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16. Abstract

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The Impact of Modifying the Jones Act on US Coastal Shipping

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ABSTRACT

This study assesses exempt coastal shipping defined as exempted from the US-built stipulation of the Jones Act, operating with functional crews and exempted from Harbor Maintenance Tax (HMT). The study focuses on two research questions: (a) the impact of the US-built exemption on the cost of coastal shipping; and (b) the competitiveness of exempt services. The assessment is based on three typical case studies, the first two involving domestic cargoes (containers and trailers), referred to as Domestic Long and Short and provided by RoRo (Roll-on, Roll-off) ships; the third involving international cargo (ISO containers), referred to as Feeder Short and provided by LoLo (Lift-on, Lift-off) ships.

The analysis begins with reviewing coastal shipping and, especially, recent studies of it, followed by specification of the case studies, including rationale, routes, ships, and ports. A special section is devoted to a review of various types of ships, their construction cost in the US and abroad, and their crewing requirement. Then, an operating/cost model is employed for calculating required freight rates for the shipping services. These rates are compared to those charged by alternative truck and rail services along with their respective service level (trip time and frequency). A complementary assessment was conducted regarding future developments that may favor or disfavor coastal shipping. A brief comparative review of the US and the European coastal (short-sea) shipping concludes this study.

The study finds that building the selected ships in foreign yards could save about 40% of the capital cost of the RoRo ships and 60% for the LoLo ships. However, due to favorable financing terms available for using US shipyards (Title XI), the reductions in door-to-door required freight rates would only amount to 13%, 11%, and 4% respectively.

The study also finds that none of the exempt coastal-shipping systems in the case studies would be competitive: the Domestic-Long has a significantly higher cost and much more limited scope of services than IM rail; the Domestic-Short has insufficient port-to-port traffic potentials; and the Feeder-Short has significantly higher cost than trucks, stemming from high port cost. The researchers believe that the study's findings can be generalized to conclude that exempt coastal shipping of containers and trailers in the US is unviable.

The study concludes with a brief comparison between the US and European setting regarding coastal shipping, suggesting that because of fundamental differences one should not infer from the success of European short-sea shipping to a probable success for US coastal shipping.

There is no implementation potential. The study is concerned with a proposed modification to the Jones Act and related policies regarding coastal shipping. The findings of the study do not indicate a need for such a modification or a respective implementation.

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IMPLEMENTATION STATEMENT

The study is concerned with a proposed change in the Jones Act and related policies regarding coastal shipping. Since the findings of the study do not indicate a need for such a change, there are no foreseen implementations.

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BACKGROUND AND OBJECTIVE

Jones Act, US-Flag Ships and Domestic Shipping

The subject of this study is assessing the impact of granting a waiver from the US-built stipulation of the Jones Act to coastal services along the Atlantic and Gulf Coasts of the US. The Jones Act, the informal name of Section 27 of the Merchant Marine Act of 1920, relates to goods and passengers transported by water between US ports, defined as *domestic trades* or cabotage. The shipping system that handles these trades is defined as *domestic shipping*. The Jones Act mandates that all domestic shipping shall be exclusively provided by US-flag ships, defined as ships fulfilling four stipulations: (a) owned by US citizens; (b) crewed by US citizens or permanent residents; (c) constructed by US shipyards; and (d) operated under US laws and regulations.

While originally directed at domestic shipping, the Jones Act affects many other water-related activities in the territorial waters of the US. Oil-drilling rigs and the supply boats that serve them, dredgers employed in ports' channels, tug boats used for ship assist in deep-water ports and inland waterways, and ships involved in marine salvage -- all are required to be US-flagged. Also, the 1954 Cargo Preference Act, an amendment to the original Jones Act, stipulates that only US-flag ships can handle government cargoes, mainly relief cargo sent to developing nations. Finally, the 2004 Maritime Security Program mandates that US-flag ships should handle Department of Defense cargoes, mainly troops, military equipment, and supplies destined to foreign countries. Altogether, the Jones Act fleet includes 89 ships operating in US foreign trades, 100 ships in domestic trades, and 38,000 vessels in US inland waterways and the Great Lakes. The subject of this study, granting a Jones Act waiver to coastal shipping of containers and trailers, involves only a very small and well defined segment of the water-related activities subject to the Jones Act. The limited scope of coastal shipping makes granting such a waiver plausible, at least in theory.

Open-Sea vs. Inland-Waterway Domestic Shipping

This study is concerned with one of the original activities included in the Jones Act; domestic shipping of freight. Domestic shipping is commonly divided into two segments:

- ***Open-Sea Services*** **–** Involving routes outside the mainland US, in unprotected water; and
- ***Inland-Waterway Services*** **–** Involving routes within the mainland US, in harbors, lakes, rivers, and artificial waterways.

Because of the difference in navigation conditions, vessels involved in the two segments are different. In Europe, however, there are services defined as Sea-River that combines legs in open sea and rivers; for example, a service between ports in the lower Rhine River and the UK. There also was one, unsuccessful, attempt in the US to develop such a service between the Mississippi River and Mexico. Sea-River services are quite rare, however. Accordingly, this study is only concerned with open-sea shipping. In this respect it should be noted that a previous study on Inland Waterways Containerships found that the Jones Act has limited impact on the inland-waterway shipping segment *[1]*.

Coastal vs. Offshore Domestic Shipping

The open-sea segment of domestic shipping includes two types of services:

- ***Offshore Services*** **–** Involving routes between the mainland and off-shore US states and territories such as Puerto Rico, US Virgin Islands, Alaska, Hawaii, and Guam; and,
- ***Coastal Services*** **–** Involving routes along the coast line of Mainland US, between ports in the Atlantic, Gulf and Pacific Coasts. Another often-used term is contiguous and non-contiguous trade routes.

