IV. FOREIGN EXPERIENCE

IV.1 GENERAL

This chapter is an expanded version of a similar chapter that was included in the previous Phase I report.[48] It summarizes the international experience in planning and operations of coastal and short sea shipping systems, focusing on Europe and Japan. Both regions have large and well-established coastal systems. These systems were already briefly discussed in Section II on Definition of the Coastal System, especially in the context of selecting fast and high-speed vessels.

The chapter is organized according to the two regions included here, Europe and Japan, with each discussed in a separate section. Each section begins with a general overview of the shipping system, followed by brief case studies of special interest.

IV.2 EUROPEAN COASTAL SYSTEMS

European Commission Initiatives

Europe has congested road and rail systems. To ease congestion, the Commission of the European Communities has a declared policy of diverting traffic from land to water. The Directorate General for Transport / DGVII has been assigned to implement this policy. In addition, mainly as a response to mounting public pressure, several national governments established their own policies to facilitate this diversion. For example, the German government recently endorsed a suggestion by an independent commission to impose a new toll of about $0.24 per mile on trucks. This toll is in addition to another new tax on fuel, called eco-tax.

DGVII has established a special fund to support research and development of water transport. As a result, there has been an "explosive research related to short sea shipping during the last six years". Over 80 of these research papers were discussed in the first three European Research Roundtables on Short Sea Shipping.[49]

Short-Sea, Coastal, River/Sea and Inland Waterways Shipping

The European continent is surrounded by a series of small seas, including the Mediterranean and North Baltic seas. These small seas create a natural setting for a wide system of short-sea services. Hence, short sea shipping is much larger than the two other

[48] The Center for the Commercial Deployment of Transportation Technologies, "High Speed Ferries and Coastwise Vessels: Evaluation of Parameters and Markets for Application - Phase I", by National Ports & Waterways Inst., January 1999, Section B.

[49] See: Psarftis, H.N. and Schinas, O.D., "State of the Art", for the Commission of the European Communities, Directorate General for Transport / DGVII, July 1996.

short-range shipping systems, coastal and inland waterways. This also explains why the collective term used in Europe for all the three shipping systems is Short Sea Shipping (SSS). This term will also be used in the same context in this section.

Currently, the European short-sea system is quite large, encompassing a fleet of about 600 containerships of various sizes. As indicated above, there is no clear differentiation in Europe between short sea, coastal, river/sea and inland waterways (river) shipping. In fact, all of these shipping forms that are dedicated to short-distance trades employ the same types of vessels. Likewise, many services incorporate coastal, short-sea, and inland waterway legs.

Geographic Setting of Short Sea Shipping

Europe is commonly divided into 2 main coastal regions: the North Sea/Atlantic and the Mediterranean coasts. Each of these regions includes several coastal *ranges* called basins or arcs. Figure 18 presents a map of Europe with arrows describing the main European coastal regions and ranges of coastal shipping. As seen in the figure, the European coastal system encompasses a total of 7 ranges. The European coastal systems are either intra-range or inter-range, a fact that determines the type of vessels used, mainly in terms of capacity and speed.

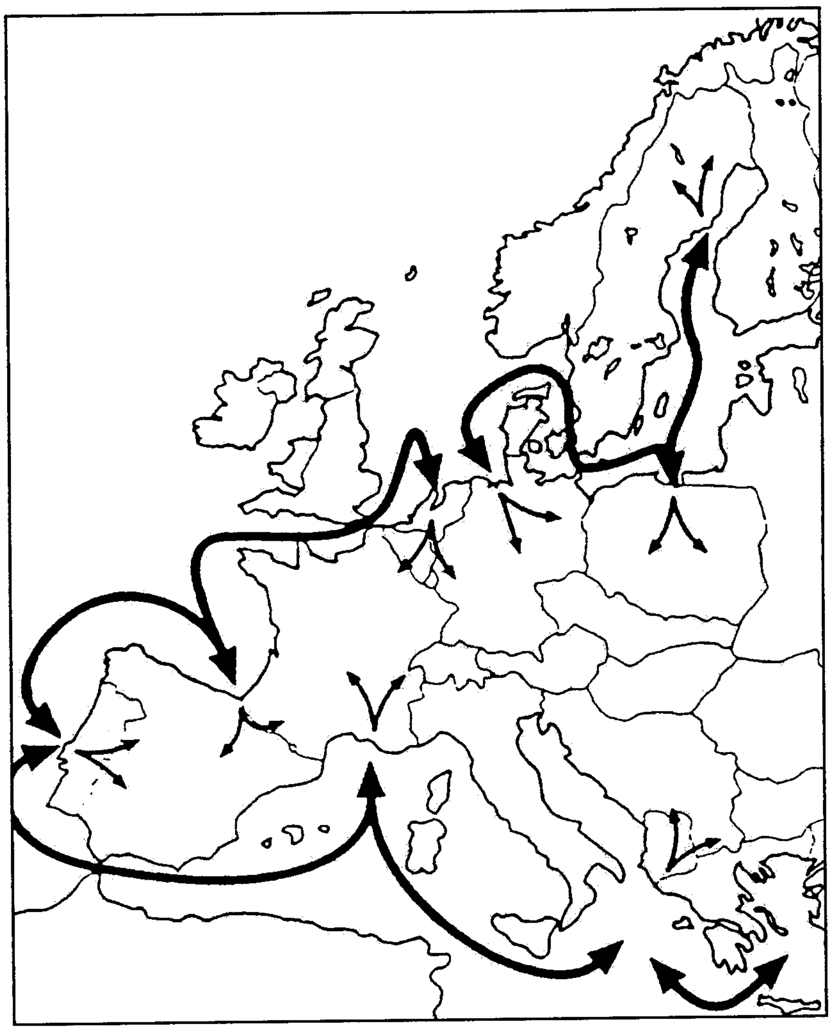
A broader definition of the European range includes neighboring regions, namely the Levant, Black Sea, North Coast of Africa and the West Coast of Africa. The expanded short-sea system encompasses coastal distances of several thousands miles, which exceed the common range of short sea shipping and are long enough to support deep-sea ships. In fact, there are several deep-sea services between North Europe / U.K. and the East Mediterranean / Black Sea that employ containerships of over 1,000 TEUs. Hence, on this route, short-sea and deep-sea services compete against each other.[50] Feeder service for deep-sea containers is another short sea service that is related to deep-sea, mainly for services to Asia and the U.S. In many cases the feeder services are combined with short-sea services for containers.[51]

Inland waterway services are a third competitor for some of the above traffic. The European setting is unique because of its cross-continent system of inland waterways, with the Rhine-Main-Danube-Rhone at its center. In addition, Europe has river/sea vessels that can sail on both the coastal and inland routes. For example, there are two alternative water routes connecting the North Sea and the Mediterranean and/or the Black Sea: (a) sailing along the coast and around the Iberian Peninsula; or (b) using inland waterways. In addition, there is always the option to use road or rail, including several

[50] A similar situation could develop in the U.S. For example, a deep-sea service between New York and the East Coast of South America could stop in Miami and the Caribbean. This combination is presently infeasible because of the Jones Act.
[51] A recent case in point is a new combination service by OOCL, which handles the short sea trade between the U.K. and several Baltic ports along with Asian and American deep-sea containers to these ports transshipped in the U.K.

established land bridges. Altogether, short-sea shipping in Europe faces competition on two fronts, from other shipping systems and from land-based transport systems, especially rail.

Figure 18. European Coastal System



Focus on Vessel's Speed and Terminal Automation

While the previous section defined the shipping systems by their route, the more common European definition is by vessel usage, regardless of route. Accordingly, the term Short Sea Shipping (SSS) only relates to all-freight shipping systems. Another term, "ferry", relates to systems that handle a mixture of freight, passengers and cars.

Salient technological thrusts in both the European short-sea and ferry systems are: (a) increasing vessels' speed and (b) automating port handling. The U.S. coastal systems selected for detailed analysis included fast and high-speed vessels developed in Europe.

However, unlike the European, the selected port system for the U.S. is low-tech, in line with the U.S. concept of an "open system".

Stena

Stena is the largest European operator of both short-sea and ferry services. Its main shipping divisions are Stena Line, the operator of ferry services and Stena Ro/Ro, and the operator of all-freight short-sea services. Recently, Stena Line has merged with P & O, another large operator of ferries. Stena Ro/Ro has a close relationship with Tor Lines, another large short-sea operator of Ro/Ro vessels. In addition to ferries and Ro/Ro's, Stena is involved in bulk shipping and offshore drilling.

The most renowned Stena operation is the ferry system based on the HSS (High Speed Sea Service). The fleet includes 4 vessels, three HSS 1500 and one HSS 900, all built during 1996 and 1997. All vessels are based on the so-called Catamaran design. This design allows the vessel to sail in seas with average to significant wave condition of between 5 m and 9 m with no slamming. The larger HSS 1500 is 127 x 40 x 4.8 m (length x beam x draft. Twelve truck lanes can be arranged on the unusually wide main deck. This facilitates loading and unloading.[52]

Each HSS is propelled by 2 x GE LM 2500 engines and 2 x GE LM 1600 engines, with a total of 100,000 HP.[53] The gas turbines are linked to water jets through a reduction gearbox. The combination of turbines of various sizes enables power grading according to circumstances. The two smaller turbines generate speed of 24 knots and the two large turbines generate 32 knots. Altogether, the turbines generate 40 knots. Maximum speed is 42 knots.

Vessel capacity is for 1,500 passengers, 375 autos and 50 16-m trucks, with a total freight capacity of 1,500 DWT. The construction cost was indicated at about $100 million per vessel vs. $50 million for a conventional ferry of the same capacity, but half the speed. Hence, the investment per capacity unit (ton-NM) was the same, but offered an improved level of service.

Stena recognized that a fast turnaround at ports on each end is key to increasing utilization of the costly system. Their operations plan was based on an overall port time of 30 minutes, including 10 minutes for berthing / sunbathing, 10 minutes for unloading and 10 minutes for loading. To achieve a 10-minute discharge of 375 cars or 50 trucks and 100 cars, Stena uses four stern openings, all linked to a 2-level ramp that includes two passenger walkways. The ramp is the width of the ferry. Figure 19 presents a picture of Stena HSS ferry.

---

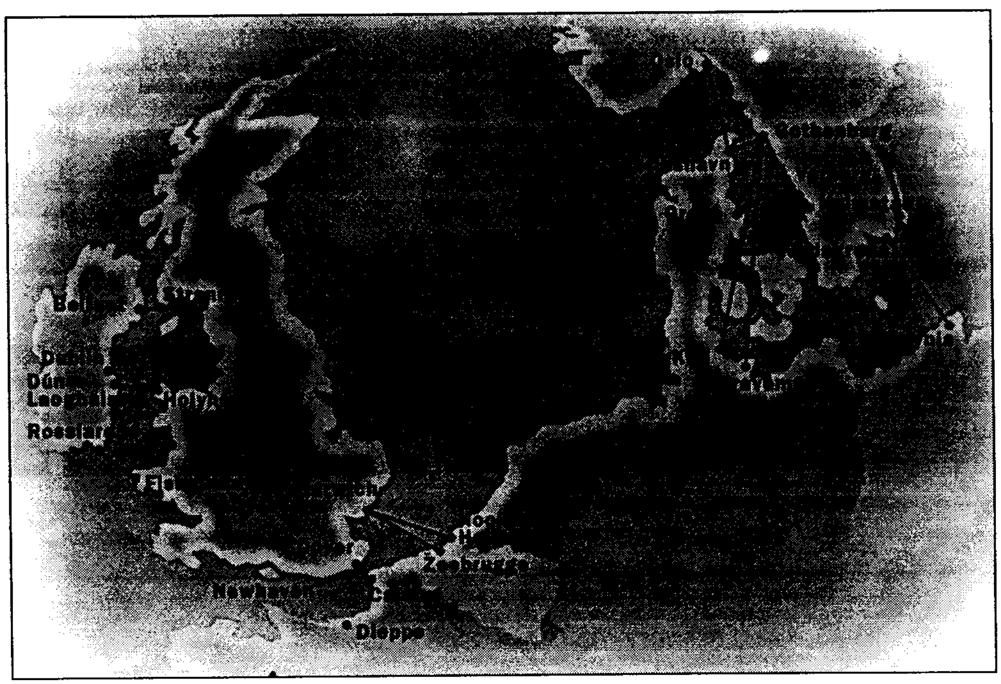
[52] The ratio between length and beam, a common indicator in hull design, is 3 : 1 vs. 6 : 1 for high-speed monohull.

[53] For comparison, the largest containerships of 6,500 TEUs are also propelled by an engine of 100,000 HP, although a diesel one.

Figure 19. Stena High Speed Sea Service Ferry

Stena mainly deploys the HSS as crossing ferries between England, Ireland and Holland, and across the Skagerrak, between Norway and Denmark (Figure 20). The typical route distance is short, 50 - 100 NM, which is covered in 1 - 3 hours. The main usage of the HSS is for passengers and cars. However, during the night and winter months, when passenger traffic is much slower, they also carry trucks. While carrying trucks the speed is greatly reduced. Stena is hesitant to disclose information regarding operational and financial data of the HSS services. The key features of the vessels are patent-protected.

Figure 20. Stena Line Services

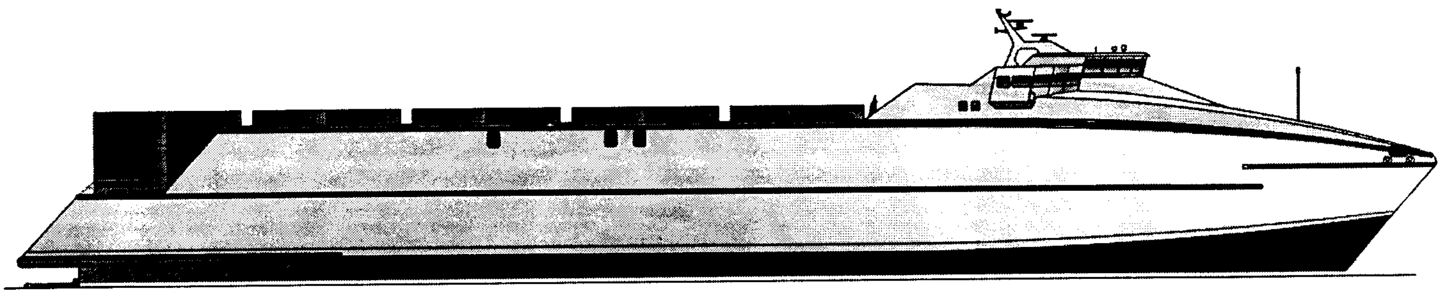


Austal ships

Austal Ships is an Australian shipbuilder that has recently established a partnership with Bender, a U.S. shipbuilder, to construct a shipyard in Mobil, AL, to develop a U.S. version of the fast catamaran. Austal Ships has already developed an all-freight version of the HSS 1500, called "high-speed" freighter, with four basic configurations for containers, trailers, pallets and passengers.

The most interesting one is the configuration for containers. Boxes are staged 2-high on special bogey frames that function as railcars. Hence, the vessel has 4 trains on-board, each with 10 railcars. Handling the vessel involves pulling or pushing the trains. Terminal handling includes loading / unloading the railcars by large gantry cranes, similar to the RMGs of deep-sea terminals. Figures 21 and 22 present the container vessel and the terminal.

