td>362</td>
</tr>
<tr>
<td>Sea freight</td>
<td>620</td>
<td>620</td>
<td>860</td>
<td>250</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Total</td>
<td>1,564</td>
<td>1,440</td>
<td>1,438</td>
<td>840</td>
<td>712</td>
<td>612</td>
</tr>
</tbody>
</table>

The cheaper option is thus via Shanghai, and the use of IWT saves up to US$ 228.

2. Changsha-San Francisco

Table VII.5, summarizing the total costs from Changsha to San Francisco (table VII.5) is also rather simple to compute with THC at destination. Again, Shanghai comes out as the cheapest option, with an added bonus when using IWT. From the table, two interesting facts can be derived:

- Transoceanic sea freight is cheaper than inland transport, except when IWT is used;
- Guangzhou is practically equivalent to Shanghai, if rail is the only mode available.

Table VII.5. Total cost from Changsha to San Francisco

<table>
<thead>
<tr>
<th>From Changsha to San Francisco via</th>
<th>Hong Kong, China by rail</th>
<th>Hong Kong, China via Guangzhou + IWT</th>
<th>Guangzhou by rail</th>
<th>Shanghai by rail</th>
<th>Shanghai return via Wuhan</th>
<th>Shanghai one-way via Wuhan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inland transport</td>
<td>944</td>
<td>820</td>
<td>578</td>
<td>590</td>
<td>462</td>
<td>362</td>
</tr>
<tr>
<td>Sea freight</td>
<td>590</td>
<td>590</td>
<td>475</td>
<td>390</td>
<td>390</td>
<td>390</td>
</tr>
<tr>
<td>THC at destination</td>
<td>740</td>
<td>740</td>
<td>740</td>
<td>740</td>
<td>740</td>
<td>740</td>
</tr>
<tr>
<td>Total</td>
<td>2,274</td>
<td>2,150</td>
<td>1,793</td>
<td>1,720</td>
<td>1,592</td>
<td>1,492</td>
</tr>
</tbody>
</table>
3. Changsha-Reims

Table VII.6. shows transport to Europe. For simplification, only one European transit port and one inland mode have been selected, as was explained earlier.

Table VII.6. Total cost from Changsha to Reims

<table>
<thead>
<tr>
<th>From Changsha to Reims via</th>
<th>Hong Kong, China by rail</th>
<th>Guangzhou by rail</th>
<th>Shanghai by rail</th>
<th>Shanghai return via Wuhan</th>
<th>Shanghai one-way via Wuhan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chinese inland transport</td>
<td>944</td>
<td>820</td>
<td>578</td>
<td>590</td>
<td>462</td>
</tr>
<tr>
<td>Sea freight to Le Havre</td>
<td>450</td>
<td>450</td>
<td>700</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>European inland transport</td>
<td>529</td>
<td>529</td>
<td>529</td>
<td>529</td>
<td>529</td>
</tr>
<tr>
<td>Total</td>
<td>1,923</td>
<td>1,799</td>
<td>1,807</td>
<td>1,619</td>
<td>1,491</td>
</tr>
</tbody>
</table>

Once again, Shanghai is the cheapest option, but this is due only to IWT, because, as seen earlier, Shenzhen would be marginally cheaper than Shanghai if only rail was considered, while it does not suffer the same sea freight penalty as Guangzhou.37

4. Other considerations

These results are linked to a specific quotation for international freight, and may vary according to the shipping line selected. However, they do display interesting variations, showing the various factors to be taken into consideration.

The main conclusion is that IWT increases the hinterland for all inland origin/destinations (O/D) served directly by river transport, especially concerning Shanghai. Similarly, IWT increases the hinterland of Hong Kong, China, for most O/D in the Pearl River Delta region. The same was found true for Europe, to the benefit of Le Havre, faced with competition from Antwerp. It can thus be said that IWT is the best friend of seaports, when they can be served by it.

37 With a land transport cost of only US$ 570 and a sea freight cost of US$ 500, the total cost is US$ 1,599, slightly cheaper than via Shanghai by rail.
Two other issues remain to be discussed.