There is little technical difference between ships involved in these two types of domestic shipping services, since both include navigation on the open sea. There is a major difference between the two in terms of competition, however. Coastal services face modal competition from land-based transportation services by truck, rail, or their combination. This is not the case with offshore shipping services which do not face land-based competition. As a result, while presently there are no coastal shipping services in the US, there is a well-developed system of off-shore shipping services provided by Jones-Act ships.

Jones Act and Offshore Domestic Shipping

Offshore domestic shipping is perceived as high cost, mainly because of the Jones Act, and therefore as adversely impacting the economies of the US offshore states and territories dependent on it. Recently, there have been several initiatives to allow a waiver of the Jones Act to offshore domestic shipping of containers and trailers, or even to overhaul the entire Act. Such a change, well beyond that contemplated here, would require a comprehensive legislative action *[2]*. Political predictions regarding future legislature is not part of the scope of this study; still it seems unlikely that a comprehensive overhaul of the Jones Act will take place in the near future in light of the powerful opposition that it may face. This observation is bolstered by the substantial investment in newbuildings recently undertaken by several Jones Act carriers (see Tote's Newbuilding). Hence, for all practical purposes, it can be assumed that offshore services will continue to be provided by Jones Act ships at least in the foreseeable future. To restate, this study only relates to a Jones Act waiver for a very narrow shipping segment of US domestic shipping: coastal shipping of containers and trailers.

Objection from Offshore Domestic Lines

Presently, there is a well-developed system of offshore services between the Atlantic, Gulf Coasts, Puerto Rico, and US Virgin Islands – but there are no coastal services along the Atlantic and Gulf Coasts. It seems, therefore, that there should be no reason for Jones Act operators providing offshore services to object to the granting of a Jones-Act waiver to coastal services since, apparently, they are not interested in providing along-coast services with their Jones-Act ships. Still, there is at least a theoretical possibility that these domestic lines may be interested in the future in providing coastal services. A decision by domestic lines to employ their present US-flag ships to provide coastal services would eliminate the need to modify the Jones Act, the subject of this study. The researchers believe that is not a realistic option.

An industry survey conducted by the researchers during the summer in 2013 indicated that offshore US services are mostly provided by four major lines: Horizon Lines, Sea Star (Tote's subsidiaries), Trailer Bridge and Crowley. These lines employ a total of 17 US-flag ships and barges of various sizes in these services. In June 2013 there also was an announcement of an additional, single-ship service by National Shippers of America (NSA). The above-mentioned lines employ old, inefficient and high-cost US-flag ships on their mainland / Puerto Rico trade route. In the survey, the researchers found that Horizon Lines, currently the largest shipping line operating on this trade route, employed the 1973 Horizon Trader, with dimensions of 248 x 29 x 9.1 m (LOA x beam x draft), 31,495 dwt and 2,139 TEUs, equipped with an fuel-inefficient steam-turbine main engine and a 30-man crew. Sea Star employed the 1974 Sea Star's El Faro, reconstructed in 1992/2006, with dimensions of 241 x 28 x 8.5 m, 17,300 dwt and 1,200 TEUs, with a 26-man crew. Crowley and Trailer Bridge, the two other lines in this trade, employed slow tug- barge pull combinations, with some of the barges constructed in the early 1970s. Even the newcomer, NSA, employed National Glory, a small containerships, with dimensions of 149 x 22 x 7.5 m, 12,500 dwt and 373 TEUS, built in 1988. All these ships, although actively employed on offshore services, should be considered as "historical," since the economic life of ships is usually 20 – 25 years. Moreover, in recent years, ship technology has undergone major developments including hull shape, types of engine, automation, and respective manning. The only reason these historical and very expensive ships are still employed is the high cost of replacing them by new Jones Act ships (newbuildings). Likewise, unlike coastal services, offshore services face no competition from land-based services of trucks and rail. The reason for not having coastal services based on existing Jones Act ships is simply their high cost, which is much higher than competing land-based services. Since this situation is unlikely to change even with the newbuilding (see below), it is not reasonable to expect that any of the lines involved in offshore services will initiate coastal services employing its current or newbuilding fleet.

As noted above, some of these lines are currently involved in newbuilding programs. However, the new ships are expensive and are unlikely to reduce cost. Moreover, it seems that the tendency among domestic lines is to build relatively-large and fast LoLo ships, 3,100-TEU and 22ks in the case of Tote / Sea Star, which are not well suitable for coastal services (see section on Tote Newbuilding). Hence, there is no reason for present domestic lines solely involved in offshore service to oppose granting a Jones Act waiver to potential operators of coastal services. In fact, these lines could be the operators of coastal services employing foreign-built ships.

Hybrid Offshore and Coastal Services

The above section differentiates between offshore and along-shore or coastal services. There is, however, a possibility of combining the two, creating "hybrid services," consisting of offshore and coastal legs in a single service. For example, in June 2013, Horizon Lines added to its Houston/Puerto Rico service an intermediate port of call in Jacksonville, FL, but only in the eastbound direction. It seems that the reason for adding the Jacksonville call to this service has more to do with Horizon's desire to add a mid-week, Jacksonville/Puerto Rico departure to its currently weekend one, than with its desire to offer a Houston/Jacksonville coastal service. The addition by Horizon of a mid-week Jacksonville/Puerto Rico departure is mainly intended to substitute a past mid-week service discontinued in January 2013.

The new coastal service also takes advantage of an underutilized ship capacity. Apparently, Horizon is unable to fill the entire ship with Houston/Puerto Rico freight. Because this service is based on an underutilized leg, its rates could be priced competitively with land-based transport modes between Houston and Jacksonville despite its much longer route. The new service, referred to as Gulf Atlantic Express (GAX), is provided by a single ship, the 1,300-TEU Horizon Producer built in 1974, on a bi-weekly basis. Therefore, its level of service is low and overall capacity for handling containers between Houston and Jacksonville is limited. Likewise, the service uses international containers (see section on International vs. Domestic Cargo Unit). Figure 1 below shows the service map of Horizon, with the GAX marked in blue.