Figure 21. Austal Highspeed Freighter



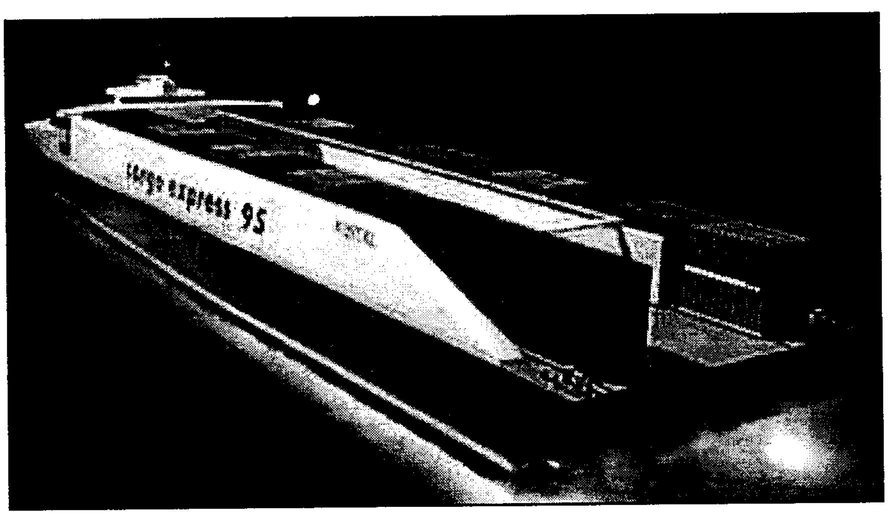
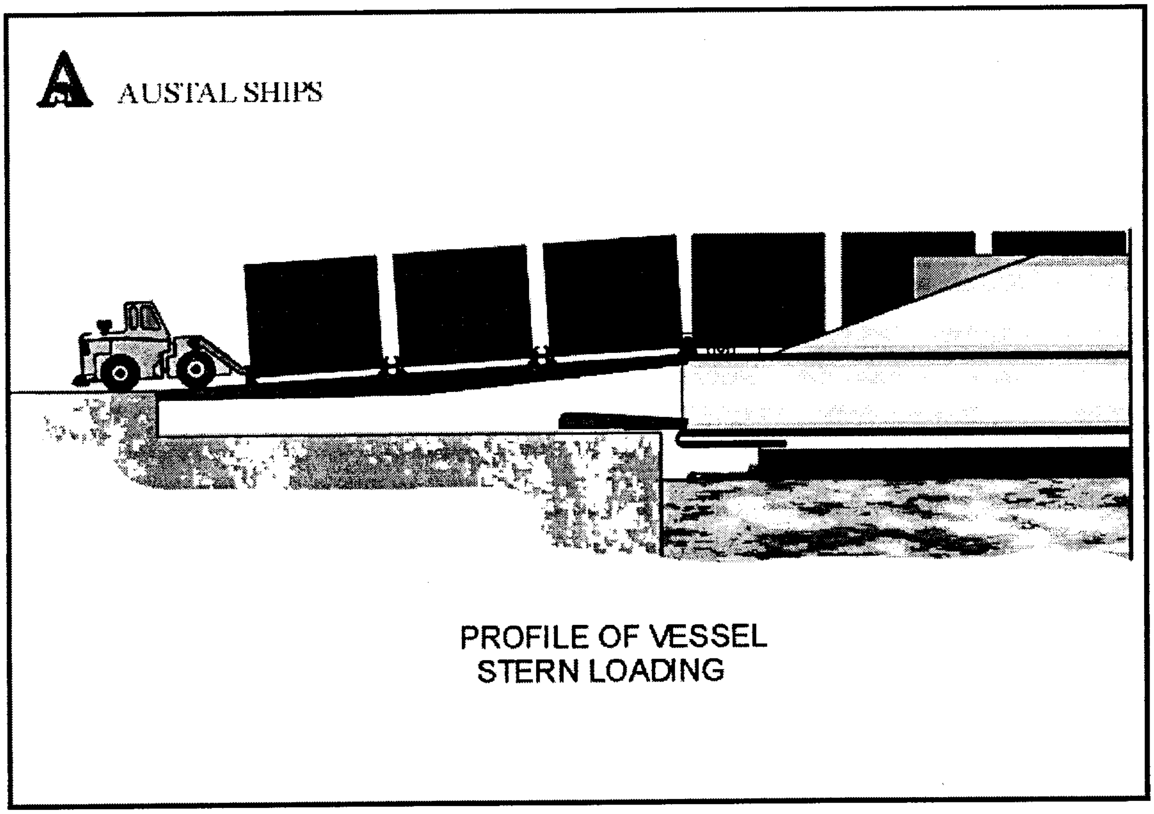
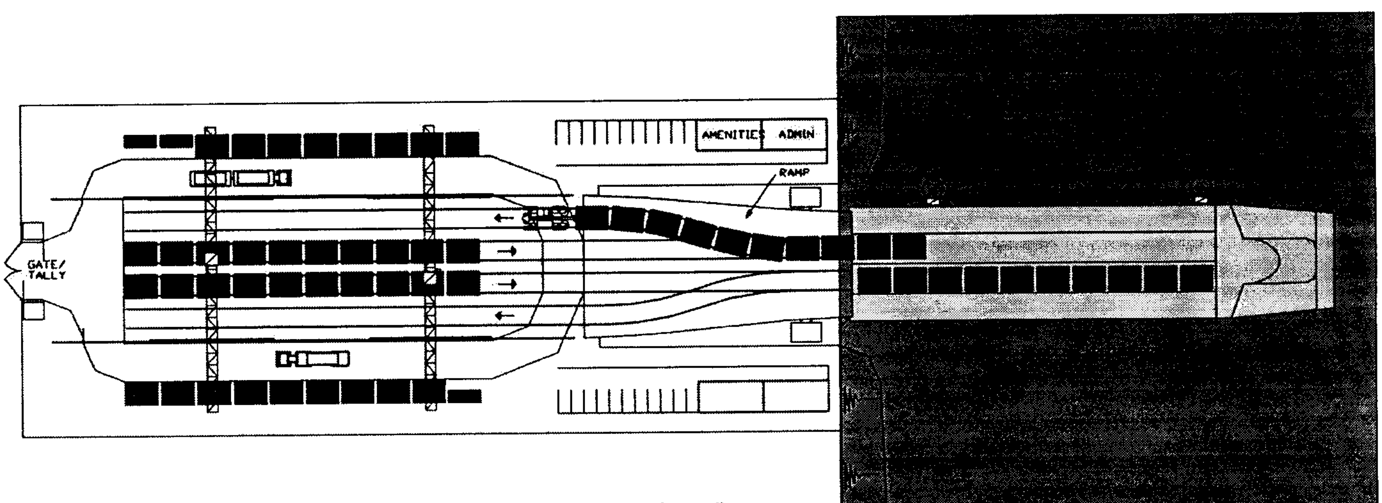


Figure 22. Austal Highspeed Freighter Terminal Configuration





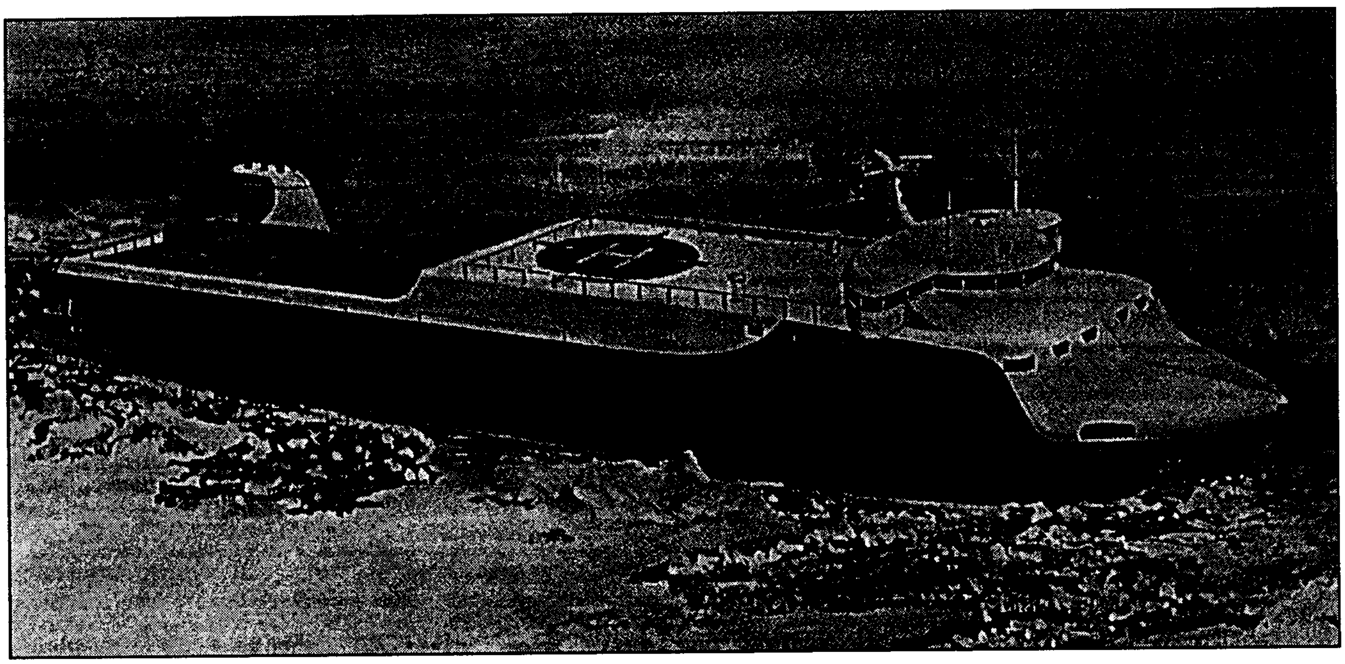
Design courtesy of Port & Harbour Consultants, Perth, Western Australia
Tel +61-8-9278-8131 ; email <calkinj@worley.com.au>

MariTerm

The MariTerm project was launched as a cooperative research effort by a consortium of Swedish manufacturers headed by the Swedish Transport Research Board.[54] The aim of the study was to devise a "total transport system", based on specialized vessels and specialized ports, to replace truck transportation along the Swedish Baltic coast. The key component of the proposed system was "completely mechanized ports", with "fully automatic handling of cargo units from their positions onboard the vessel to the terminal and vice versa". This automation was in line with the study's observation that the obstacle for such a coastal service "is the very costly shifting of cargo units between vessels and shore". Mooring of the vessel was also expected to be accomplished without assistance from the shore.

The dimensions of the proposed MariTerm vessel (Figure 23) were 122 x 21.3 x 5.0 m, with capacity of 274 TEUs (4,000 DWT) and a speed of 18 knots. The proposed crew was only 4 persons, with two crews required per vessel. All crewmembers were expected to stand watch, since "there is no need for watch-free master". The vessels were equipped with an automated, conveyor-like storage/retrieval system and a side ramp. The Swedish estimated construction cost, including the handling system, at $20 million, or twice the cost of a conventional vessel of similar DWT. Nevertheless, the calculations suggested that the system was feasible, despite stiff competition from land-based systems.

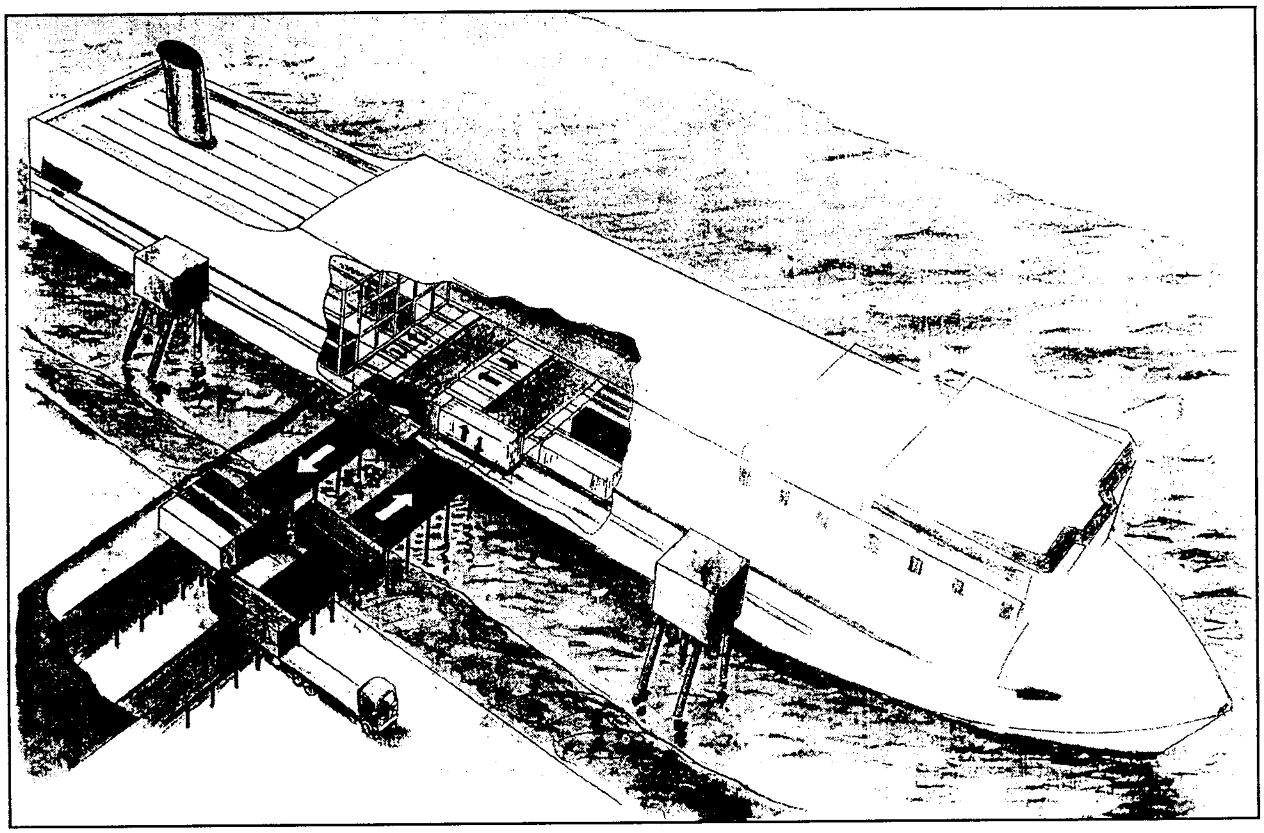
Figure 23. MariTerm Vessel



[54] Swedish Transport Research Board, "Coastal and Short Sea Shipping Technical Feasibility Study", TFB Report 1993:9. All quotes are taken from this report.