- **Interest**

  Especially in the case of high-value goods, interest accruing after the goods have been paid for has to be taken into consideration if the goods are time-sensitive.

  By using Hong Kong, China, instead of Shanghai, the goods could be brought in Europe one week earlier, if the goods had missed the weekly departure in Shanghai, but caught the same vessel three or four days later in Hong Kong, China. In this particular example this translates into monetary terms as follows: for each per cent of interest, one day costs US$ 5.50. The cost difference between Shanghai and Hong Kong, China, on the Europe run being at the most US$ 532, one week gained would nullify the difference at a 10.7 per cent interest rate, although this rate is quite low by business standards.

  This may explain why the Pearl River hub retains such a market position on the east-west run. The far superior variety of shipping lines calling there makes it very likely that a faster delivery time can be achieved using this hub, resulting in global savings on logistics costs.

  However, if the goods are delivered earlier, they may have to be stored and the interest for inventory should therefore also be considered. JIT is important for scheduled transport services. If the goods can be delivered just in time, this interest will have no cost implication.

- **Insurance**

  When IWT is used, pilferage and breakage are likely to be lower than by road transport. The insurer takes this into account, whenever the value of the goods is such that it is over the FIATA claims limit and requires specific goods insurance. Thus, if, insurance is included, the global cost through an IWT solution can be lower than by rail or road. Use of IWT thus extends again the hinterland of ports such as Le Havre and Shanghai.

  On one side, the insurance premium for the sea and road solution might be 0.6 per cent of 110 per cent of goods value, for instance, and on the other 0.55 per cent for one IWT leg, i.e. US$ 200,000 x 110% x 0.55% = US$1,210 per container.
I. Conclusions

This case study clearly shows the potential benefits of using IWT in multimodal transport systems. It demonstrates savings of financial costs for the user of IWT within international multimodal transport. For the country, use of multimodal transport including IWT may also generate other economic benefits, such as energy savings, less air pollution and less road congestion.

The logic provided in the case study may be used to make cost estimations for various transport routes and to publicize these to shippers and freight forwarders. In places where IWT is not well utilized, Governments may play a catalytic role to undertake such studies. If necessary, pilot operations should be organized to demonstrate the commercial benefits of recommended routes.
Annex I.


If nothing is done, total road freight transport in Europe is set to grow by about 50 per cent until 2010. Cross-border traffic is expected to double by 2020. For cross-border road freight, this means a foreseen growth of about 12 billion ton-km per year. It translates into further congestion, pollution and accidents. The socio-economic cost of the additional 12 billion ton-km on roads has been estimated at more than € 3 billion per year (approximately US$ 1 = € 1).

The Marco Polo programme shall contribute to maintaining the modal repartition in freight transport at its 1998 levels. To achieve this objective, it shall support actions in the freight transport, logistics and other relevant markets. “Actions” within the Marco Polo programme have to be (1) related to the freight logistics market, (2) executed by undertakings, and (3) contribute to reducing congestion in the road freight transport market and/or to a better environmental performance of the freight transport system.

The Marco Polo programme features three types of action:

(1) modal shift actions, which should focus on shifting as much cargo as possible under current market conditions from road to short sea shipping, rail and inland waterways, where a subsidy of up to 30 per cent of the costs is provided. The award shall take the form of a yearly lump sum payment based on the actual tonne-kilometres shifted from road (€1 per 500 ton-km shifted) and shall not surpass 30 per cent of the eligible costs for an action. The minimum subsidy threshold per modal shift action shall be €1 million. The duration of the subsidy agreement must not be longer than 38 months;

(2) catalyst actions, which is another name for demonstrations projects, for instance starting-up new services, which should change the way non-road freight transport is conducted in the Community, breach the so-called “structural market barriers” and stimulate market actors’ willingness to take risks beyond the traditional commercial incentives. The financial assistance for catalyst actions, through contracts, shall be limited to a maximum of 35 per cent of all expenditure necessary to achieve the objectives of, and caused by, the action. As a rule, the
maximum duration of these contracts shall not be longer than 50 months. The minimum subsidy threshold per catalyst action shall be € 3 million;