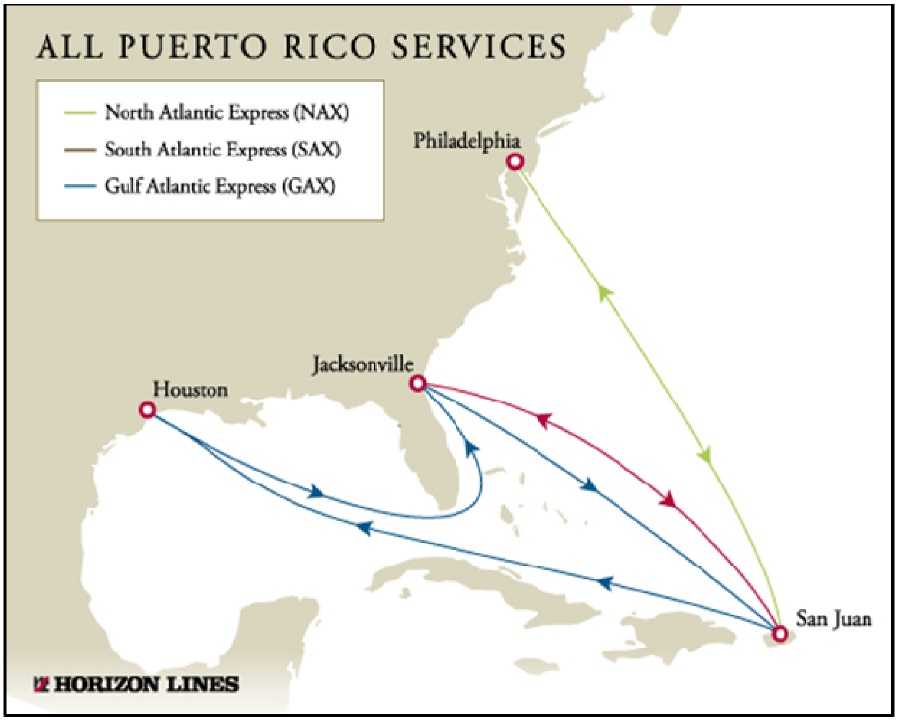

Figure 1
US mainland / Puerto Rico services of Horizon Lines

While this is the only instance of a hybrid coastal/offshore service at this time, similar services based on underutilized coastal legs and therefore priced at below full cost may evolve in the future following the newbuilding programs. For example, Horizon could add a Jacksonville call to its NAX service, as well as Crowley which operates a similar service. If this, indeed, is the case, it is reasonable to assume that domestic lines will object to competition from Jones-Act waived operators along these routes. Hybrid services, however, are not the subject of this study.

Coastal Services and International Trade

The previous sections addressed domestic shipping lines involved in domestic trades. In addition to domestic trades, coastal services could serve international trades. Coastal services in this case would function as extensions to deep-sea services handling international, marine containers based on International Standard Organization (ISO), as part of a global hub and spoke shipping system. The hub-and-spoke system consists of two types of services and ships: (a) deep-sea, mainline services employing large container ships, defined as “mother” ships, and only calling at “hub” ports; and (b) shorter, coastal services, employing smaller ships, defined as “feeder” ships, providing connections between hub ports and smaller coastal ports.

At present, there is no hub-and-spoke shipping in the US because most ports are directly called by mother ships. The conversion to a hub-and-spoke system may be triggered by the 2015 expansion of Panama Canal and the respective deployment of large post-Panamax ships on the Asia / US East and Gulf Coasts through-Panama trade route. Following a worldwide trend, the larger mother ships are likely to limit their call to hub ports, creating demand for feeder services between hub and regional ports. Another reason for reducing the number of direct calls might be the physical constraints of some ports especially in terms of channel depth and crane height (see section on Port of Boston).

Exempt Coastal Services

Definition of Exempt Coastal Shipping Services

The Jones Act mandates that all US domestic shipping shall be exclusively provided by US-flag ships, defined as ships fulfilling four stipulations: (a) owned by US citizens; (b) crewed by US citizens or permanent residents; (c) built by US shipyards; and (d) operated under US laws and regulations. The objective of this study is to assess the impact of the relaxation of the above stipulation (c) of the Jones Act, along with changes in ship crewing and exemption from some taxes, on the viability of coastal services of containers and trailers. There have already been several past cases in which such exemption from the Jones Act was granted, allowing reflagging of foreign-built ships.

The study's main hypothesis is that this relaxation will substantially lower the cost of coastal services, rendering them competitive with land-based services. This, in turn, will result in the development of new coastal services along the Atlantic and Gulf Coasts. The new coastal services are expected to be provided by self-propelled coastal ships, similar to those employed in Europe, distinguished by higher speed and better reliability than the tug-and-barge systems employed by past US coastal services.

More specifically, this study intends to examine the viability of ***exempt*** coastal shipping services, defined as those provided by:

- ***Foreign-built*** ships;
- Operated by US-based ***functional*** crews; and
- Exempted from Harbor Maintenance Tax (HMT).

The viability relates to the cost and level of service (mainly trip time and frequency) of the water-based services relative to competing land-based services along the same routes. The US-built waiver granted to operators of the water-based services is intended to level the field of competition between water-based and land-based transport systems. Land-based transport operators are not subject to the same restrictions as ship operators; they are free to operate foreign-built equipment. It should be emphasized that the exemption for US-built ***only*** relates to coastal ships handling containers and trailers and not to those handling other cargoes. In this study, trailers also encompass flat beds, straight trucks, car carriers and all types of cargoes on wheels. The US has a well-developed system of coastal shipping of liquid cargoes, especially petroleum and its products, with most recent newbuildings based on the Articulated Tug Barge (ATB) design, as will be discussed later.

Functional Crews

Although foreign built, all coastal ships of exempt service assessed in this study are registered in the US and crewed with US citizens and permanent residents, as stipulated by the Jones Act. The crew size, as will be further elaborated (see Crewing Cost), is determined according to the operational and safety requirements. It will be based on present crews of Jones Act tug-and-barge systems, especially ATBs, involved in coastal services for bulk cargoes. Likewise, the salary level of these crews will be in line with that presently paid by bulk services. It is also assumed functional crews for port operations and a level of salary similar to that in present terminals handling offshore Jones Act services.