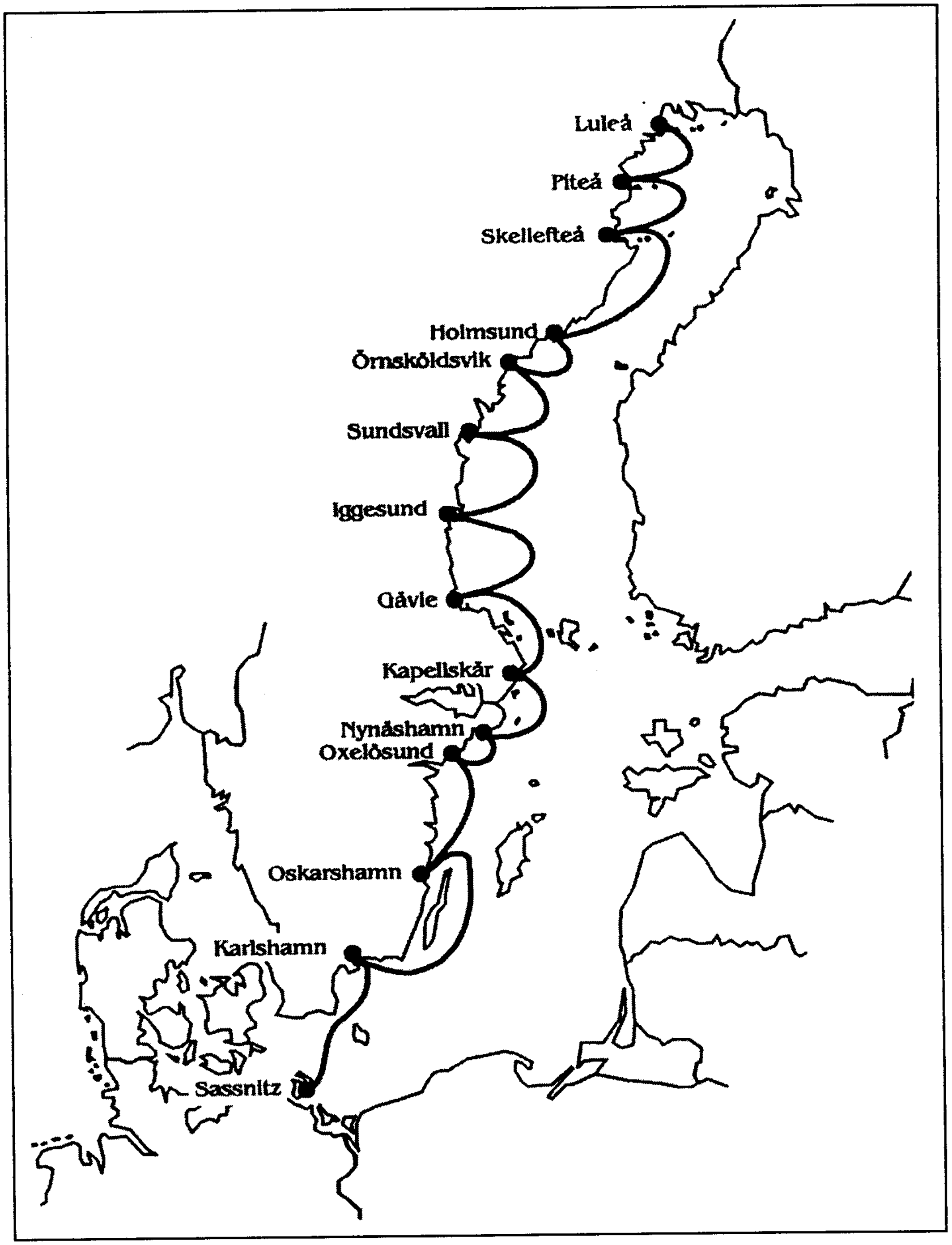
The terminal handling system was based on a ship-side conveyor, automatically moving cargo units to/from the shore through a side opening in the vessel. The productivity of the system was about 60 units/hour, so port time was expected to be 1 - 2 hours. Since all ports were dedicated to his type of service, the vessels were expected to work on arrival. The selected cargo units were swapbody containers with corner castings of ISO standards. Swapbody is a common intermodal unit in Europe, based on a metal box the size of a marine container with folding legs. Handling of the swapbodies is by elevating trailers. No crane or forklift is required. The required investment in each terminal was about $15 million, including berthing structures and handling machinery but excluding waterfront land, channel and road access. Figure 24 presents the described terminal arrangement.

Figure 24. MariTerm Terminal Arrangement



The proposed route covered all major cities on the Swedish Baltic coast. Total distance was 1,045 NM (1,935 km). The service was expected to call at each of the 14 terminals, with an average distance of 80 NM between them. The short-distance between terminals was the reason for naming the service the "hopper". The service itinerary was based on a daily call at the same time at each port (bus-like system). Seven ships were required for the service and its total annual capacity was calculated at 2.5 million tons. It was also estimated that with a hinterland radius of 50 km, the system would provide a full coverage for almost the entire Swedish inhabited area. The operating concept of the service followed the principle of "total transport system", with one entity in charge of vessel and terminal operations. Therefore, a point-to-point transportation service was provided to shippers. Figure 25 provides a map of the service route.

Figure 25. MariTerm Proposed Service Route



The overall conclusion of the study was that the proposed system could be viable. The average cost of the service was calculated at about $0.86/truck-mile, with each truck carrying 15 tons of cargo. Because of the level of service considerations it was estimated that the hopper service could be competitive for distances of 500 km and over. Unfortunately, the Swedish government has never implemented the recommendations of this highly publicized project.

Ro/Pax

The most popular vessel design for European ferries is the fast Ro/Pax, a mixture of trailers, trucks, cars and passengers. These vessels have capacity ranging between 5,000 - 10,000 dwt and a speed of 22 - 28 knots. For example, vessels of this design recently built include: (a) Stena's Seapacer class, a series of 4 newly built, with 7,000 dwt, 400 passengers, 170 trailers and 22 knots; (b) TT Line, which operates 7 vessels between Germany and Sweden, a 36,000 GRT, 7,200 DWT, 190 x 29.5 x 6.2 m, 22 knots, 1,000 passengers and 200 trailers (it will be delivered in August of 2001); (b) Attica Enterprise, a large Greek ship-owner, 6 Superfast ferries, 31,500 GRT, 204 x 25.4 x 6.4 m, 28 knots, 1,400 passengers plus 4 decks for cars; (d) Irish Sea, a major operator in Northern Europe / Nordic market, ordered a ferry with 50,000 GRT, 208 x 31 m, 2,000 passengers and 270 trailers.

Cassettes and Stora Boxes

Most European short sea vessels are Ro/Ro. But, instead of using road trailers, the European system has undertaken an interesting turn by using Mafis trailers and cassettes. A Mafi is a low trailer with small, solid wheels. The term Mafi[55] is derived from the name of the first manufacturer and relates to a specialized trailer, which has higher loading capacity and smaller, solid wheels. Also, smaller wheels allow for: (a) better space utilization of the Ro/Ro garages' height; and (b) lower center of gravity that improves stability.

A cassette is a large pallet consisting of two longitudinal beams, four short legs and a plywood deck. The cassette is moved by a "translifter" which is a low trailer inserted underneath the deck. The original system was intended to carry paper rolls that were too large and too heavy for ISO boxes. Since the cassettes are staged inside the garage of a Ro/Ro vessel, there is no need for boxes. Typical dimensions of cassettes are 12.25 x 2.6 x 0.85 m (length x width x height). Tare weight is about 4.5 tons and payload about 60 tons. A recent cassette design has increased its capacity to 80 tons or 4 TEUs.

Cassettes have the advantage of higher utilization of the garage height of Ro/Ro vessels. Likewise, handling productivity is higher because each unit can carry 4 TEUs. Their main disadvantage is that they cannot move on public roads. Hence, unlike road trailers, the cassette is an interim storage unit. Costs involved in providing the cassettes and translifters are quite high (see discussion in Section II.3).

---

[55] Another term, rolltrailer, is also in use.

It is interesting to note that a U.S.-based naval architecture firm, Advance Marine Enterprise, developed (for DARPA) a design of a cassette vessel, based on an existing Ro/Ro vessel operated by Gordon Lines. The vessel was designed to carry 141 cassettes, each holding 4 TEUs (2 high), or a total of 640 TEUs. The vessel's dimensions were 156 x 23.5 x 6.25 m (LOA x beam x draft), and its 16-knot speed was based on a 4,500 kW engine. The intended service route for the vessel was coastwise.

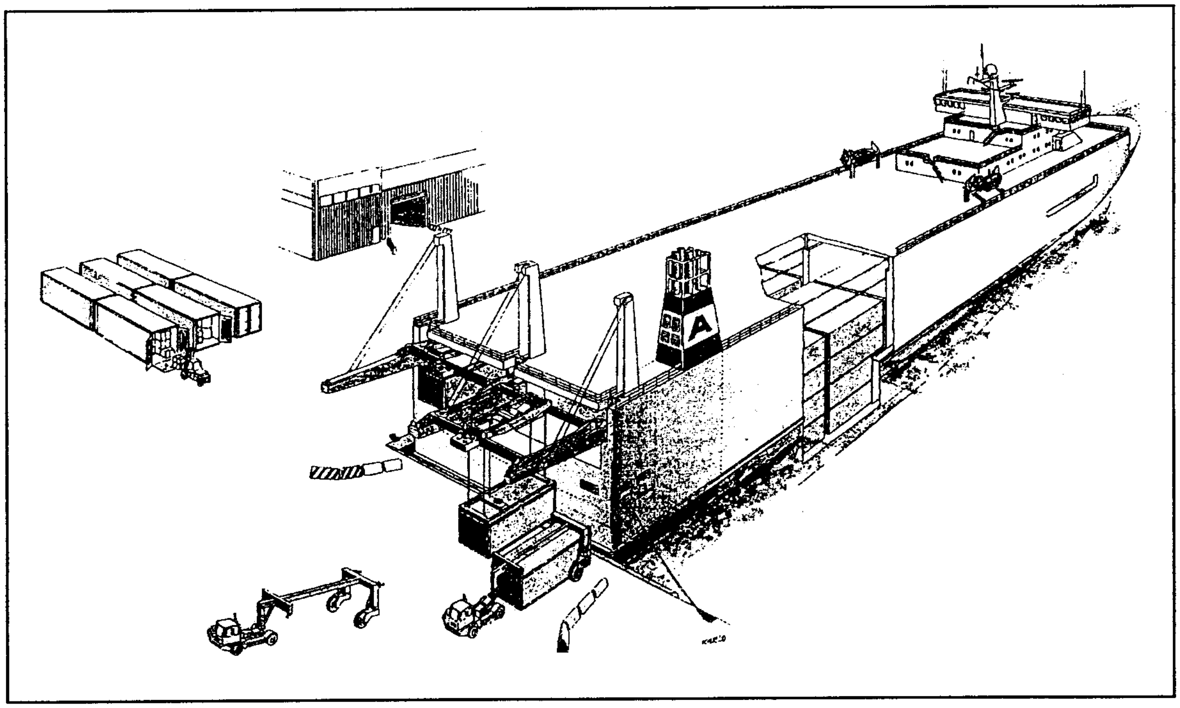
A recent, interesting alternative to the cassettes are Stora boxes, also called StoraEnso Cargo Units (SECU). The boxes were devised by Enso, a large forest product manufacturer of Stora boxes, as part of a total transportation system. The boxes have dimensions of 13.8 x 3.6 x 4,8 m and a gross weight of 90 tons (three times the ISO marine container). A service based on these jumbo boxes was announced between Gothenburg, Sweden and Zeebrugge, Belgium. Three Ro/Ro vessels, each with a capacity of about 1,000 boxes, have been constructed and have recently started service. The service was intended to bypass Germany and it's congested roads (see introduction). The three Stora vessels will provide for 5 calls per week and a total annual throughput of 2.5 million tons. The collection and transfer of products from the 7 paper mills around Gothenburg is by unit trains with special wagons. In Belgium, the boxes will have to be destuffed. It is unclear what cargo will be using the boxes on the return trip to Sweden. Recently, the port of Gothenburg inaugurated a new paper terminal with 5.7 hectare of concrete pavement for handling the boxes. The port also ordered 7 special terminal tractors for the new boxes and a special straddle carrier. Another Stora service, between Belgium and the U.K., is expected shortly.

Trailer Cassette and Container Pallet

Three other port handling systems of interest were mentioned in European professional literature: (a) CASH, (b) container pallet; and (c) stacked cassettes. CASH, the abbreviation of Cassette Ship Handling is based on a self-sustained vessel that does not need any shore support. The vessel is totally enclosed with overhead cranes. The crane rails extend over and above the dock through an opening in the stern. Figure 26 presents the CASH system.

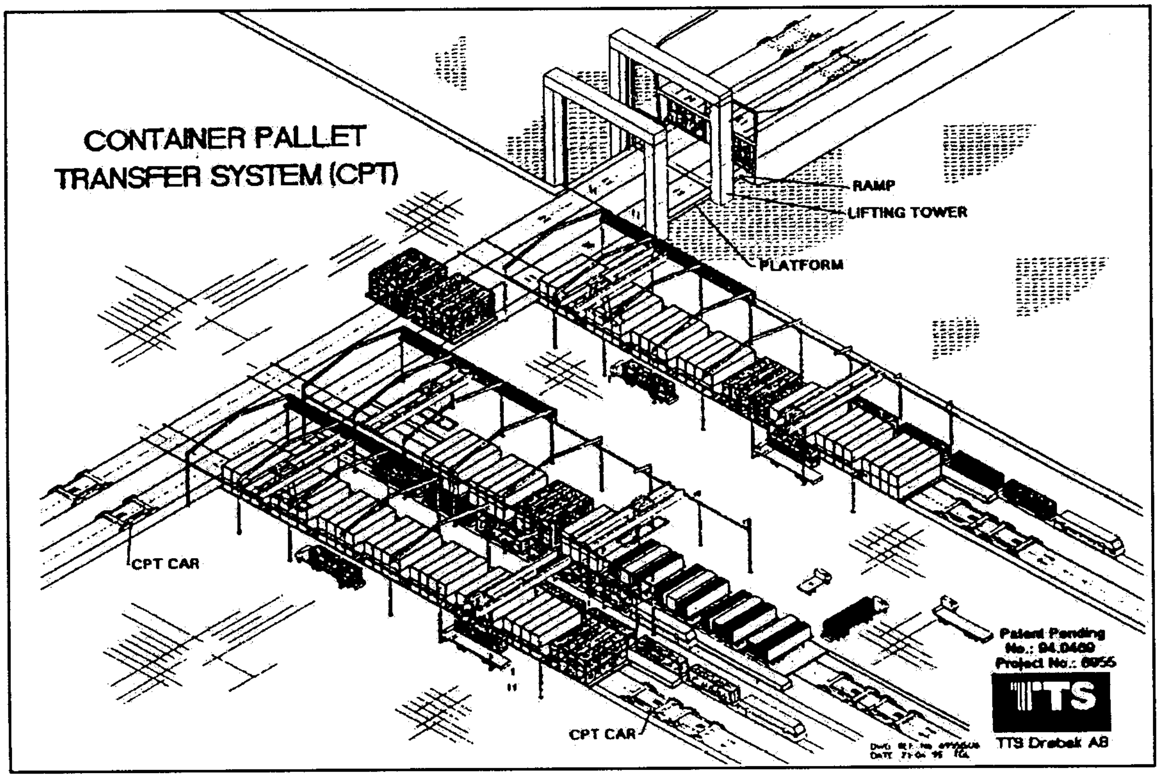
The second handling system is based on a totally different approach. The system involves large "container pallets", with each pallet consisting of 20 TEUs (400 tons). Being an intermediate device for creating a multi-container unit, the pallet has some resemblance to the cassette. However, unlike the cassette, the pallet is designed to be moved in/out of the vessel by special dollies. The pallet is lifted from above and staged in the yard by a huge overhead crane. The advantage of this system is its large throughput of about 900 TEUs/hour. The disadvantage is the need for specialized ports and equipment with an investment of about $100 million per terminal. Figure 27 presents the container pallet system.

Figure 26. CASH Concept



Source: Ahlmarks (MariTerm AB, 1993)

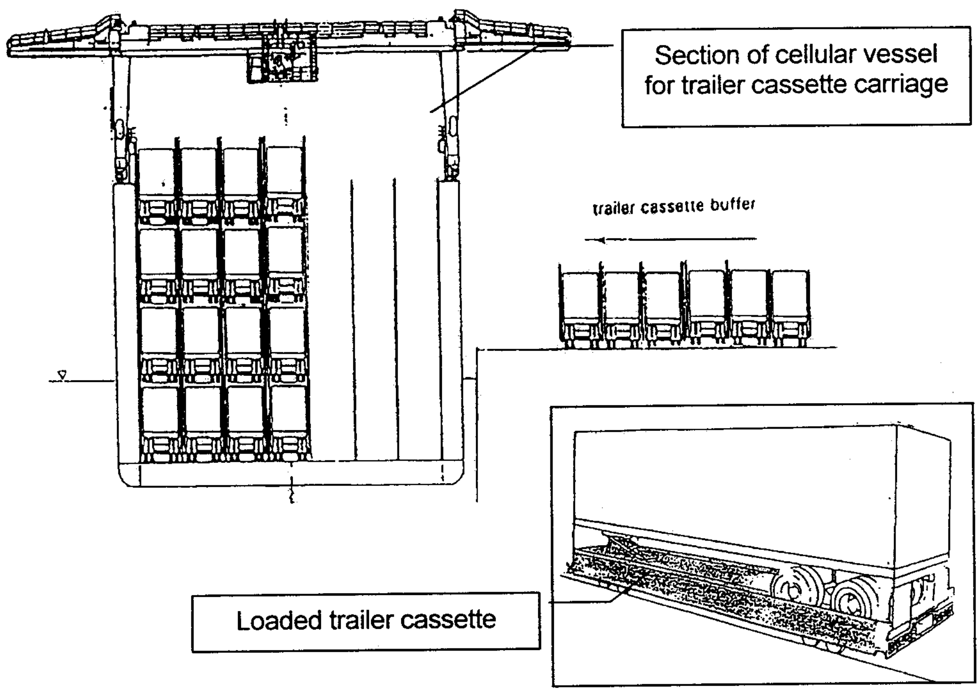
Figure 27. Container Pallet System



The third system, the stacked cassettes system, is geared toward handling trailers mounted on cassettes. The specially designed cassettes have side supports that allow stacking the cassettes in hatches of open-hatch ships with travelling gantry. The crane's trolley can carry a cassette or a container from the ships' hull to the dock and vice-versa. Figure 28 presents a schematic depiction of the trailer cassette system.