(3) **common learning actions**, which should enhance knowledge in the freight logistics sector and foster advanced methods and procedures of cooperation in the freight market. Community financial assistance for common learning actions shall be limited to a maximum of 50 per cent of all expenditure necessary to achieve the objectives, and caused by, the action, and shall be granted on the basis of subvention contracts, with appropriate provisions for steering and monitoring. As a rule, the maximum duration period of the contract shall not be longer than 26 months. The minimum subsidy threshold per common learning action shall be € 500,000.

The financial framework for the implementation of the Marco Polo programme, for the period from 1 January 2003 to 31 December 2007, shall be € 115 million.

The earlier programme (PACT) spreads its funding as shown in table A.1.

Table A.1. Share of PACT funding per mode of transport concerned

<table>
<thead>
<tr>
<th>Rail</th>
<th>Short sea shipping (SSS)</th>
<th>Inland waterway (IWW)</th>
<th>Rail-SSS</th>
<th>Rail-IWW</th>
<th>Sea-river</th>
<th>Trimodal</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 %</td>
<td>20%</td>
<td>9%</td>
<td>12%</td>
<td>3%</td>
<td>6%</td>
<td>5%</td>
</tr>
</tbody>
</table>

The IWT item covered 9 per cent of the total, against 45 per cent for rail, while IWT represents half the traffic of rail. Even including mixed items on a prorated basis, the ratio is still biased against IWT, 15 per cent versus 54 per cent.

Further, according to European Commission sources, 1 EUR of external cost is saved each time 52 ton-km has shifted to IWT, while the same goal is achieved only when 85 ton-km has shifted to rail. Table A.2. provides the details of the calculations:
Table A.2. Marginal average external costs of transport by mode (€ per 1,000 t-km)

<table>
<thead>
<tr>
<th>Cost element</th>
<th>Road (^1)</th>
<th>Road (^2)</th>
<th>Inland waterway</th>
<th>Short sea shipping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident</td>
<td>5.44</td>
<td>1.46</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Noise</td>
<td>2.138</td>
<td>3.45</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pollutants</td>
<td>7.85</td>
<td>3.8</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Climate costs</td>
<td>0.79</td>
<td>0.5</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>2.45</td>
<td>2.9</td>
<td>1.0</td>
<td>Less than 1.0</td>
</tr>
<tr>
<td>Congestion</td>
<td>5.45</td>
<td>0.235</td>
<td>Negligible</td>
<td>Negligible</td>
</tr>
<tr>
<td>Total</td>
<td>24.12</td>
<td>12.35</td>
<td>Maximum 5.0</td>
<td>Maximum 4.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost difference to road</th>
<th>€ 11.8 per 1,000 tkm</th>
<th>€ Ca. 19 per 1,000 tkm</th>
<th>€ Ca. 20 per 1,000 tkm</th>
</tr>
</thead>
<tbody>
<tr>
<td>External cost savings by shifting 1,000 tkm from road</td>
<td>€ 11.8</td>
<td>€ 19</td>
<td>€ 20</td>
</tr>
<tr>
<td>€ 1 cost savings generated by transferring freight from road</td>
<td>85 tkm</td>
<td>52 tkm</td>
<td>50 tkm</td>
</tr>
</tbody>
</table>

*Notes: 1* HGV on motorway.  
*2* TRL draft final report.
Annex II.