LITERATURE REVIEW

American Marine Highway Program

Coastal shipping has been exhaustedly studied in the last 20 years, with many published reports. The most relevant of these studies were those supported by the American Marine Highway (AMH) program, managed by the Maritime Administration / Office of Marine Highways and Passenger Services. The studies financed by AMH grants were conducted by several consultants with whom we conducted in-depth interviews. The AMH system encompasses an envisioned, nation-wide network of coastal and inland waterways routes ("corridors"), with each route and respective water-based service named after the interstate parallel to it. Of the AMH's 32 routes, the two most relevant to this study are M-95 and M-10; the first refers to a coastal route along the Atlantic Coast and the second to that along the Gulf Coast. Figure 2 shows a schematic illustration of AMH's routes.

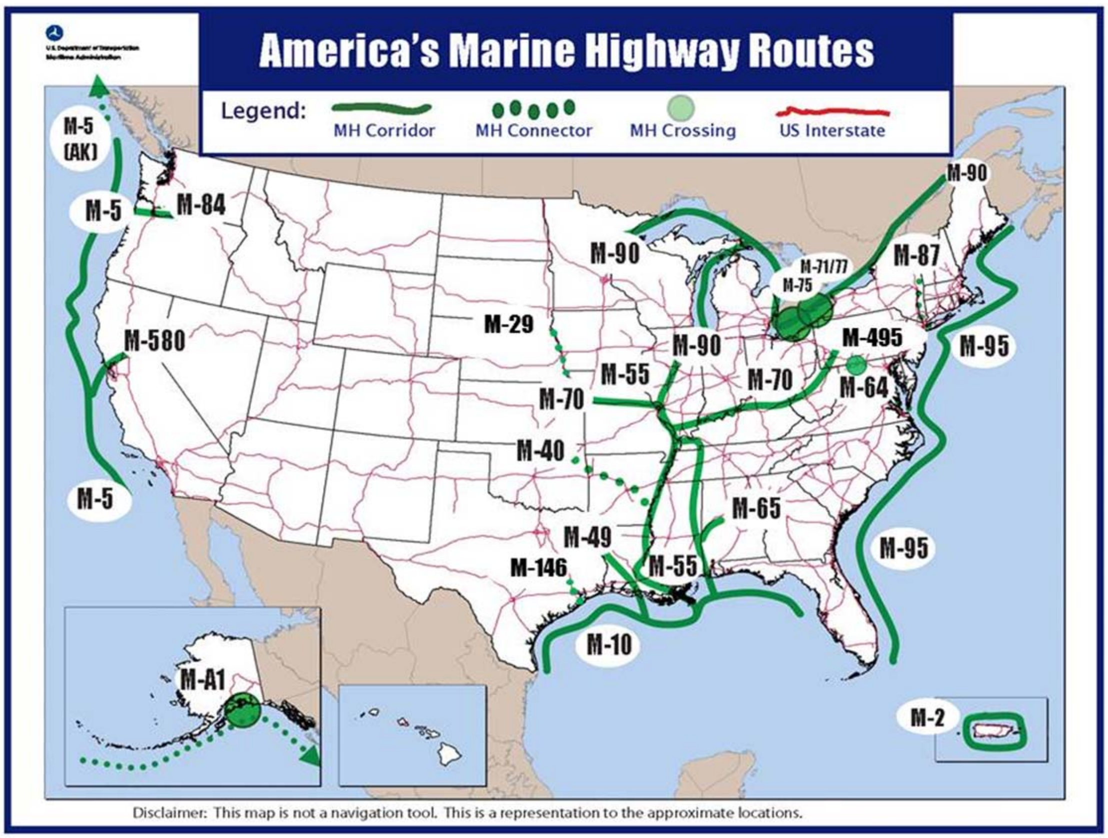

Figure 2
America's marine highway corridors

More recently, MARAD sponsored a comprehensive study dedicated to potential coastal services along M-95. The study was completed and a final report was submitted by its authors on June 2012, but not released yet (as of this writing) by MARAD. In this respect, it should be noted that since one of MARAD's main objectives is promoting US maritime industries, MARAD will not consider, and may even object to, any employment of foreign-built ships which, presumably, could substitute for US-built ones.

In addition to sponsoring studies, AMH has appropriated in Fiscal Year 2010 $7 million for capital investments. The largest portion of it, $4 million, was allocated to Port Manatee to provide SeaBridge, a Jones Act tug-barge service, with a second barge, to increase its frequency from once every 10 days to 5 days. As will be further described in a later section (see Seabridge – Domestic-Long), the prospects of having a second barge did not convince SeaBridge to continue operations and the service was terminated before the second barge was constructed.

Other Relevant Studies

Three studies in the long list included in Appendix A were found particularly relevant to this study:

- *America's Marine Highway Report to Congress*, MARAD, April 2011. The report is an interim summary of AMH's series of studies and respective workshops. The report does not provide feasibility assessments of specific services. It only describes the general concept and elaborates on the benefits of coastal shipping services, especially external benefits such as relieving road congestion and reducing air pollution. Because of these benefits, the report recommends that the Federal Government should support coastal services and suggests several initiatives that the government could undertake in this respect.

- *American Marine Highway Design Project*, Herbert Engineering Corp., October, 2011 (HEC). The report summarizes a comprehensive analysis of 11, dual-use, commercial and military ship designs. The technical part of the report includes the specifications of these designs along with estimated cost of building them in US shipyards. The economic part includes calculations of Required Freight Rates (RFR) for selected routes, comparing them with rates of alternative rail and truck services. The study's main finding is that for most Atlantic and Gulf Coast routes, water-based services by Jones Act ships are either marginally or not competitive with respective land-based services.