All systems are based on specialized ships and specialized handling methods. Hence, they do not suit the operational concept of universality as depicted in Chapter II.

Figure 28. Trailer Cassette System



Source: J. Lieska, 1996.

IV.3 JAPAN'S COASTAL SYSTEMS

Coastal Systems' Overview

Japan's geography consists of a series of islands. The islands themselves are mountainous and with narrow coastal plains, where most of the population is concentrated. Coastal roads and rails are very congested, with the rail primarily used for passengers. This setting is very conducive to coastal and inter-island shipping. As was the case in Europe, there is no clear differentiation between the two.[56]

[56] There would not be a differentiation in the U.S. except for Jones Act.

Most of the coastal shipping services are based on a combination of passengers, cars and trucks. Altogether, there are 12 major ferry operators, offering 30 separate services, which link 40 ports on the 4 major Japanese islands.[57] The fleet includes 62 combination and 4 all-freight ferries. There is a parallel but much smaller system of ferry services on the short-sea routes between Japan, Korea and China. The coastal system carried 2.3 million trucks and trailers in 1996, mostly for distances over 300 km, at an average speed of 20 knots. While the number of trucks has been increasing at a rate of 7% annually, the number of passenger has been decreasing 16.5% annually. Currently, most of the income on the 300-km and over distances is from freight. The Japanese coastal shipping system traces its routes to the era when Japan's four major islands did not have fixed-link connection. The system is large and successful as illustrated by the fact that in 1995, 25% of the truck transport for trips of 100 km and over was provided by coastal shipping.

A typical ferry has a capacity for 100 12-m trailers and 300 - 1,000 passengers. Recently built ferries have a speed of over 25 knots. Most noticeable were two 27-knots ferries introduced on a 1,024 km route, reducing trip time from 29 to 21 hours. An interesting feature of the system is that the ports are highly subsidized. They are controlled by the Ministry of Transport and are managed by public bodies, which is in line with the declared national policy of shifting freight from land to water. Likewise, there are subsidies for vessel construction.

The Techno-Superliner Project

As indicated above, a major policy objective for the Japanese government has been a modal shift for freight, from land to water. The government realized that only a radical change in the technology and operations of coastal shipping might divert significant cargo volumes from truck to water. Consequently, the government began, in 1989, an innovative R & D program dedicated to the development of a high-speed cargo vessel named "Techno-Superliner" (TSL). The TSL's performance targets were a speed of 50-knot, a 1,000-ton, 500 nautical mile range, and sufficient seaworthiness to navigate through rough seas. The latter was considered essential for providing a reliable all-season transport system. The shipping system was expected to provide 2/day services between the metropolitan Tokyo, Hokkaido, Japan's northernmost region and Kyushu, Japan's southernmost.

Following the government initiative, the Association of Techno-Super Liner was established by seven leading shipbuilders. Each of the builders developed its own design. In parallel, a TSL Affair Office was established in the Ports and Harbors Bureau, of the Ministry of Transport in July 1992.

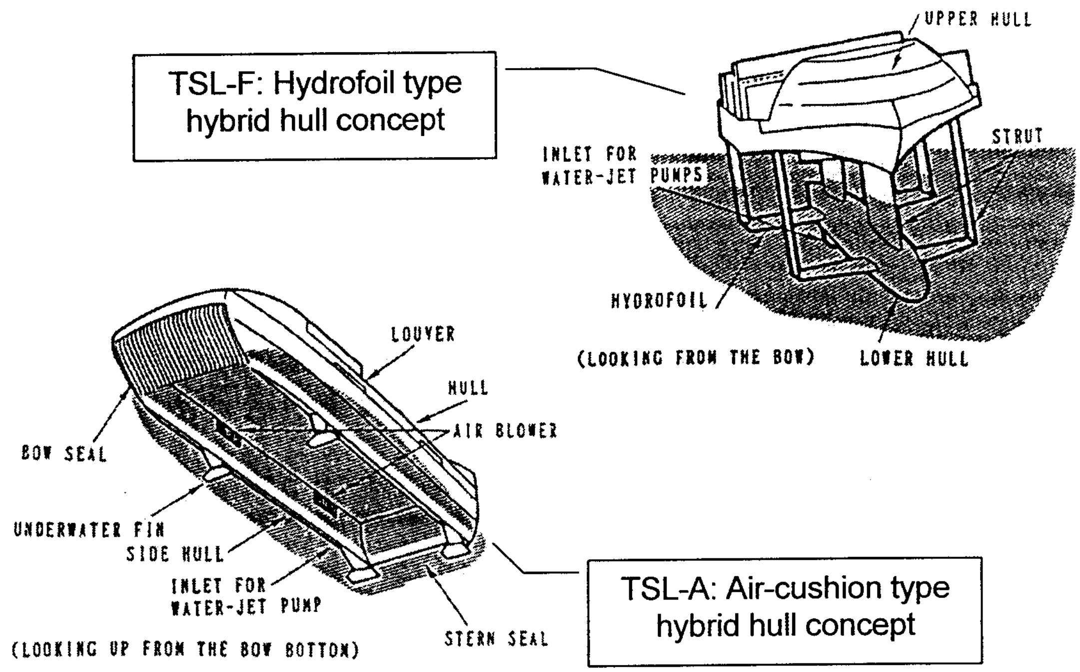
The TSL vessel was based on two hull forms that were selected among the seven designs, a Hydrofoil and an air cushion vessel. After a long period of development and experimentation, two large-scale models were constructed, a Hydrofoil model with 17 x 6

---

[57] Source: Baird, J. A. "The Japan Coastal Ferry System," Napier University Business School, Edinburgh, Scotland, UK, 1998.

m (length x breadth), and an air-cushion model with 70 x 19 m. Figure 29 presents a schematic drawing of the two TSL models. Testing of the two models was completed in 1994.

Figure 29. Japanese TSL Designs



Based on testing of these models, the actual designs of the two vessels were finalized in 1995. The Hydrofoil design had dimensions of 72 x 37 x 18.6 x 14 m (length x breadth x depth x draft); the air-cushion had dimensions of 127 x 27.2 x 11 x 7.3 m. Both were designed to carry about 300 TEUs, with boxes stacked 2-high on deck. Interestingly, the literature does not mention carrying trailers or cassettes.

The TSL terminals were designed to handle only TSL vessels. A goal was set to handle the entire vessel, with about 300 moves (in/out), within 2 hours. A parallel goal was to handle the same number of moves to/from trucks, also within 2 hours. The Japanese realized that handling 150 moves/hour could only be achieved by using a multi-container system. Both vertical and horizontal handling concepts were considered. The vertical system was based on a conventional gantry, except that its lifting was increased to 4 TEUs. Special inter-box connectors were designed for this purpose along with a multi-point spreader. The horizontal system was based on a self-propelled loader, mounted on an elevating platform that would lift the container from underneath and carry it to shore.

No further development activity on the TSL project was reported since testing of the model vessels was completed. It seems, however, that the prospects of the project have diminished as time passed. This is primarily due to two factors: (a) the speed advantage of the TSL 50-knots has been eroding when compared to the recent, but with a conventional design, coastal vessels with speeds of 27-knots; and (b) the recent increase in fuel cost. Moreover, the project lacked support from the Japanese ferry lines claiming that the TSL costs 4 times (!) that of an existing 25-knot ferry but has only twice its capacity (50:2). It seems that a more suitable system for Japan should be based on vessels with a speed of 30-knots, based on diesel engines.

V. COMPARATIVE COST AND PERFORMANCE MODEL

V.1 ANALYTICAL FRAMEWORK

Objective

The purpose of the cost and performance model is twofold:

- To serve as a planning tool for a prospective developer of coastal shipping; and
- To preliminarily assess the viability of coastal services based on the vessel types previously selected for analysis.

These vessels were: (a) tug & barge with capacity of 500 TEUs (hereinafter called barge); (b) 500-TEU Lo/Lo containership (Lo/Lo); (c) 370-TEU fast Ro/Ro; (d) 200-TEU high-speed monohull (monohull); and (d) 88-TEU high-speed catamaran (catamaran). The assessment relates to both cost and trip times.

Model's Structure

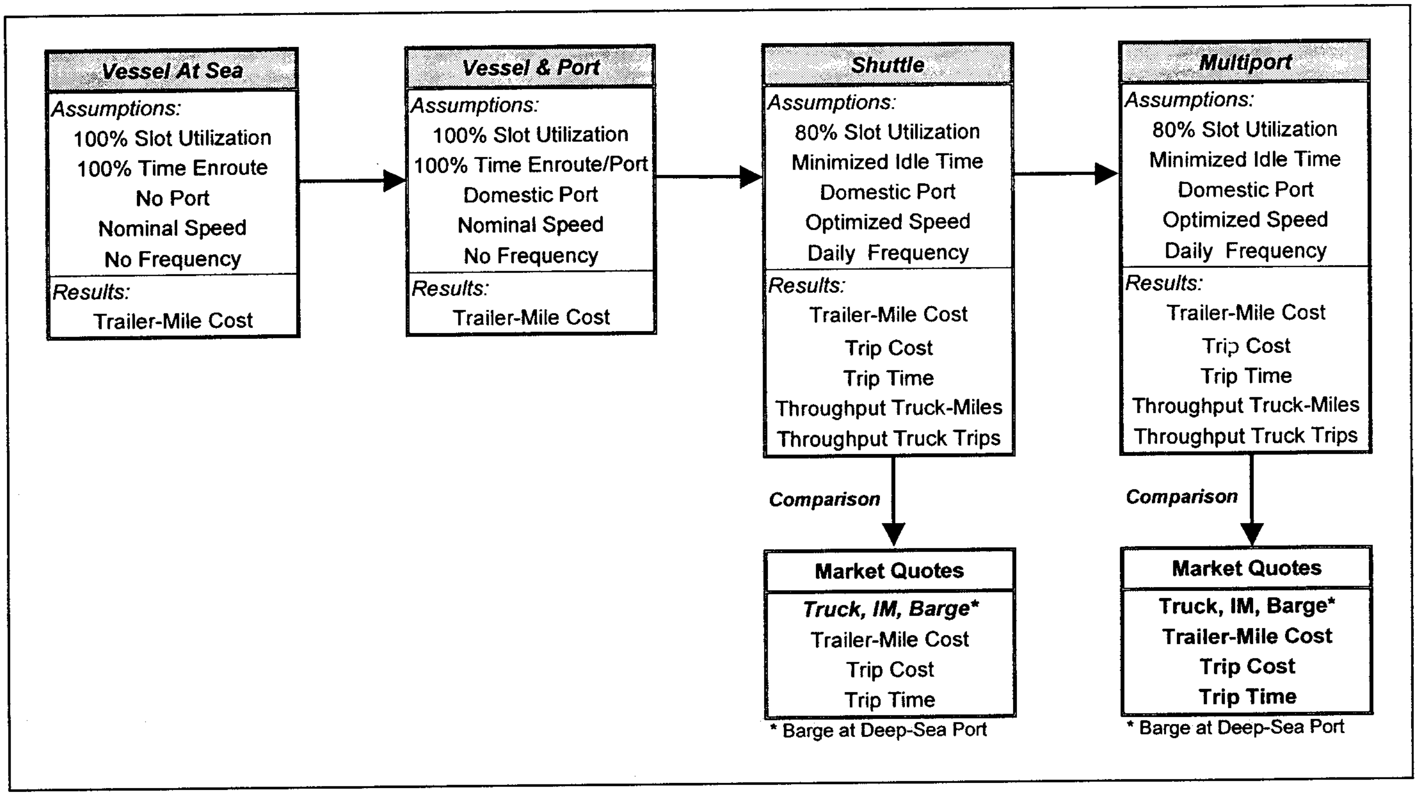
The model consists of four cost calculation modules, each is aimed at a different level of assessment. The modules are:

- Vessel at Sea -- The cost of the vessel itself while at sea;
- Vessel at Sea and at Port -- The same as the above plus the cost of the vessel's time spent at port along with handling cost;
- Shuttle Service -- The same as the above but related to deployment on a 2-port rotation with a selected frequency; and
- Multi-port Service -- The same as above, but with deployment on a complex rotation that involves calling on several ports.

The last two modules include the calculation of trip times in addition to trip costs.

The first module provides a quick assessment of the cost performance of various types of vessels, without giving consideration to distances, ports or routes on which they might be deployed. The second provides for a more detailed analysis, including definition of ports and distance, although it is still unrelated to a specific route. The third module relates to an actual service based on a shuttle pattern, and involves decisions on number of ships, sailing speeds, utilization, etc. The fourth is similar to the third, except that it addresses a more complex service pattern that involves several ports. Figure 30 presents the structure of the Cost and Performance Model.

Figure 30. Structure of Cost and Performance Model



Service Optimization

The last two modules involve analysis of actual services. The user begins by selecting a service route, then a required frequency. In response, the model calculates a preliminary number of vessels for the service. However, the number of vessels in a service must be a whole number and this fact could create underutilization of the vessels. The model has built-in macros that allow the user to modify vessel speed to reach maximum utilization. Changing speed could also affect the number of vessels needed to provide the service with the required frequency. Adding or subtracting a vessel affects vessel cost. Likewise, changing speed affects fuel consumption and cost. All changes and their impacts are automatically calculated by built-in formulas. Another consideration that may affect decisions is the impact of changes in speed on trip time which, in turn, affect demand. Altogether, the planner (model's user) can use the model to examine the trade-off between number of vessels and their speed and optimize his decisions.

For example, the result of the initial calculation could be that under standard sailing conditions the number of ships required for a service is 3.3. This means that the service requires 4 vessels, which, in turn, will only be utilized 82.5% (3.3 / 4) of their time. The planner can elect to increase speed by 10% and provide the service with only 3 vessels (3.3 / 1.1). But, the increase in speed will result in higher fuel consumption and higher fuel cost. By evaluating the resulting cost and performance (trip time), the planner can make better decisions regarding the number of vessels that are needed and the speed at which they should sail. This decision is also affected by the price of fuel. The ability to manipulate the number of vessels, speed, fuel cost and the total cost and trip time is a key feature of this model. This feature is especially important in planning services for high-speed vessels, which have both high construction and high fuel costs.

Model's Inputs and Outputs

The model's main inputs include:

- Operating characteristics (capacity, speed, fuel consumption) at sea and at port;
- Sea distances between NAFTA ports on the East Coast;
- Service pattern (shuttle or multi-port, including ports of call and sequence);
- Port entry times for each type of vessels; and
- Cargo handling rates and costs for each type of vessel.

Input data for 5 basic types of vessels (see Section II.2) are included in the model. However, the model's design allows a planner to use any input. That is, the planner may use the model to analyze the deployment of any type of vessel along any route and with any service pattern. Figure 31 presents the technical characteristics of the 5 basic vessels.

Figure 31. Vessel Technical Characteristics

Technical Parameters	High Speed Catamaran	High Speed Monohull	Fast Ro/Ro	Small Lo/Lo	Tug / Barge
Length overall (meters)	112.0	161.7	182.6	131.5	121.9
Beam (meters)	25.0	26.4	25.5	19.5	30.5
Draft (meters)	3.6	7.0	6.6	5.2	3.7
DWT	1,405	4,000	12,350	6,227	
Capacity (14.6 m trailers / 40' containers)	**44**	**100**	**185**	**250**	**250**
Container capacity (TEU)	**88**	**200**	**370**	**500**	**500**
Lanemeters capacity (meters)	644	1,460	2,715		
Accommodation for drivers/passengers	48	100	12	16	
Total power (kW)	45,000	36,600	23,040	9,380	6,705
Main engines	2	2	4	2	1
Power per engine (kW)	22,500	18,300	5,760	4,690	6,705
Type of engine / propulsion	gas turbine / water jets	diesel / propeller	diesel / propeller	diesel / propeller	diesel / propeller
Service speed (knots at 90% MCR)	**36.0**	**25.2**	**21.6**	**14.0**	**9.0**
Maximum speed (knots at 100% MCR)	40.0	28.0	24.0	15.6	10.0
Fuel consumption at service speed (MT)	8.6	6.0	4.6	1.6	0.6
Fuel type	IFO	IFO	IFO	IFO	IFO
Construction cost (US$ millions)	45	49	35	25	12

The model's outputs for the first two modules are average costs. For the third and fourth modules they include, in addition to average cost, trip cost, trip time, and volumes between port pairs that are required to achieve reasonable utilization (defined here as 80% of vessels' capacity).