Resolution 55/1 on sustainable development of inland water transport
in the Asian and Pacific region
Adopted by
The United Nations Economic and Social Commission for Asia and the Pacific
at its fifty-fifth session

The Economic and Social Commission for Asia and the Pacific,

Recalling its resolution 51/8 of 1 May 1995, the annex to which contained the New Delhi Action Plan on Infrastructure Development in Asia and the Pacific, in which inland water transport was accorded high priority,

Bearing in mind the Rio Declaration on Environment and Development and Agenda 21, as adopted at the United Nations Conference on Environment and Development, held at Rio de Janeiro, Brazil, in June 1992, which provided general policy guidance and set out requirements for improvement of the global environment,

Noting the Vienna Declaration adopted at the Regional Conference on Transport and the Environment convened by the Economic Commission for Europe and held at Vienna in 1997, in which countries were urged to promote a shift in passenger and freight traffic from roads to inland waterways and other more ecologically efficient modes of transport,

Recognizing the need for national coordination in the use of water resources,

Recognizing also that inland water transport is an integral component of the overall transport system of the region and is one of the most advantageous transport modes, having the least impact on the environment, the lowest cost for domestic and international transport, enormous capacity reserves and the least energy consumption,

Recognizing further the potential of inland water transport for encouraging and supporting increased economic and social development in rural areas and alongside waterways,

Noting with satisfaction the recommendations of the Regional Policy-level Meeting on Sustainable Development of Inland Water Transport, held at Nanjing, China, in September 1998,

1. Urges concerned regional members and associate members:
   
   (a) To integrate inland water transport within intermodal transport systems to provide door-to-door services for the movement of domestic and international traffic, thereby responding to market demand for convenient and competitive service while optimizing the economic, financial, environmental and social benefits that can be derived from each mode in the entire transport chain;
   
   (b) To undertake detailed examination of the technical and administrative issues related to bringing national waterways into operation with the objective of facilitating international traffic;
   
   (c) To accord appropriate priority to inland water transport in policy, planning and investment based on detailed analysis of the economic, financial, social and environmental benefits, and to promote public awareness of such benefits, thereby encouraging a modal shift to inland water transport where appropriate;
   
   (d) To enhance cooperation between national agencies responsible for inland water transport and water resources management for navigation purposes through coordinated national planning and the development and implementation of policies;
   
   (e) To increase the public sector resources allocated to inland water transport to reflect the relative priority of such transport and to encourage partnerships between the
To encourage the following:

(i) The adoption of appropriate legislation and creation of a regulatory environment for the protection and effective utilization of inland waterways;

(ii) Safety in navigation, taking adequate care of the year 2000 problem;

(iii) Facilitation of cargo trans-shipment between seagoing ships and inland vessels for onward distribution;

(iv) The recognition and strengthening of the role in socio-economic development of country boats and small vessels operated by the informal sector, with particular reference to poverty alleviation in rural areas;

(v) The utilization of dredged materials, wherever economically advantageous and socially and environmentally acceptable, to raise and revitalize farmland, strengthen bank protection and reclaim land;

(vi) Development of statistical information systems to support policy, management and operational decision-making, taking adequate care of the year 2000 problem;

(vii) Development of tourism along inland waterways;

(g) To establish or strengthen appropriate centres and institutional capacity to undertake studies and research to identify physical and institutional bottlenecks that are hindering the efficient development and operation of inland water transport, and to promote human resources development to address those deficiencies;

2. Requests the Executive Secretary:

(a) To assist riverine members and associate members, on request, in formulating policies and strategies to foster the development of inland water transport and its integration with other transport modes, and to encourage a modal shift of cargoes to inland water transport where appropriate;

(b) To promote technological advancement of the inland water transport sector through the provision of technical assistance;

(c) To assist in increasing the awareness of policy makers and the public of the economic, social and environmental advantages of inland water transport, through the preparation and publication of informative and authentic materials for wide dissemination in the region;

(d) To promote human resources development in the inland water transport sector and experience sharing through networking among riverine members and associate members within the ESCAP region and also with countries outside the region;

(e) To organize, in close collaboration with the public and the private sectors, an international conference-cum-exhibition on inland water transport in conjunction with the third session of the Committee on Transport, Communications, Tourism and Infrastructure Development, to be held in 2000;

(f) To report to the Commission in 2001 on the implementation of the present resolution;

3. Requests donor governments and agencies to support projects that promote the integration of inland water transport within intermodal transport systems and its integration into comprehensive planning for water resources management.

28 April 1999