- *Comparison of US and Foreign-Flag Operating Costs*, PricewaterhouseCoopers, September 2011. The study was conducted for MARAD under instructions by the US Congress. Its main finding is that the average daily operating cost of a US-flag vessel is roughly 2.7 times that of a foreign-flag one. Operating cost mainly consists of crew (on-board labor) costs. The study does not address capital (construction) cost.

The authors also consulted their own study on coastal shipping:

- *High Speed Ferry and Coastwise Vessels: Assessment of a New York / Boston Service*, National Ports & Waterways Inst., University of New Orleans, April 2003, for the Center for the Commercial Deployment of Transportation Technologies. The study reviews several designs of coastal ships and assesses the feasibility of coastal services provided by them.

None of the above-mentioned studies and those included in Appendix A examines the possibility of waiving the US-built stipulation of the Jones Act, the subject of this study.

Need for Federal Support

A general observation, based on the above studies and other studies reviewed by the researchers, is that coastal, water-based services based on the Jones Act are not competitive with comparable land-based services. Put differently, all coastal shipping services included in past studies are found either unviable or marginally viable. This explains, indeed, why presently there are no coastal services in the US. Accordingly, the almost universal conclusion (and in some of them, also recommendation) of these studies is that without financial support by federal or local governments, coastal services will not be developed in the US. These studies claim that such support is justified by coastal shipping's external benefits: (a) environmental, mainly relieving road congestion and reducing air pollution; and (b) national security, providing military-useful ships in time of national emergency. This study assumes no financial support by Federal and local governments, except for the exemption from US-built of the Jones Act.

Main Sources of Information

As elaborated above, there have been many studies on the Jones Act and coastal shipping, including those conducted by members of this study team. These studies, especially the three noted above, serve as the initial source of information. In parallel, for this report the researchers conducted an exhaustive review of academic journals, industry publications, and trade magazines. The results are compiled according to the following categories: US Shipping Lines, Ship Design and Cost, Port Design and Cost, Cost of Capital and Taxation, Trucking, Railroads, Fuel and Environmental Regulations, and European Short-Sea.

While there have been many studies devoted to the Jones Act and coastal shipping in the US, none have specifically addressed the impact of the Jones Act modifications suggested here, namely exemption from US-built and functional crewing, on coastal shipping. The assessment of this impact is a complex undertaking, requiring insight gleaned from the experience of actual operators. Hence, the main source of information for this study is a series of in-depth interviews, face-to-face, by telephone, or via Skype, with present and potential operators of US-flag and foreign shipping lines, naval architects, port engineers, port authorities, terminal operators, truck lines, railroads, freight brokers and, especially, potential investors in new coastal-service ventures. The authors also conducted in-depth interviews with consultants and researchers who were involved in previous studies, among them MARAD's staff in charge of AMH and the project manager and key stuff involved in HEC study. Altogether, over 50 interviews were conducted for this report.

CASE STUDY SELECTION

Two-Related Research Questions

As already noted, this study intends to examine the viability of exempt coastal service. More specifically, the study is set to examine two related research questions:

(a) *What would be the "net effect" of US-built exemption?*
The net effect is measured in our study by the difference in the Required Freight Rate (RFR) of coastal services employing US and foreign-built ships. The term "net" indicates that the effect includes in addition to ship's construction cost ship's financing cost.

(b) *Would exempt coastal services be viable?*
Exempt coastal services are defined above as those operating foreign-built services with functional crews and with HMY waiver. The viability of these services is measured by their competitiveness with current land-based services along the same routes which, in turn, relates to their cost (RFR) and level-of-service.

Commercial Operations

This study only addresses the commercial aspects of the water and land-based services. Ship selection for the various coastal services is based on technical and commercial factors, ignoring the military-useful features which are pivotal in HEC study such as speed, service range, strength of decks, and self-sustainability. Accordingly, selected ships are based on the configuration deemed most suitable for their respective trade lanes. As a result, the preliminary review included many ship configurations, among them RoRo (Roll-on, Roll-off), LoLo (Lift-on, Lift-off), RoCon (Roll-on, Roll-off Container), ATB, and others, along with a wide range of capacities and service speeds.

No External Benefits and/or Public Support

Relieving road congestion, reducing air pollution, and obtaining subsidies because of it, as practiced is some European countries, is not considered here. Likewise, public support by MARAD, as was the case with SeaBridge, or by port authorities, as is the case with James River barge service, are excluded in this study. The coastal services are assessed here purely on their commercial viability.

Favorable Cost Assumptions

Despite the large number of studies conducted thus far, detailed information on both water and land-based transportation systems is not always available. The approach taken here is to allow the water-based system the benefit of the doubt and use cost data favoring this system.

Selected Categories of Services and Specific Case Studies

Selection Rationale for Case Studies

Coastal shipping services along the Atlantic and Gulf Coasts of the US can be characterized according to three general factors: (a) region and length of route; (b) type of cargo; and (c) type of ship. The combination of these three factors creates a wide range of possible services, however. This wide range is demonstrated in the first two studies mentioned in the previous chapter. The first study, by MARAD, assesses 32 possible routes for coastal services; the second, by Herbert Engineering Corp., assesses 11 possible ship designs that could be deployed on coastal services.

Based on examination of these and other studies and, especially, industry interviews, the authors first defined three categories of services, each characterized by a generic combination of cargo, route and ship. Then, within each category the researchers selected the specific case study which preliminarily appeared the most promising. The selection of categories and case studies was also influenced by past and planned services by private operators. As already noted, none of the examined studies and services were based on exempt coastal services.

Although this study focuses on three case studies, the authors believe that the findings of the analysis of these cases can be generalized to provide reliable answers to the two research questions poised at the beginning of this chapter.

International vs. Domestic Cargo Units

Theoretically, a coastal service can handle international (ISO) or marine containers, domestic containers, and domestic trailers, provided all are moving along the same route. In reality, however, mixing international and domestic freight is operationally problematic.