Since the coastal service is assumed to be part of a trucking service, all average costs are calculated as a DPM, or dollar per statute mile and not nautical mile. Trip costs do not include the cost of trailers, since trailers are assumed to be owned by truck lines. Trip (transit) times include travel time at sea and port times on both ends (departure and arrival).[58]

V.2 VESSELS AT SEA

Vessel's Cost Structure

The vessel-at-sea cost assesses the most basic cost characteristics of the 5 vessels selected for preliminary analysis. The operating cost of vessels at sea has two components:

- Fixed Cost -- Cost of construction of the vessel (capital cost), crew, maintenance and insurance; and
- Variable Cost -- Cost of fuel and the related consumables.

The separation of cost into these two components intends to facilitate manipulation of vessels' speed in order to achieve higher time utilization.

Main Cost Factors

The fixed costs consist of two sub-components: (a) costs that relate to the vessel's construction cost; and (b) costs that relate to the vessel's crew. The first sub-component includes amortization of the construction (capital) cost at 10% over 20 years and maintenance and insurance are assumed as percentages of capital cost. The second sub-component is based on reduced manning of 8 persons for small Lo/Lo and fast Ro/Ro barge, 14 for the high-speed monohull and 9 for the high-speed catamaran. The crew size for the first three vessels is based on present crewing of foreign vessels of similar size where bridge functions are highly automated. The crew size for the high-speed vessels is based on shipyard specifications. Figure 32 presents the composition of crews and assumed cost ($/year).

To reflect differences in fuel consumption, the variable cost is divided into costs at sea and at port. Fuel consumption is based on shipyard specifications and common consumption

[58] No allowance is given to cut-off and pick-up times, assuming both could be very short. The proposed domestic ports are essentially truck terminals with limited gate processes.

standards for diesel engines (grams/kw-hour). All costs are based on fuel prices as of the fall of 1999, which have risen considerably since then. However, the recent price hike of fuel influences the operating costs of trucks more than vessels. Hence, the general conclusions of the forthcoming analysis are expected to apply to the post-price-rise period.

Figure 32. Crew Costs

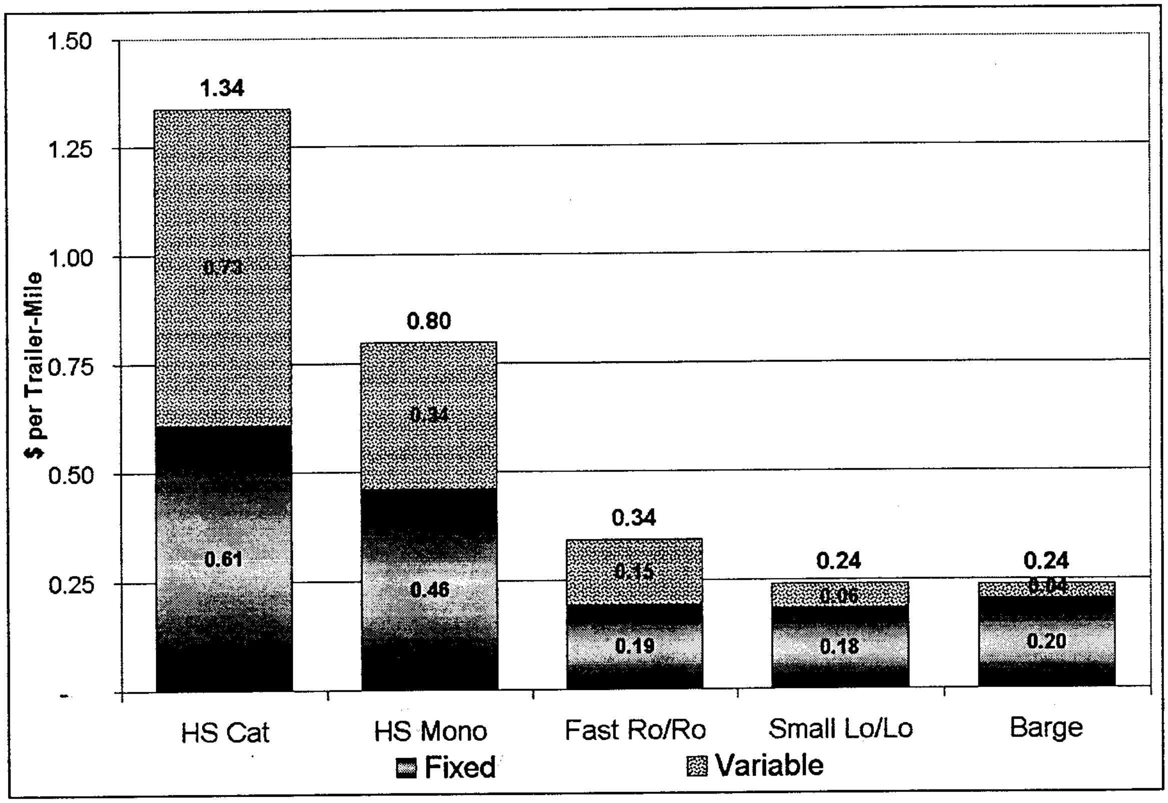
Position	HS Catamaran		HS Monohull		Fast Ro/Ro		Small Lo/Lo		Barge	
	Crew	Salaries	Crew	Salaries	Crew	Salaries	Crew	Salaries	Crew	Salaries
Master	1	114,000	1	114,000	1	95,000	1	95,000	1	85,500
Chief Engineer	1	114,000	1	114,000	1	95,000	1	95,000	1	95,000
First Mate (Navigator)	1	54,000	2	108,000	2	108,000	2	108,000	2	108,000
Second Engineer	1	54,000	2	108,000	1	54,000	1	54,000	1	54,000
Able Seaman	4	168,000	7	294,000	2	84,000	2	84,000	2	84,000
Kitchen Staff	1	47,000	1	47,000	1	47,000	1	47,000	1	47,000
Crew requirements	9	551,000	14	785,000	8	483,000	8	483,000	8	473,500
Overhead		60%		60%		60%		60%		60%
Total crew costs ($/yr)		**881,600**		**1,256,000**		**772,800**		**772,800**		**757,600**

Average Costs per Mile

The calculation of the average costs at sea of the 5 vessel types indicates that the barge and the Lo/Lo vessel systems have a similar cost structure, with $0.24/mile. Also, the breakdown between fixed and operating costs is similar. The similarity in results seems to be in contradiction with the fact that the capital cost of the Lo/Lo, at $25 million, is more than twice that of the tug and barge, at $12 million. Both have the same capacity of 500 TEUs. However, the higher construction cost of the Lo/Lo vessel is offset by its higher speed. At 14 knots it is almost 60% faster than the 9-knot barge. Figure 33 presents a bar chart with the vessel-at-sea costs.

The cost of the fast Ro/Ro, at $0.34/mile, is about 50% higher than that of the two slow-speed vessels. Although the speed difference between the two is only 17% (28 vs. 24 knots), the cost of the high-speed monohull, at $0.90/mile, is three times higher than that of the Ro/Ro. The high-speed catamaran has the highest cost, at $1.34. This is almost 50% higher than the high-speed Ro/Ro while its speed is about 40% higher (40 vs. 28 knots). All cost figures exclude port costs and assume full space and time utilization. This means the vessel is 100% full and gainfully sailing 100% of its time.

Figure 33. Vessel-at-Sea Costs



V.3 VESSELS AT SEA AND PORT

Port's Times and Costs

The cost analysis here is similar to the previous one, except that it introduces the impact of ports on the cost and performance of the various vessels. Port handling rates assumed here reflect the differences in the two cargo handling systems. The barge and small containership are Lo/Lo (lift on / lift off, boxes), while the rest are Ro/Ro (roll on / roll off, trailers). Reach-stackers are the lifting equipment assumed to be used for the Lo/Lo barge and vessel's cranes are assumed to be used for the small Lo/Lo. Cargo handling rates (moves/hour) of Ro/Ro vessels are usually higher than Lo/Lo's.[59] Based on discussions with the industry, the rates assumed here are 30 moves/hour for Ro/Ro and 20 moves/hour for Lo/Lo.

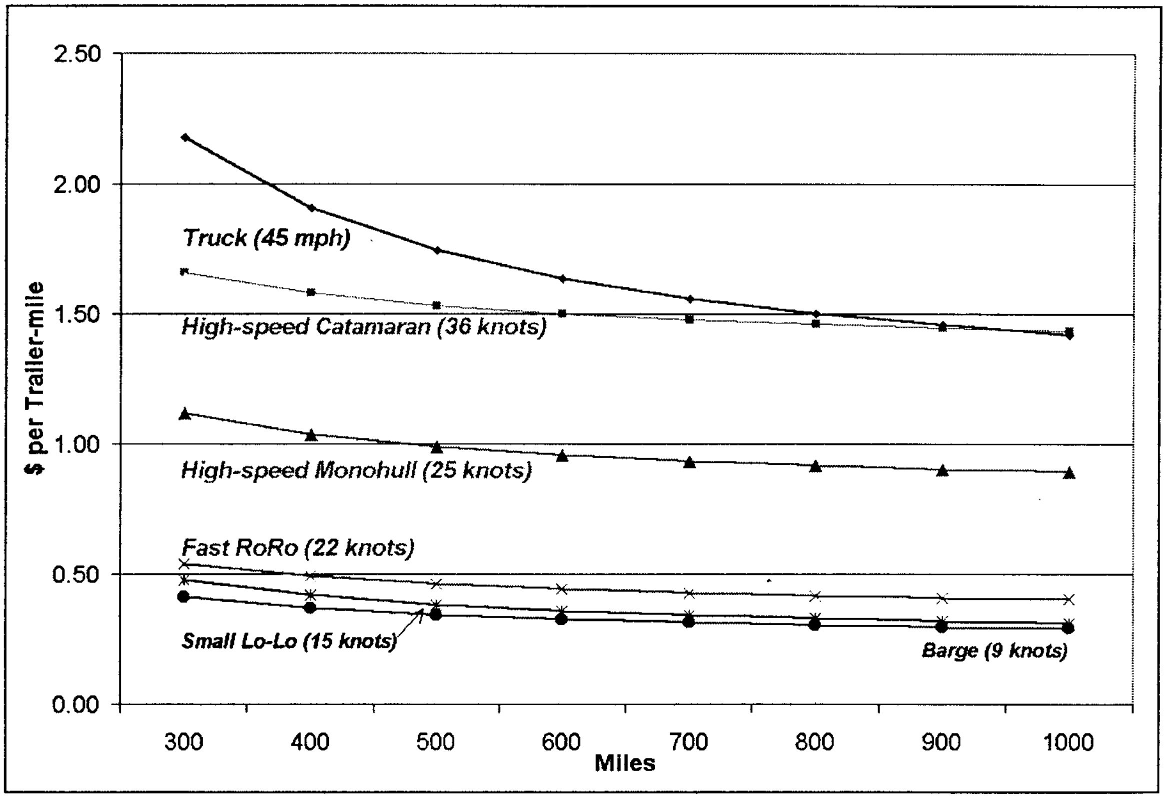
Port cost for handling cargoes at the domestic terminal is assumed at $40/box for the Ro/Ro. Since Lo/Lo requires additional terminal activities and equipment (lifting on/off chassis) their port cost is assumed higher, at $60/box (See Section II.3).

[59] This is not the case when several cranes can handle the Lo/Lo ship while the Ro/Ro has a single ramp.

Average Costs per Mile

The cost calculation here is for a shuttle service, with vessels loaded to 100% of their capacity and utilizing 100% of their time (as in the previous calculations). The resulting costs vary with the distance. Because of the fixed components, especially the port cost, the shape of the average cost curves resembles hyperbola with a long and almost flat tail. The shape of the line indicates that as the distance increases, the relative importance of the port cost decreases. Beyond 600 miles, the cost lines are horizontal and parallel. The figure also includes a line representing trucking cost, based on the regression of rates (see Section II.6). The high initial cost of trucking reflects the $400 minimum charge that truck lines impose, and is not directly related to their actual cost. Figure 34 presents the vessel at sea and port cost curves.

Figure 34. Vessel at Sea and Port Costs



Since trucking data is based on market prices while vessel data is based on operating cost under ideal conditions, comparing trucking and shipping costs as shown in the figure is inappropriate. The figure only intends to provide a general indication of the cost structure of the various coastal operations.

V.4 SHUTTLE SERVICE

Threshold Traffic Levels

The shuttle service pattern is the simplest service to develop and manage, since it only involves the handling of cargo flows between two ports. It is also the most common pattern employed by present U.S. and foreign coastal services. The main problem with this pattern is identifying a port pair with a cargo flow that is sufficient to fill the entire vessel capacity. Based on preliminary cargo flow data analyzed in Section II.6, it seems that no two ports along the East Coast can support a daily service using any of the 5 selected vessels. Nevertheless, and for comparison, the model was run for one pair of ports, which is presumably the most promising: New York and Miami. The number of vessels and their speed were adjusted in order to achieve the lowest trip cost (optimization). Average utilization of vessel space (slot TEUs) was assumed at 80%, to reflect variations in demand.

Trip Costs, Times and Cargo Volumes for a New York to Miami Shuttle

The number of vessels required for a daily frequency service on this 1,010 nautical mile route varies according to each vessel's speed and port time. The shuttle service requires 12 barges, 8 Lo/Los, 5 Ro/Ro's, 4 monohulls, or 3 catamarans. The resulting trip costs range from $551 for the barge to $1,379 for the monohull and $2,288 for the catamaran (see Figure 35). There is a respective difference in trip times, from 135 hours (5.6 days) for the barge, 94 hours (3.9 days) for the Lo/Lo to 47 hours (1.9 days) for the monohull and 32 hours (1.3 days) for the catamaran. For comparison, the trip time for trucking this route was quoted at 1.5 days for team drivers, 2.5 days for solo driver and 3 days for intermodal rail service.

As seen above, the barge's service is substantially inferior to that offered by trucking. Discussion with truck lines indicated that the delivery time difference is so significant that the cost advantage of barge usage would be negated. The Lo/Lo service is much better than the barge's, although still much inferior to trucking. It seems that as was the case with the barge, the cost differential vis-à-vis trucking would not be sufficient to overcome the inferior level of service.[60]

The amount of cargo available on this route is an even more critical concern than cost. According to a preliminary estimate based on secondary sources, the traffic between New York and Miami, presumably the most promising route for coastal shipping, is only about 100 trucks/day in each direction.[61] The requirement for the barge and Lo/Lo are 225 boxes/day. This is substantially beyond the present market demand and perhaps even the long-term demand. This is also the case with the fast Ro/Ro service that requires about 185 trucks/day and even the monohull with 100 trucks/day. The catamaran with 44 trucks/day may qualify here in terms of volume -- but not in cost.

---

[60] There is another cost here, the inventory cost of both the goods and equipment (boxes and trailers) underway.

[61] There is no feeder traffic along this long route.