The first reason is technical; cargo units of the international and domestic traffic are different. The dimensions of common international containers are 20 or 40 x 8 ft. (length x width); the common domestic container (or trailer) is predominantly 53 x 8.5 ft. Figure 3 illustrates the difference by showing a domestic container riding on ISO containers, with both mounted on a double-stack, articulated well-car. Both types of boxes can be lifted by the same spreader bar. However, a common ship-to-shore (STS) gantry crane is only designed for up to 45-ft. long boxes. Another difference between these boxes is that while ISO boxes can be stacked 9 or 10-high, domestic boxes can only be stacked 2-high. Accommodating different types of boxes on the same ship would complicate its design and may result in lost space and higher cost, unless the ship is “pure” RoRo.

Type	Dimension (ft)			Volume (cu ft)	Volume Ratio	Stacking Levels
	L	W	H			
40-ft Standard	40	8.0	8.5	2,393	1.00	9
53-ft Domestic	53	8.5	9.5	3,857	1.61	2

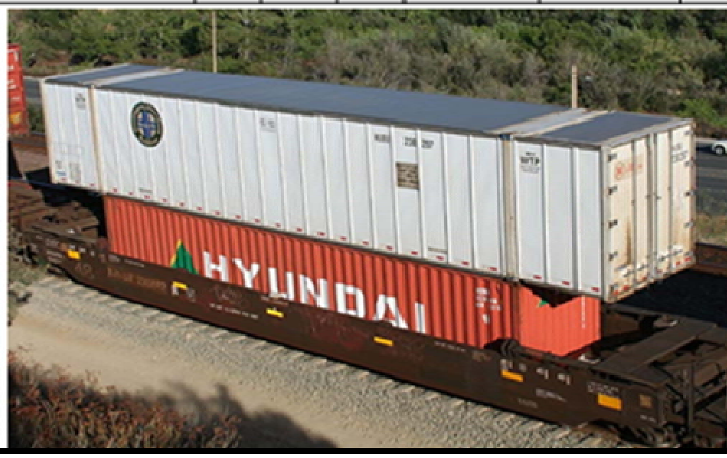

Figure 3
Marine vs. domestic containers
(Source: Ashar, 2009)

The second and much more critical reason relates to port operations. International terminals are operating under tight customs and security regimes. These terminals also have elaborate gate systems, with gates usually only open during the day time. It is difficult to imagine that customs would allow domestic containers to be handled at an international terminal short of elaborate security arrangements, which are likely to substantially increase port costs. Domestic terminals can handle international containers after they are cleared by customs ("domesticized"), but then these boxes are considered as domestic cargo for all practical purposes. Altogether, the coastal service applications included in these case studies are geared to either handling domestic or international traffic, but not both.

The following provides definitions and rationales of the three selected categories or applications of coastal services and within each category the specific case study selected for further analysis.

Domestic Long-Distance (Domestic-Long)
This category of coastal services relates to coastal routes longer than 500 nautical miles (NM). Almost all coastal services assessed in previous studies belong to this category. The underlying rationale for the popularity of this case study is simple: the main advantage of a water-based service is its line-haul; its main disadvantage is its port cost; in a long-distance

service the port cost accounts for a smaller percentage of the total cost. Additional ship-related considerations are: (a) ships providing this service should be relatively large in order to lower their unit cost (scale economy); and (b) ships' service speed should be relatively high in order for the transit time on the relatively-long route to be competitive with faster land-based services.

The preliminary analysis also indicates that the competition for this service would mainly be from intermodal (IM) rail, or from rail services specializing in handling containers and trailers. Truck services for longer routes are substantially higher cost than rail and therefore are mainly used for time-sensitive traffic, or traffic generated far away from IM yards (also referred to as IM terminals). The latter is not the case in coastal services along the Atlantic and Gulf Coasts, since almost all ports have IM yards either "on-dock," meaning within their marine terminals or "off-dock" but within short distance of these terminals. Coastal shipping, by its nature, has lower speed and longer transit time relative to land-based transport systems. Therefore, it is not expected that coastal shipping services will handle time sensitive cargoes on relatively long routes, such as refrigerated cargoes. This, in turn, will avoid the need for having reefer plugs on-board ships and save both on ship's and port's capital costs.

The case study that appears most promising in this category of coastal shipping is a two-port shuttle service between Philadelphia, PA, and Jacksonville, FL, a distance of 850 miles by land. This service is intended to connect the South Atlantic and Florida regions with the Delaware Valley and North Atlantic regions. Based on previous studies and interviews, and considering that the competing rail having a daily service along this route, it seems that the minimum frequency of such service should be two sailings per week and the ship capacity around 300 trailers and containers. This amount of traffic does not justify the development of new, dedicated ports, including access channel, turning basin, docks, yard, etc. Hence, the ports of call for this service should be based on dedicated domestic terminals located within the boundaries of existing deep-sea ports (see more at RoRo Terminals).

As noted above, port cost is the most critical cost component of coastal services. In order to substantially reduce port cost, lifting of boxes by shore-based fixed or mobile harbor cranes should be avoided. Accordingly, the ship-type of this service should be RoRo, with all cargo aboard ship mounted on wheels. The RoRo design will also allow the service to handle both domestic containers on chassis and domestic trailers. However, RoRo ships have a relatively low capacity because of the height taken by wheels and width taken by aisles between trailers. Following the recommendation of both the HEC study and that by a potential operator, it is proposed to increase the capacity of the Domestic-Long ships by designing the weather deck for handling double-stack containers on cassettes. The advantage of cassettes is increasing ship capacity by about 50% without adding much to the ship's construction cost. The disadvantage of cassettes is the additional investment required for cassettes and special tractors required to move them (translifters). Cassettes also require additional terminal handling for loading/unloading containers to/from cassettes, which add to the port cost (see RoRo Terminals).

Domestic Short-Distance (Domestic-Short)

This category of coastal services was not investigated by the AMH studies; it was the focus of only one previously-mentioned, limited-budget study (see Most Relevant Studies). The underlying rationale for coastal services in this category is different than that in the Domestic-Long. Due to the short distance, the advantage of the water-based service in Linehaul transportation is small, if any, compared to a land-based services which, because of the short distance, are likely to be provided by trucks. Hence, this category of coastal services could be viable only in a few selected cases, whereby the coastal highway is highly congested with no viable alternative, resulting in high trucking cost. This, indeed, is the usual case around several large urban centers located along the coast. In fact, the coastal service in this category functions as a ferry, relaying the traffic around or bypassing an obstacle to the road traffic, which in this case is urban congestion.

The short-distance coastal shipping service usually competes against trucks. Because of the short distance, the competing truck service is a simple, direct door-to-door service provided by the same truck. The coastal shipping service is more complex, however, because in addition to the water trip, there are two ship-handling processes at marine terminals and two drays to/from marine terminals. Hence, the trip time of the water-based service is much longer than the land-based service. Accordingly, as is the case with Domestic-Long, the Domestic-Short should target time-insensitive and cost sensitive cargoes. For this type of cargo, next-day delivery is usually sufficient. The additional day of transit time allows for a relatively-low service speed for coastal ships, resulting in substantial savings in fuel consumption. The lower speed also allows savings in ship construction cost due to the possibility of employing a boxier hull shape and a smaller engine. The service has to be provided at a relatively high frequency to be able to compete with trucks.

The case study that appears most promising in this category is a shuttle service between New York and Boston, a distance of about 250 miles by land. The selected ship should have capacity for about 100 units, all on wheels, arranged in two decks. The desirable service frequency required to compete with trucking services is 2/day.

Naturally, port cost accounts for a large share of the overall cost in the Domestic-Short. Hence, unlike the Domestic-Long, for this service to be viable, it should be based on low-cost dedicated terminals, with limited facilities and storage area. These terminals could be located outside the main ports since the ships employed in this service are relatively small and with shallow-draft. To further save on port cost, all cargo should be on wheels (RoRo), with no cassettes and no need for lifting of containers.

International Short-Distance (Feeder-Short)

The category of coastal shipping serving international containers is commonly defined as feeder, based on the role of this short-range service in the overall shipping system of containers. Presently, there are no feeder services in the US. The need for a US-based feedering system may rise in the future, especially following the 2015 expansion of Panama Canal and the respective deployment of large post-Panamax ships on the Asia / US East and Gulf Coast, routed through-Panama Canal. The expanded Canal will allow the transit of ships with capacity of up to 13,500 TEUs, defined as New Panamax ships (NPX), which are about 2.5 times larger than the 4,500-TEUs Panamax ships currently used. Smaller, post-Panamax ships are already deployed on the Asia / US East and Gulf Coast trade route through the Suez Canal, the largest of which, with 9,200 TEUs. The service is provided by Mediterranean Shipping Company, deployed on the Golden Gate. The service calls at New York but not at Boston. The introduction of large containerships on deep-sea trade-routes is usually accompanied by the transformation of the shipping service system into a hub and spoke model, briefly mentioned in the earlier section on Coastal Services and International Trade. In this model, the larger deep-sea “mother ships” limit their calls to hub ports, in which they transfer or *transship* their boxes to smaller “feeder ships” for further distribution to smaller regional ports. The term deep-sea is used to denote long-distances shipping services involving crossing the ocean; it is contrasted with short-sea, a European term referring to short-distance shipping services. Coastal feedering services are widespread worldwide, but not in the US, mainly because of the high cost of US-flag ships operating under the Jones Act. As noted in the Other Relevant Studies section of this report, the 2011 PriceWaterhous Cooper study found that the cost of operating US-flag ship is 2.7 times that of a comparable foreign-flag ship.

The previous two coastal services are focused on domestic cargo, although they can carry “domesticized” international containers (ISO) as well. However, there is no point in using the Domestic-Long for international containers since the deep-sea ships of international services usually call directly at all the main ports along the coast line. For the same reason, there is no point in suggesting adding a fourth case study devoted to long distance feeder services. The use of Domestic-Short for international containers is possible, but most likely not cost effective, since it involves an extra dray of boxes from the international terminal to the domestic one. Once a truck is on the road after picking up a box from the marine terminal, it is likely to continue with the box all the way to its final destination.

The feedering system involves existing international marine terminals with the feeder ship usually handled by the same terminal equipment used by mother ships. However, the handling process, or the ship-to-ship transfer defined as *transshipment*, is simpler than the ship-to-shore process. The transshipment only involves ships; there is no handling of trucks and no gate processing. Hence, the handling cost is expected to be cheaper than that of the full ship-to-shore cost. The competition for Feeder-Short is usually from trucks offering direct, door-to-door services, similar to the case of Domestic-Short. There are exceptions as will be seen in the case study selected here whereby the hub port has an on-dock system of IM yards.

The case study that appears most promising in this category is a shuttle service between New York (Newark, NJ) and Boston, MA, a distance of 250 miles by land. A feeder service along this route already has been provided by Colombia Coastal Transport (CCT) for about 20 years before it was terminated. The Port of Boston is a relatively small port, which currently has only three deep-sea weekly services to: (a) North Europe, by Mediterranean Shipping Company (MSC); (b) West Mediterranean, also by MSC; and (c) North Asia, by China Ocean Shipping Company (COSCO) and its alliance partners *[3]*. It is reasonable to assume that, following the expansion of Panama Canal, COSCO (and other lines) will deploy post-Panamax ships on the All-Water Panama Asia service. These post-Panamax, eventually reaching NPX (13,500 TEUs), will substitute the present Panamax (4,500 TEUs) ships. The present facilities of the port are not suitable for handling large post-Panamax ships (see Port of Boston), which may force COSCO to consider substituting its direct Boston call by mother ships by feeder calls. The feeder's ships size that preliminarily seems best suited to the short-range feeder service has the capacity of 400 FEUs (800 TEUs). This ship is smaller than that proposed by American Feeder Line (see next chapter).