Figure 35. Shuttle Costs

Route Parameters and Assumptions							
Itinerary	NY-Miami-NY						
Ports in Itinerary	2						
Total Distance (nautical miles)	2,020						
Frequency	Daily						
Vessel Capacity Utilization	80%						
Cargo Exchanged at Ports (times capacity)	4.00						
Vessel / Port Parameters	**Unit**	**HS Catamaran**	**HS Mono**	**Fast Ro/Ro**	**Small Lo/Lo**	**Tug/ Barge**	
Service Speed	Knots	36	25.2	21.6	14	9	
Capacity	Trailers	44	100	185	250	250	
Handling Rate	Moves/Hour	30	30	30	20	20	
Handling Cost	$/Move	40	40	40	60	60	
Port Entry/Exit Time	Hours	0.5	0.5	0.5	1	1.5	
Calculation of Service Parameters	**Unit**	**HS Cat**	**HS Mono**	**Fast Ro/Ro**	**Small Lo/Lo**	**Barge**	
Roundtrip Transit Time	Hours	63.11	93.16	115.52	188.29	270.44	
(Time in Ports + Travel Time)	Days	2.63	3.88	4.81	7.85	11.27	
Vessels for Daily Service	**Vessels**	**3**	**4**	**5**	**8**	**12**	
Slack Time	Hours	9	3	4	4	18	
Idle Time Percentage (idle/voyage time)		12%	3%	4%	2%	6%	
Calculation of Service Costs	**Unit**	**HS Cat**	**HS Mono**	**Fast Ro/Ro**	**Small Lo/Lo**	**Barge**	
Trips per year	trips/year	121.7	91.3	73.0	45.6	30.4	
Fixed cost	$/trip	79,455	127,261	105,853	140,333	151,888	
Variable cost - at sea	$/trip	75,070	79,357	64,528	34,629	20,607	
Variable cost - at port	$/trip	937	1,287	1,518	792	-	
Total cost	$/trip	155,462	207,905	171,899	175,754	172,494	
Cost per trailer-nautical mile	**$/trailer-nm**	**2.19**	**1.29**	**0.57**	**0.44**	**0.43**	
Commercial Parameters NY-Miami / Miami-NY Service (1,010 nm)	**Unit**	**HS Cat**	**HS Mono**	**Fast Ro/Ro**	**Small Lo/Lo**	**Barge**	
Transit Time (one way)	hours	31.6	46.6	57.8	94.1	135.2	
Cost per trailer (one way)	$/trailer	$2,288	$1,379	$661	$559	$551	
Trailer-trips per year	trailers	12,848	29,200	54,020	73,000	73,000	

Notes:

Transit time includes 2*(port entry/exit time) + 2*(loading/unloading complete vessel) + travel time between ports

Cost includes 2*(handling rate)

Average Costs, Times and Cargo Volumes for a NY to Miami Multi-port Service

Presumably, the coastal service will have a larger potential traffic if it is employed in a multi-port route (see Section II.6). Employing the Lo/Lo vessels on a multi-port route will increase their trip time, which was already too long in the shuttle route. Even in the case of the faster Ro/Ro, trip times of a multi-port service, at 74 hours between New York and Miami, are too long for the service to be compatible with trucking. A preliminary conclusion can be made here: barge, small Lo/Lo containership and fast Ro/Ro seem to be unfit for the proposed coastal shipping service along the East Coast.

The two high-speed vessels are the only ones that can provide competitive trip times. The trip cost of the catamaran at $1.76 per mile, or at about $2.1 when a 20% overhead is added, is much higher than the cost of solo trucking at about $1.6 per mile. The catamaran has similar trip times to those of trucking using team drivers and could presumably compete with them on the premium cargo that is served by team drivers. However, this segment of premium cargo is very limited and will not be sufficient to provide for a daily service. Only the monohull seems to have the right combination of trip time and cost that suits market requirements. Hence, the following analysis is limited to this type of vessel. Figure 36 presents the costs and trip times for a multi-port service for the three faster vessel types serving the Central Loop.

Figure 36. Central Loop Service Parameters

Service Parameters	Unit	HS Catamaran	HS Monohull	Fast Ro/Ro
Vessels for Daily Service	vessels	4	5	7
Average Speed	Knots	28	24	21.6
Cost per trailer-nm	$/trailer-nm	2.02	1.33	0.66
Cost per trailer-mile	$/trailer-m	1.76	1.16	0.57
Total Trucking-segments	units/day	106	240	444
	units/year	38,544	87,600	162,060
NY-Miami Trip Cost	$/trailer-trip	2,422	1,618	840
NY-Miami Trip Time	hrs	48	60	74

Notes:
1. "Trucking segments" measures how many trucking highway segments are removed from the road.
2. Trip Cost includes port handling costs.
3. Travel time includes vessel at sea, port entry/exit and port handling times.

V.5 MULTI-PORT SERVICE OF HIGH SPEED MONOHULL

Overall Service Structure

The multi-port service pattern is the only pattern that can generate a sufficient cargo volume to support a coastal shipping system. The overall scheme of coastal services envisioned for the East Coast of NAFTA countries consists of 3 multi-port loops:

- Northern Loop -- including New York, Boston and Halifax;
- Central Loop -- including New York, Norfolk, Charleston and Miami; and
- Gulf Loop -- including Miami, New Orleans, Houston and Tuxpan.

It should be noted that the above 3-loop service structure is preliminary and assumed here only for illustration purposes.[62] The advantage of the multi-loop structure is that it allows adjusting vessel capacity to the traffic density on each segment of the East Coast. The Central Loop could employ larger vessels than the two other loops due to the heavier traffic. The three loops are expected to have coordinated schedules to facilitate longer trips. For example, a trip between Boston and Tuxpan requires vessel-to-vessel transfers at New York and Miami. The schedules of the Northern, Central and Gulf Loops should allow for this match to be smooth and with minimal layover. Coordinated schedules are already common in deep-sea services whereby mother and feeder exchange cargoes in hub ports. Also, the loops should provide each other with traffic. For example, cargoes moving from Boston to Tuxpan could add to cargoes moving from New York southbound onboard the Central Loop vessel and later on, for the Gulf Loop vessel.

Detailed Analysis of the Central Loop with Monohulls

The average cost of the high-speed monohull is $1.33 per mile. This cost only includes operating costs, to which 20% may be added for overhead and profit.[63] Assuming charges are calculated on the basis of distance, a detailed calculation of the trip cost for the monohull indicates that to cover its operations cost, a ship owner will have to charge $1,620 for the leg from New York to Miami, $1,040 to Charleston, and $470 to Norfolk. With 20% allocated for overhead and profit, their rates will be increased to $1,940, $1,250 and $570 respectively. Truck charges for these trips are $2,000, $1,100, and $800 respectively. Hence, the monohull service could be priced competitively with trucking. Figure 37 presents the summary of the calculations. Appendix A includes the detailed calculations.

Trip times for the monohull also appear to be in line with those of trucks. For example, in the longer leg, New York / Miami, the time will be 60 hours or 2.5 days, which is similar to trucking with single driver (solo). If the more sophisticated counter-rotating service pattern is assumed, the monohulls trip time will be shortened to 47 hours as was the case in the shuttle (see below).

The volume required for the monohull also seems within reach. As in the shuttle service, the total New York loading would amount to 80% of the vessel's capacity, or 80 trailers. However, unlike the shuttle, out of the 80 trailers, only 36 would be destined for Miami, assuming 45% of the ship capacity is allocated to it (80 x 0.45), with the rest destined to Norfolk and Charleston. Moreover, it can be assumed that some of the New York loading will include trailers generated by the Northern Loop (e.g., Boston) and destined for the Gulf Loop (e.g., New Orleans). For example, if 5 trailers/day are generated by the Northern

[62] For example, the Central Loop can be extended to Boston. There could be overlapping between loops in order to increase frequency. For example, if the Northern Loop remains the same, the New York / Boston segment will have double frequency (2/day).

[63] The assumption of 20% overhead, which is quite low, is because the service is marketed directly to truck lines using trucks owned equipment. A much higher overhead will be needed if the service is marketed to shippers (retail) using shipping lines' equipment.

Loop and 5 are destined to the Southern Loop, the requirement for local New York to Miami cargo might be reduced to 26, or about 1/4 of the present daily flow between New York and Miami which is estimated at about 100. Altogether, it seems that the market potential can support this service. Another possibility, not discussed here, is to deploy monohulls with smaller capacity, say for 80 trailers (see below).

Figure 37. Central Loop Service Parameters Using HS Monohull Vessel

Assumptions

Capacity	100 Trailers
Utilization	80%
Port Handling Rate	30 Trailers/hr
Port Handling Cost	40 $/trailer
Port Entry/Exit Time	0.50 hrs
Speed	24.19 knots
Average cost	1.33 $/trailer-nm
Overhead	20%

Trip Times (hours)

From / To	New York	Norfolk	Charleston	Miami
New York		16	37	60
Norfolk	17		21	43
Charleston	37	21		23
Miami	60	43	22	

Calculation: At Sea + Port Exit/Entry + Port Handling

Trip Costs ($ per trailer)

From / To	New York	Norfolk	Charleston	Miami
New York		471	1,041	1,618
Norfolk	471		650	1,227
Charleston	1,041	650		657
Miami	1,618	1,227	657	

Calculation: 2*Port Handling + ($/nm)*distance

Suggested Rates Including Overhead ($ per trailer)

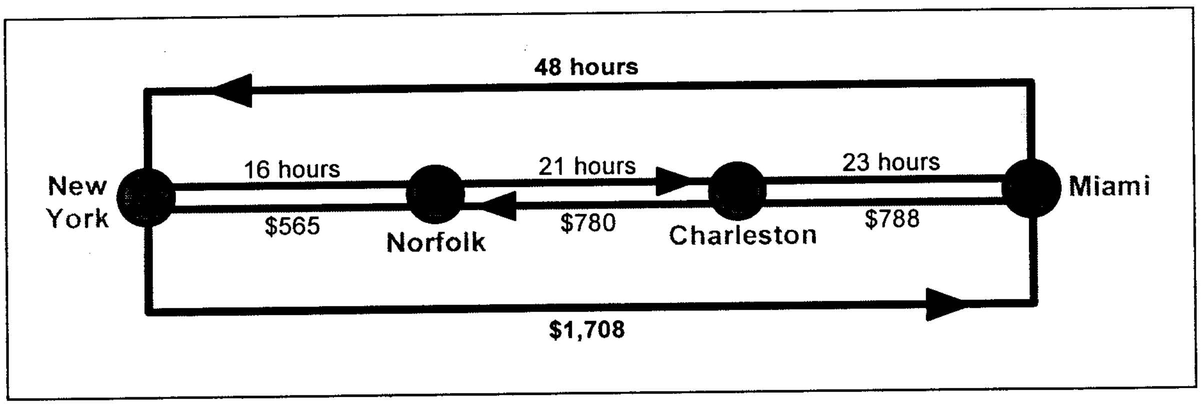
From / To	New York	Norfolk	Charleston	Miami
New York		565	1,249	1,942
Norfolk	565		780	1,473
Charleston	1,249	780		788
Miami	1,942	1,473	788	

Counter-Rotating Loops

The main disadvantage of a multi-port service relative to a shuttle is the longer trip time due to stops at way ports. One way to overcome the longer trip times, especially for the end points, is to deploy a service pattern based on counter-rotating loops (see Section II.5). However, for simplicity of analysis, costs and times were only calculated above for a simple service pattern where the vessels call the same ports in each direction (commuter). Also for simplicity, only the results of the Central Loop are discussed here. The results of calculations for all loops are provided in Appendix A.

A service based on counter-rotating loops will have lower costs because of the reduced number of port calls. For example, the trip cost between New York and Miami that was calculated above at $1,940 would be $1,710. However, a counter-rotating loop with a daily frequency has twice the capacity of a single loop utilizing a commuter type service. A reasonable implementation scenario would be to first introduce a commuter service and when volumes increase, convert it to the counter-rotating service pattern. Figure 38 presents an illustration of a counter-rotating loop along with trip costs and times.

Figure 38. Central Loop Service Based on Counter-Rotating Pattern



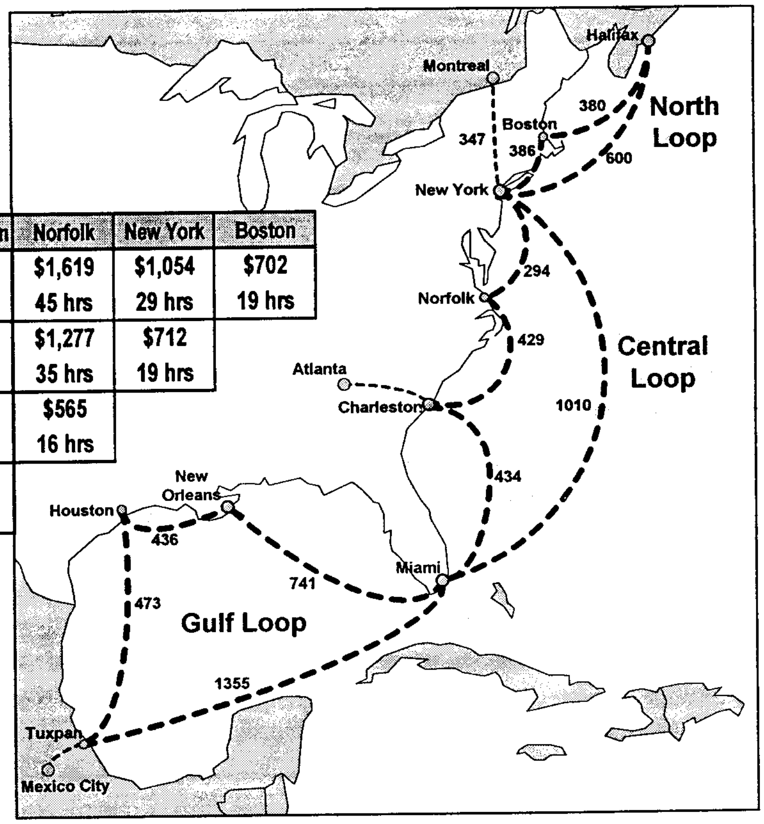
As indicated above, the counter-rotating loops can extend to the entire East Coast region. In the case of the longest trip between Halifax and Tuxpan, the trip time will be 138 hours (5.7 days) and the cost $5,020. A New York to Tuxpan trip will have a trip time of 109 hours (4.5 days) and cost of $3,970. As noted in Section II.6, the cost for a similar trip as quoted by an existing shipping line was $4,500. However, the shipping line service is provided on a weekly basis and the trip time is much longer. Figure 39 presents an illustration of the 3-loop structure along with trip times and costs.

Annual volume

A coastal service provided by fast monohull Ro/Ro vessels appears to be economically viable. Such a service, when employing a 100-truck vessel at 80% utilization on a daily basis, removes 80 trucks per day from the road, or 29,000 trucks per year. However, in the case of the Central Loop, this traffic is for each of the segments served: New York / Norfolk, Norfolk / Charleston, and Charleston / Miami. Hence, in terms of segments of I-95, the impact is higher, amounting to 88,000 truck-trips/year. If the two other loops are added, operating smaller vessels of 80 and 60 truck capacity, the overall annual traffic that could be removed from the road would amount to more than 200,000 truck-trips/year.

Figure 39. Multiport Coastal System

From / To	Tuxpan	Houston	N. Orleans	Miami	Charleston	Norfolk	New York	Boston
Halifax	$5,020 138 hrs	$4,736 132 hrs	$4,040 111 hrs	$2,762 77 hrs	$2,304 66 hrs	$1,619 45 hrs	$1,054 29 hrs	$702 19 hrs
Boston	$4,679 128 hrs	$4,395 122 hrs	$3,699 101 hrs	$2,420 67 hrs	$1,962 56 hrs	$1,277 35 hrs	$712 19 hrs	
New York	$3,967 109 hrs	$3,682 103 hrs	$2,987 82 hrs	$1,708 48 hrs	$1,250 37 hrs	$565 16 hrs		
Norfolk	$3,732 105 hrs	$3,448 98 hrs	$2,752 78 hrs	$1,473 43 hrs	$781 21 hrs			
Charleston	$3,047 84 hrs	$2,763 77 hrs	$2,067 57 hrs	$789 23 hrs				
Miami	$2,259 61 hrs	$1,974 55 hrs	$1,279 34 hrs					
N. Orleans	$1,547 44 hrs	$792 20 hrs						
Houston	$851 24 hrs							



A more precise way to measure the impact of the coastal service is to compare truck-mile statistics. A calculation based on the trip allocation assumed before yields that the Central Loop service could generate the equivalent of 75 million truck-miles per year. According to Reebie's data (see Section II.6), there are 541 million truck miles between Regions 2, 3, 5, and 7, the regions served by the Central Loop. Hence, the daily service can remove 14% of the inter-city traffic in this region. Figure 40 presents the calculation of truck-miles.

Figure 40. Impact on Highway System

Truck-miles per day (Reebie Database)				
Region	2	3	5	7
2		416,569	63,394	142,741
3	385,060		41,080	22,851
5	103,901	77,165		27,720
7	120,761	42,607	38,910	
			Total Truck-miles per day	1,482,760
			Total Truck-miles per year	**541,207,313**
Assumed Market for Central Loop				
From / To	**New York**	**Norfolk**	**Charleston**	**Miami**
New York		7,320	17,520	45,756
Norfolk	12,444		3,900	9,310
Charleston	7,300	3,900		19,584
Miami	45,756	22,344	11,520	
			Total Truck-miles per day	206,654
			Total Truck-miles per year	**75,428,710**
			Share of Total Traffic	**14%**

Investments

The operation of the Central Loop requires 5 high-speed monohull Ro/Ro vessels. The other two loops require 11 more vessels. Altogether, a comprehensive, 3-loop system requires 16 vessels. The construction cost of this fleet is about $700 million. There is an additional cost to develop 9 ports estimated at about $90 million. Hence, the overall investment in the proposed coastal shipping system based on high-speed Ro/Ro vessels with monohull design is $790 million. Its impact will be to remove more than 230,000 truck-trips annually from the road system (Figure 41). A coastal system based on counter rotating loops will require 30 ships and a total investment of $1.3 billion, and will remove 467,000 truck-trips annually off the road.

Figure 41. Overall Investment in Coastal System (US$ millions)

Service	Terminals		Ships			Capital Investment			Truck Segments per Year
	Units	Unit Cost	Units	Unit Cost	Capacity	Terminals	Ships	Total	
Central Loop NY-Norfolk-Charleston-Miami	4	$10	5	$49	100	$40	$245	$285	109,500
North Loop Halifax-Boston-NY	2	$10	4	$44	80	$20	$176	$196	58,400
Gulf Loop Miami-Houston-N.Orleans-Tuxpan	3	$10	7	$40	60	$30	$278	$308	65,700
All Network	**9**		**16**			**$90**	**$699**	**$789**	**233,600**

Notes:
For the North/Gulf loops, construction of only two/three additional terminals will be needed since NY and Miami would already be built.
"Truck segments" measures how many trucking highway segments are removed from the road on a yearly basis.

VI. CONCLUSIONS

VI.1 PRESENT SITUATION IN THE U.S. AND ABROAD

The existing U.S. coastal shipping system is mainly based on pull barges calling at deep-sea terminals. The barges handle international containers, providing feedering services for loaded boxes and repositioning for empty ones. The present system is not geared toward handling domestic trailers and containers because of the low, 9-knot speed of the barges and the related long trip times, and because of the low frequency of their services. Hence, with one exception, all coastal traffic of domestic trailers and containers is handled by road, with a small portion by rail. The exception is a single operation, on the West Coast, which handles a limited volume of domestic cargoes. The objective of this study is to devise a coastal system for domestic trailers and containers, which could also handle international containers, wherever possible.

Unlike the U.S., coastal shipping in Europe and Japan handles domestic trailers and containers, usually in combination with passengers and autos. Most coastal vessels employed abroad are fast, 24-knot RoPax, which are Ro/Ro vessels with accommodations for passengers. However, there are also several all-freight coastal services based on fast Ro/Ro's. A recent trend is to employ high-speed, 40-knot RoPax.

VI.2 COASTAL SYSTEM DEFINITION: VESSELS, TERMINALS, RANGE AND SERVICE PATTERN

Based on U.S. and foreign experience, 5 types of all-cargo vessels where selected for analysis, including: (a) 500-TEU, 10-knot Lo/Lo barge; (b) 500-TEU, 15-knot Lo/Lo containership; (c) 370-TEU, 24-knot Ro/Ro vessel; (d) 200-TEU, 28-knot monohull Ro/Ro; and (d) 90-TEU, 40-knot catamaran Ro/Ro.

A preliminary cost analysis indicated that the present system of deep-sea terminals couldn't be utilized to support the coastal system because of its high cost and operational inflexibility. The high cost stems from the specialized facilities and handling equipment, which are designed to handle much larger, deep-sea vessels. The inflexibility stems from Customs' regulations and resulting, cumbersome processing at the terminal's gates. For the coastal system to become competitive with trucks, it should be based on domestic terminals that function as an integral extension of the highway system. The terminals should be dedicated to handling the smaller, shallow draft coastal fleet and only include the most basic facilities and limited handling equipment (if any). Gate procedures should be minimal and both the gate and berth available for operations 24 hours a day at no additional charge. All cargoes should be on wheels and readily available. Under these conditions, handling costs at such terminals are estimated at $40 - 50, which is similar to costs at truck terminals in the hinterland, but three to four times lower then charged at deep-sea terminals.

The coastal range selected for analysis is the East Coast of the U.S., Canada and Mexico, the NAFTA countries that established simplified custom and trade procedures. The ports of call included in the analysis are: Halifax, Canada, Boston, New York, Norfolk, Charleston, Miami, New Orleans, Houston and Tuxpan, Mexico. Two service patterns were defined as examples for a detailed quantitative analysis: (a) a two-port, New York / Miami shuttle; and (b) a multiport loop, including New York / Norfolk / Charleston / Miami.

VI.3 MARKET POTENTIAL AND COMPETITION

Detailed data on truck traffic, especially on the I-95 corridor for which the quantitative examples are attempted, were unavailable. The only available data were derived from secondary sources, mainly tonnage movements between coastal regions. Analysis of these data indicated that most of the traffic is intra-regional, while the inter-regional traffic, especially between far apart regions for which coastal shipping may be attractive, were limited. For example, while the traffic within the New York region amounted to 2,500 trucks/day, the traffic between New York and Miami was estimated at only 100 trucks/day in each direction.

A survey of trucking rates as of summer 1999 indicated that the rate per mile was $1.3 - 1.5 for long distances and up to $3.2 for short distances in congested areas such as the Baltimore - Boston corridor. Truck lines also used rail, mainly for long distances, with the so-called intermodal rate, quoted at about $0.20 lower than the all-truck rate. The selection of rail services was, however, limited. The total charge for the trip between New York and Miami was about $2,000 for all-truck and $1,700 for intermodal (truck & rail).

The potential market for coastal shipping is the inter-regional traffic that currently moved by trucks. From discussions with the industry it became apparent that only a coastal service with a truck-like service in terms of trip times and service frequency can induce meaningful traffic generation for this waterborne option. Cost saving alone, even drastic, will not move traffic from the land to the water mode. The coastal shipping service should be provided as an integral part of trucking, very similar to that of the intermodal rail. Coastal shipping should provide the long distance haulage and trucks the local drayage on the two ends. In such setting, the main users and beneficiaries of coastal shipping would be truck lines. Coastal shipping will simply expand the truck lines' intermodal options, especially in regions where rail services are unavailable or track capacity is taken by passenger trains.

Presently, trucks' intermodal services that use rail are provided on a daily basis. Hence, a major factor for the integration of coastal services with the trucking system is also to have a daily (or higher) frequency.

VI.4 COST AND PERFORMANCE ESTIMATES

A cost and performance model was developed to assess the 5 selected vessels. The first series of calculations addressed a prospective shuttle service between New York and Miami. The traffic on this route is somewhat limited, at about 100 trailers/day. It is assumed that a reasonable estimate of market share for the coastal service should not be beyond the 20 - 30% range. In this case, the service could only be provided by the smallest capacity vessel, the 44-trailer catamaran, which also might be partially loaded. This vessel, however, was also proven to be most expensive, with cost of about $ 2.2 per mile. The next lowest capacity vessel, the high-speed monohull, would require a load of 80 trailers/day in each direction to provide daily frequency on a non stop New York / Miami shuttle service.

A multiport service has a 3-4 times larger traffic potential. But, because of the additional port calls, multiport is about 20% more expensive and has 15% longer trip times than a shuttle. Still, even the larger multiport potential is insufficient to fill the capacity of the barge, Lo/Lo and fast Ro/Ro on a daily basis. Also, because of the extra calls, trip times of these slower vessels would be much longer than those offered by trucks.

The only vessel type that could be considered viable for the coastal service is then the high-speed monohull. This vessel seems to posses the "right" combination of speed, capacity and cost. Cost calculation of a multiport service of this vessel yielded an average of about $1.33. Suggested rates, assuming 20% for overhead and profit, could be based on $1.60 per mile. The trip time for a New York / Miami trip using high-speed monohull would be 60 hours (2.5 days) and priced at about $1,950, which are similar to those of trucking. This cost figure is based on port cost of $40 per trailer for a Ro/Ro handling.

With comparable costs and service levels, coastal shipping services could fit well with trucking, offering additional intermodal choices. Hence, coastal shipping has the potential to reduce road congestion. Also, it has apparent environmental and safety advantages.

VI.5 OVERALL SERVICE STRUCTURE

The envisioned service structure for the East Coast range could consist of three multiport loops: (a) North Loops, between New York and Halifax; (b) Central Loop, between New York and Miami; and (c) Gulf Loop, between Miami and Tuxpan. Each loop could employ vessels with different capacities, depending on traffic density. The schedules of the loops should be coordinated, to allow for fast inter-loop transfer in case of longer trips (e.g., Boston to Tuxpan). The longer trips are the most attractive in financial terms.

A preliminary calculation indicates that 16 vessels are needed for the entire 3-loop coastal system to provide a comprehensive service with a daily frequency. Such a coastal system will also require a network of 9 domestic terminals. The initial investment in vessels is estimated at $700 million and in terminals at $90 million, or a total of about $790 million. If only one loop is considered, for example the Central Loop (New York / Miami), the investment cost is reduced to $285 million, still a significant investment and a high threshold for implementation.

While the service of the proposed coastal system is based on daily frequency, with future increase in road congestion, the coastal system may be expanded by enhancing its frequency to 2/day and even higher. Higher frequency, in turn, further enhances the system's competitiveness. Higher frequency will also facilitate the development of a more sophisticated service pattern, based on counter-rotating loops, resulting in shorter trip times (Figure 39).

VI.6 IMPACT ON ROAD CONGESTION

The annual traffic that a basic coastal shipping system with a daily frequency could handle is about 234,000 truck trips per year. An expansion of coastal shipping is foreseen in a number of coastal segments along I-95 in the East Coast, I-5 in the Gulf, and I-5 in the West Coast. Especially congested is Northeast segment of I-95, between Norfolk and Boston. This segment also has limited track capacity for rail service, since most of it is dedicated to passenger trains. Once the coastal infrastructure has been developed in this region, it is reasonable to expect that the service frequency may be enhanced to 3 and 4 per day. Some of the services in this segment may also be expanded to secondary ports such as Brooklyn (NY), Philadelphia, Baltimore (using the C&D Canal), Washington D.C., etc. Hence, the impact of the expanded system on the most congested coastal highways is expected to be significant.

A system based on two counter-rotating loops serving the Atlantic Coast between New York and Miami will handle 467,000 truck-trips/year. Since most of these trips are long distance, they amount to 75 million truck-miles/year, which are about 14% of the total highway traffic (Reebie data).

VI.7 MILITARY APPLICATIONS

The high-speed monohull vessel has the most promising potential for military utilization, since it posses two essential characteristics: high speed and Ro/Ro handling system. If the coastal service is fully implemented, the military will have a fleet of 13 active, modern vessels and the respective personnel of highly-trained seafarers. A twice-daily system will involve 26 vessels and their respective crews. The vessels, however, do not meet the specific military requirements as listed in recent report "Potential DOD Use of Commercial High – Speed Sealift", by Stanely Associates, Inc., 1999. Their speed, at 28 knots, is below the required 35 - 40 knots, their capacity at 4,000 DWT is smaller than 6,000 DWT and their range in the commercial service of 1,000 NM is shorter than 3,500 NM. Simply put, the commercially viable coastal vessels are slower and smaller than what the military defined as ideal for cross-ocean deployment of mobilized resources.

An interesting solution could be to fit the coastal vessels with "dormant" features that will only be activated during the military application, such as additional engines, fuel tanks, etc. These features, however, may add to operating cost and adversely affect performance.

VI.8 RECOMMENDATIONS

The overall conclusion of this study is that coastal shipping is viable in the U.S. -- but only under certain conditions. A viable coastal system should be based on:

a) a coastwise network of low cost domestic terminals located, desirably, adjacent to deep-sea terminals;

b) a fleet of high-speed monohull vessels with reduced manning;

c) a service pattern based on highly-coordinated multiport loops; and

d) an institutional setting similar to that of the present intermodal, rail-based services.

The system as defined above is new, innovative and involves high initial investments in vessels and terminals. This study, being the first attempt to explore the new system, is limited to conceptual definition and preliminary calculations. Further efforts are required to study and implement the system.

Next efforts should focus on the following key subjects:

- Collection and analysis of more detailed and comprehensive data on truck and rail traffic in the coastal areas;
- Detailed evaluation of market segments, including estimates of cargo generation potentials by coastal ranges and port pairs;
- Development of the institutional concept in cooperation with the trucking industry, the main user and beneficiary of the system;
- Assessment of social and economic external impact generated by coastal system, including environmental and safety benefits, reduction of road congestion and delays and reduction of investments in road expansion; and
- Reevaluation of possible system contribution to the defense needs, especially in light of the recent dwindling of the U.S.-flag fleet and availability of experienced seafarers.

The ultimate success of the coastal system will largely depend on ability to create an effective coalition of its many stakeholders, including truckers, ports, carriers, shipbuilders and related Federal and local governmental agencies.

Appendix A

Cost Model Outputs

A.1 Northern Loop Commuter Service

A.2 Central Loop Commuter Service

A.3 Gulf Loop Commuter Service

A.4 Counter-Rotating Loops Service Parameters for HS Monohull Ro/Ro Vessel

A.1 Northern Loop Commuter Service

Route Parameters

Itinerary	New York - Boston - Halifax (and back)
Ports in Itinerary	4
Total Distance (nautical miles)	1,532
Frequency	Daily

Simulation Assumptions

Vessel Capacity Utilization	80%
Multiplier / Cargo Exchanged at Ports	6.00

Vessel / Port Parameters

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Service Speed	Knots	25.6	20.2	21.6	14.0	9.0
Capacity	Trailers	44	100	185	250	250
Handling Rate	Moves/Hour	30	30	30	20	20
Handling Cost	$/Move	40	40	40	60	60
Port Entry/Exit Time	Hours	0.5	0.5	0.5	1	1.5

Calculation of Service Parameters

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Cargo Exchanged at Terminals	Trailers	211	480	888	1,200	1,200
Total Loading/Unloading Time	Hours	8.00	16.00	30.00	60.00	60.00
Total Port Entry/Exit Time	Hours	4.00	4.00	4.00	8.00	12.00
Total Time at All Ports In Route	Hours	12.00	20.00	34.00	68.00	72.00
Travel Time	Hours	59.94	75.99	70.93	109.43	170.22
Round-Trip Transit Time	Hours	71.94	95.99	104.93	177.43	242.22
(Time in Ports + Travel Time)	Days	3.00	4.00	4.37	7.39	10.09
Gross Round Trip Transit Time	Hours	71.94	95.99	104.93	177.43	242.22
(With Slack Coefficient Included)	Days	3.00	4.00	4.37	7.39	10.09
Vessels for Daily Service	Vessels	3	4	5	8	11

Service Deployment Costs

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Trips per year	trips/year	121.7	91.3	73.0	45.6	33.2
Fixed cost	$/trip	76,808	124,720	105,853	140,333	139,230
Variable cost - at sea	$/trip	34,062	43,065	48,939	26,263	15,629
Variable cost - at port	$/trip	682	1,133	2,346	1,224	-
Total cost	$/trip	111,551	168,918	157,138	167,820	154,859
	$/trailer-nm	2.07	1.38	0.69	0.55	0.51

Output

		HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Vessels for Daily Service	Vessels	3	4	5	8	11
Slack Time	Hours	0	0	15	15	22
Cost per trailer-nm	$/trailer-nm	2.07	1.38	0.69	0.55	0.51
Idle Time Percentage (idle / voyage time)		0%	0%	13%	8%	8%

A.2 Central Loop Commuter Service

Route Parameters

Itinerary	New York - Norfolk - Charleston - Miami (and back)
Ports in Itinerary	6
Total Distance (nautical miles)	2,314
Frequency	Daily

Simulation Assumptions

Vessel Capacity Utilization	80%
Multiplier / Cargo Exchanged at Ports	6.70

Vessel / Port Parameters

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Service Speed	Knots	28.4	24.2	21.6	14.0	9.0
Capacity	Trailers	44	100	185	250	250
Handling Rate	Moves/Hour	30	30	30	20	20
Handling Cost	$/Move	40	40	40	60	60
Port Entry/Exit Time	Hours	0.5	0.5	0.5	1	1.5

Calculation of Service Parameters

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Cargo Exchanged at Terminals	Trailers	235	536	991	1,340	1,340
Total Loading/Unloading Time	Hours	8.00	18.00	34.00	67.00	67.00
Total Port Entry/Exit Time	Hours	6.00	6.00	6.00	12.00	18.00
Total Time at All Ports In Route	Hours	14.00	24.00	40.00	79.00	85.00
Travel Time	Hours	81.36	95.65	107.13	165.29	257.11
Round-Trip Transit Time	Hours	95.36	119.65	147.13	244.29	342.11
(Time in Ports + Travel Time)	Days	3.97	4.99	6.13	10.18	14.25
Gross Round Trip Transit Time	Hours	95.36	119.65	147.13	244.29	342.11
(With Slack Coefficient Included)	Days	3.97	4.99	6.13	10.18	14.25
Vessels for Daily Service	Vessels	4	5	7	11	15

Service Deployment Costs

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Trips per year	trips/year	91.3	73.0	52.1	33.2	24.3
Fixed cost	$/trip	103,447	158,468	148,195	192,958	189,860
Variable cost - at sea	$/trip	60,384	85,508	73,919	39,669	23,606
Variable cost - at port	$/trip	1,039	2,145	2,760	1,422	-
Total cost	$/trip	164,870	246,121	224,874	234,048	213,466
	$/trailer-nm	2.02	1.33	0.66	0.51	0.46

Output

		HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Vessels for Daily Service	Vessels	4	5	7	11	15
Slack Time	Hours	1	0	21	20	18
Cost per trailer-nm	$/trailer-nm	2.02	1.33	0.66	0.51	0.46
Idle Time Percentage (idle / voyage time)		1%	0%	12%	7%	5%

A.3 Gulf Loop Commuter Service

Route Parameters

Itinerary	Tuxpan-Houston-NOLA-Miami (and back)
Ports in Itinerary	6
Total Distance (nautical miles)	3,302
Frequency	Daily

Simulation Assumptions

Vessel Capacity Utilization	80%
Multiplier / Cargo Exchanged at Ports	6.70

Vessel / Port Parameters

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Service Speed	Knots	31.3	22.9	21.6	14.0	9.0
Capacity	Trailers	44	100	185	250	250
Handling Rate	Moves/Hour	30	30	30	20	20
Handling Cost	$/Move	40	40	40	60	60
Port Entry/Exit Time	Hours	0.5	0.5	0.5	1	1.5

Calculation of Service Parameters

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Cargo Exchanged at Terminals	Trailers	235	536	991	1,340	1,340
Total Loading/Unloading Time	Hours	8.00	18.00	34.00	67.00	67.00
Total Port Entry/Exit Time	Hours	6.00	6.00	6.00	12.00	18.00
Total Time at All Ports In Route	Hours	14.00	24.00	40.00	79.00	85.00
Travel Time	Hours	105.43	143.99	152.87	235.86	366.89
Round-Trip Transit Time	Hours	119.43	167.99	192.87	314.86	451.89
(Time in Ports + Travel Time)	Days	4.98	7.00	8.04	13.12	18.83
Gross Round Trip Transit Time	Hours	119.43	167.99	192.87	314.86	451.89
(With Slack Coefficient Included)	Days	4.98	7.00	8.04	13.12	18.83
Vessels for Daily Service	Vessels	5	7	9	14	19

Service Deployment Costs

	Unit	HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Trips per year	trips/year	73.0	52.1	40.6	26.1	19.2
Fixed cost	$/trip	130,540	220,766	190,536	245,583	240,489
Variable cost - at sea	$/trip	99,580	112,609	105,481	56,606	33,685
Variable cost - at port	$/trip	1,322	1,877	2,760	1,422	-
Total cost	$/trip	231,442	335,252	298,776	303,610	274,174
	$/trailer-nm	1.99	1.27	0.61	0.46	0.42

Output

		HS Cat	HS Mono	Fast Ro/Ro	Small Lo/Lo	Barge
Vessels for Daily Service	Vessels	5	7	9	14	19
Slack Time	Hours	1	0	23	21	4
Cost per trailer-nm	$/trailer-nm	1.99	1.27	0.61	0.46	0.42
Idle Time Percentage (idle / voyage time)		0%	0%	11%	6%	1%

A.4 Counter-Rotating Loops Service Parameters for HS Monohull Ro/Ro Vessel

Technical Assumptions		
Capacity	100	trailers
Utilization	80%	
Port Handling Rate	30	trailers/hr
Port Handling Cost	40	$/trailer
Port Entry/Exit Time	0.50	hrs
Speed	24.19	knots
Average cost	1.33	$/trailer-nm
Overhead	20%	

Northern Loop

Cargo Exchanged

From / To	Halifax	Boston	New York
Halifax		25.0%	75.0%
Boston	0.0%		25.0%
New York	100.0%	0.0%	

Cargo Flows (trailers per trip)

From / To	Halifax	Boston	New York
Halifax		12	36
Boston	0		12
New York	48	0	

Distances (nm)

From / To	Halifax	Boston	New York
Halifax		380	600
Boston	380		386
New York	600	386	

Trip Times (hours)

From / To	Halifax	Boston	New York
Halifax		19	29
Boston	19		19
New York	29	19	

Calculation: At Sea + Port Exit/Entry + Port Handling

Trip Costs ($ per trailer)

From / To	Halifax	Boston	New York
Halifax		585	878
Boston	585		593
New York	878	593	

Calculation: 2*Port Handling + ($/nm)*distance

Suggested Rates ($ per trailer)

From / To	Halifax	Boston	New York
Halifax		702	1,054
Boston	702		712
New York	1,054	712	

Calculation: Trip cost * (1 + Overhead)

Central Loop

Cargo Exchanged

From / To	New York	Norfolk	Charleston	Miami
New York		25.0%	30.0%	45.0%
Norfolk	0.0%		12.5%	12.5%
Charleston	0.0%	0.0%		42.5%
Miami	100.0%	0.0%	0.0%	

Cargo Flows (trailers per trip)

From / To	New York	Norfolk	Charleston	Miami
New York		20	24	36
Norfolk	0		10	10
Charleston	0	0		34
Miami	80	0	0	

Distances (nm)

From / To	New York	Norfolk	Charleston	Miami
New York		294	723	1,010
Norfolk	294		429	863
Charleston	723	429		434
Miami	1,010	863	434	

Trip Times (hours)

From / To	New York	Norfolk	Charleston	Miami
New York		16	37	48
Norfolk	16		21	43
Charleston	37	21		23
Miami	48	43	23	

Trip Costs ($ per trailer)

From / To	New York	Norfolk	Charleston	Miami
New York		471	1,042	1,423
Norfolk	471		651	1,228
Charleston	1,042	651		657
Miami	1,423	1,228	657	

Suggested Rates ($ per trailer)

From / To	New York	Norfolk	Charleston	Miami
New York		565	1,250	1,708
Norfolk	565		781	1,473
Charleston	1,250	781		789
Miami	1,708	1,473	789	

Gulf Loop

Cargo Exchanged

From / To	Miami	N. Orleans	Houston	Tuxpan
Miami		25.0%	30.0%	45.0%
N. Orleans	0.0%		12.5%	12.5%
Houston	0.0%	0.0%		42.5%
Tuxpan	100.0%	0.0%	0.0%	

Cargo Flows (trailers per trip)

From / To	Miami	N. Orleans	Houston	Tuxpan
Miami		16	19	29
N. Orleans	0		8	8
Houston	0	0		27
Tuxpan	64	0	0	

Distances (nm)

From / To	Miami	N. Orleans	Houston	Tuxpan
Miami		741	1,177	1,355
N. Orleans	741		436	909
Houston	1,177	436		473
Tuxpan	1,355	909	473	

Trip Times (hours)

From / To	Miami	N. Orleans	Houston	Tuxpan
Miami		34	55	61
N. Orleans	34		20	44
Houston	55	20		24
Tuxpan	61	44	24	

Trip Costs ($ per trailer)

From / To	Miami	N. Orleans	Houston	Tuxpan
Miami		1,066	1,645	1,882
N. Orleans	1,066		660	1,289
Houston	1,645	660		709
Tuxpan	1,882	1,289	709	

Suggested Rates ($ per trailer)

From / To	Miami	N. Orleans	Houston	Tuxpan
Miami		1,279	1,974	2,259
N. Orleans	1,279		792	1,547
Houston	1,974	792		851
Tuxpan	2,259	1,547	851	

Cost / Time Matrix

From / To	Boston	New York	Norfolk	Charleston	Miami	N. Orleans	Houston	Tuxpan
Halifax	$702 19 hrs	$1,054 29 hrs	$1,619 45 hrs	$2,304 66 hrs	$2,762 77 hrs	$4,040 111 hrs	$4,736 132 hrs	$5,020 138 hrs
Boston		$712 19 hrs	$1,277 35 hrs	$1,962 56 hrs	$2,420 67 hrs	$3,699 101 hrs	$4,395 122 hrs	$4,679 128 hrs
New York			$565 16 hrs	$1,250 37 hrs	$1,708 48 hrs	$2,987 82 hrs	$3,682 103 hrs	$3,967 109 hrs
Norfolk				$781 21 hrs	$1,473 43 hrs	$2,752 78 hrs	$3,448 98 hrs	$3,732 105 hrs
Charleston					$789 23 hrs	$2,067 57 hrs	$2,763 77 hrs	$3,047 84 hrs
Miami						$1,279 34 hrs	$1,974 55 hrs	$2,259 61 hrs
N. Orleans							$792 20 hrs	$1,547 44 hrs
Houston								$851 24 hrs

Appendix B

Advisory Group

1. **Alabama State Docks Department**
   Mr. E. G. Browning, Jr.
   Docks General Manager/Chief Operating Officer
   P.O. Box 1588
   Mobile, AL 36633-1588
   334/441-7201 o.
   334/441-7149 fax

2. **Port Authority of New York and New Jersey**
   Mr. Robert Beard
   Manager, Business Development Division
   Port Commerce Department
   One World Trade Center
   New York, NY 10048
   212/435-6547 direct line
   212/435-2309 fax

3. **Massachusetts Port Authority**
   Mr. Franklin B. Wellock
   Manager, Contract and Regulatory Affairs
   Contract and Regulatory Affairs
   One Harborside, Suite 200-SA
   E. Boston, MA 02128-2909
   617/946-4413 o.
   617/946-4422 fax

4. **Virginia Port Authority**
   Mr. John D. Covaney
   Senior Managing Director of Marketing
   600 World Trade Center
   Norfolk, VA 23510
   757/683-8000 o.
   757/683-8500 fax

5. **South Carolina State Port Authority**
   Mr. J. Michael Westerfield
   General Manager Cargo Sales
   P.O. Box 22287
   Charleston, SC 29413-2287
   843/723-8651 o.
   843/577-8710 fax

6. **Port of Miami**
   Mr. Charles A. Towsley
   Port Director
   1015 North America Way
   Miami, FL 33132-2081
   305/371-7678 o.
   305/493-1214 fax

7. **Port of Jacksonville**
   Mr. Rick Ferrin
   Vice President of Marine Division
   2831 Talleyrand Avenue
   Jacksonville, FL 32206
   904/630-3080 o.
   904/630-3099 fax

8. **National Shipbuilders Association**
   Mr. Alan Walker, Executive Director
   1600 Wilson Boulevard
   Rosslyn, VA 22209
   703/351-6734 o.
   703/351-6736 fax

9. **Hale Transportation**
   Mr. Steven Ferrand
   Senior Vice-President, Sales
   1801 South Clinton Street
   Baltimore, MD 21224
   410/342-1500 ext. 4204
   410/342-5300 fax

10. **Crowley AmericanTransport**
    Mr. Norman Gauslow
    General Manager Marine Operations
    P.O. Box 2110
    Jacksonville, FL 32203
    904/727-2200 o.
    904/727-4158 fax

11. **Sea Star Line, LLC**
    Mr. Michael Shea, President
    9485 Regency Square Boulevard
    Suite 400
    Jacksonville, FL 32225
    904/855-1260 o.
    904/724-3011 fax

12. **U.S. Department of Transportation**
Federal Highway Administration
Mr. Estefan Natzke
Office of Environment and Planning
Intermodal and Statewide-Programs Division
400 7th Street, S.W. - Room 3301
Washington, D.C. 20590
202/366-0150 o.
202/366-7660 fax

13. **Trailer Bridge, Inc.**
Mr. John McCown
Chairman and CEO
660 Madison Ave., 10th Floor
New York, NY 10021
213/935-9022 o.

14. **Trailer Bridge, Inc.**
Mr. Ralph Heim
President and COO
10405 Newberlin East
Jacksonville, FL 32226
1-800-554-1589 o.
904/751-7444 fax

15. **Columbia Coastal Transport**
Mr. Tom Delaney
Senior Vice-President
100 Walnut Street
Clark, NJ 07066
732/827-0300 o.
732/827-0042 fax

16. **Lt. Commander John Meier, III**
Transport Policy Officer
USTRANSCOM/TCJ5-SC
508 Scott Drive, Room 120
Scott Air Force Base, IL 62225-5357
618/256-5109 o.
618/256-7957 fax

17. **Bollinger Shipyard**
Mr. Marc Stanley, Vice-President
600 New Hampshire Ave., N.W.
Suite 1000
Washington, D.C. 20037
202/965-0807 o.
202/298-9109 fax

18. Kvaerner Masa Marine Inc.
Mr. John Avis, President
201 Defense Highway, Suite 202
Annapolis, MD 21401
301/970-2226 o.
301/970-2230 fax
E-mail: kmmu2@aol.com

19. Port of Philadelphia and Camden, Inc.
Mr. Raymond Heinzelmann
Deputy Director
3460 N. Delaware Avenue, Suite 200
Philadelphia, PA 19134
215/427-8304 direct line
213/426-2441 general number
215/426-2447 fax

20. Passenger Vessel Association
Mr. Edmund B. Welch
Legislative Director
1600 Wilson Boulevard, Suite 1000A
Arlington, VA 22209
703.707-0100 o.
703/807-0103 fax

21. Matson Navigation Company
Mr. Phillip M. Grill
Vice President
1735 New York Ave., N.W.
Suite 500
Washington, D.C. 20006-4759
202/662-8455 o.
202/331-1024 fax

22. Apex Marine Ship Management Company, LLC
Mr. Robert N. Kunkel
Director Marine Operations
2001 Marcus Avenue, Suite N-215
Lake Success, NY 11042
516/775-6700 o. (Ext. 3021)
516/775-6784 fax (E-mail: apexmar@idt.net)

23. State of Alaska
Alaska Marine Highway System
Captain Robert J. Doll
General Manager
3132 Channel Drive
Juneau, Alaska 99801

24. Captain Stephen Kosinski
CEO of U.S. Fast Packet Line, Inc.
80 Sillimanville Road
East Hampton, CN 06424-2338
860/267-1113 o.
860/647-1800 fax.

25. Sause Bros. Ocean Towing Co., Inc.
Mr. John Sweet
3710 N.W. Front Avenue
Portland, OR 97210
503/222-1811 o.
503/222-2010 fax.