The HEC study includes a similar, though longer, feeder service, focusing on Portland, Maine, about 100 NM north of Boston. However, the preliminary review of cargo potentials indicates that while there is ample southbound (export) traffic, mainly forest product, there is limited northbound (import) traffic, the higher paying freight. Likewise, the additional distance and port call requires an additional ship. Intermediate stops in Connecticut and Rhode Island ports were not considered due to the proximity of these ports either to New York or Boston.

In the case of New York/Boston, the feeder service's main competition is from: (a) a special rail service, based on on-dock IM yards in New York's main marine terminals; and (b) trucks. Based on discussions with the industry, it seems that the minimum frequency of the feeder should be 2/week in order to be competitive with rail and truck services.

Summary Description of Case Studies

A brief, comparative summary of the case studies reviewed in the previous section is warranted at this point of the analysis:

- ***Domestic-Long***
  Route – Philadelphia / Jacksonville, 850 miles
  Ship – Midsize and relatively fast RoRo, unaccompanied trailers and domestic containers on either road chassis or stacked 2-high on cassettes
  Service Frequency – 2/week (Minimum)
  Competition – IM Rail

- ***Domestic-Short***
  Route – New York / Boston, 250 miles
  Ship – Small and relatively slow RoRo, unaccompanied trailers and containers on road chassis
  Service Frequency – 2/day
  Competition – Trucks

- ***Feeder-Short***
  Route -- New York / Boston, 250 miles
  Ship -- Small LoLo
  Service Frequency – 2/week
  Competition -- Rail IM and trucks

The following chapters present detailed analyses of each case study. In line with the methodology, which seeks to reach a general conclusion regarding the impact of the Jones Act exemption based on three typical applications, the analyses are conducted in a comparative fashion. Instead of discussing and compiling data separately for each case study according to its cost factors (ship construction cost, crewing cost, etc.), the authors elected to analyze the main cost factors for all case studies to facilitate comparison between cases.

RECENT RELEVANT DEVELOPMENTS

Recent Coastal Services

Coastal shipping services are defined as services between points located along the same coastline. Presently, coastal shipping has to be provided by Jones Act US-built ships; this study assesses the impact of waiving the US-built stipulation, allowing coastal shipping to be provided by foreign-built ships. The study encompasses coastal shipping services on the Atlantic and Gulf Coasts. The most recent coastal services on these coasts were those by SeaBridge and Colombia Coastal Transport (CCT); both have been terminated. Before delving into analyses of the case studies, a short review of the two past services is included along with that of a third service currently under consideration by the Maine Port Authority. Following the review of these coastal services, recent developments in shipping expected to critically affect coastal shipping will be discussed.

SeaBridge – Domestic-Long

SeaBridge provided a single, 10-day service between Manatee, FL, and Brownsville, TX, across the Gulf Coast. The water route between these two ports is about 800 NM, hence it can be categorized as Domestic-Long. The land distance between Manatee and Brownsville is about 1,400 miles. Hence, the main rationale for this service was the shorter water route, saving about 600 road miles ("bridge effect"). However, as clearly shown Figure 4 below, a large share of freight was destined to North Carolina for which the water route is longer than the land one.

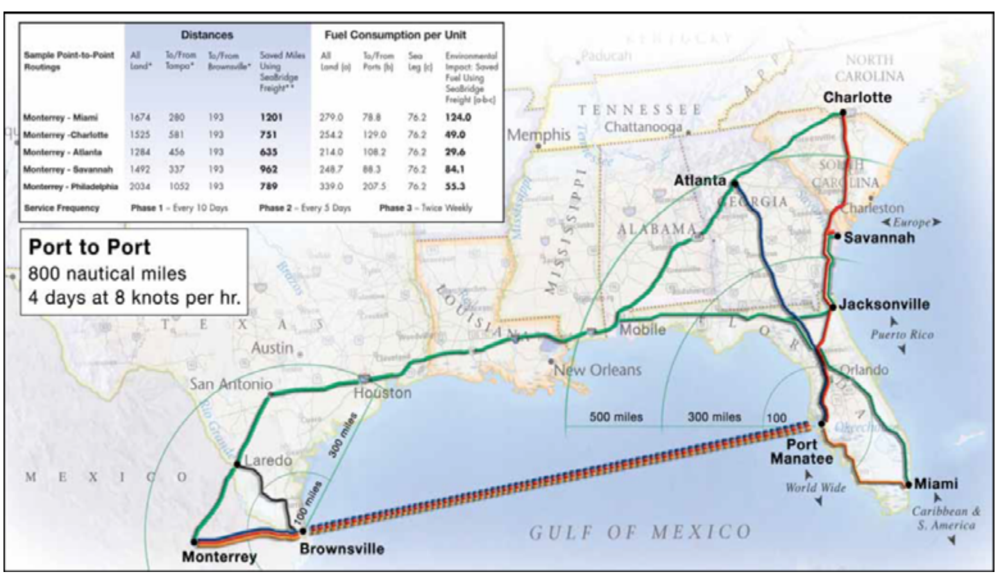

Figure 4
SeaBridge route
(Source: SeaBridge, 2013)

The service was provided by a single deck barge, with dimensions of 100 x 26 x 3 m (length x width x draft) and capacity of about 600 TEUs, pulled by a 4,200-hp tug. Service speed was about 8 k. Both the tug and the barge were chartered. The rotation time was 10 days and, accordingly, the service frequency also was 10 days. The barge was handled at both ports by Mobile Harbor Cranes (MHC).

The service catered to transporting overweight containers, mainly steel and tiles from Northern Mexico, brought by trucks to Brownsville. SeaBridge provided its services to shippers on liner terms, using leased containers. SeaBridge also provided a related land connection from Manatee to the final destination in North Carolina and Maryland. The savings to northbound shipper were reportedly up to $1,000 per container compared to the all-truck alternative. However, the service had problems attracting freight in the southbound direction.

Partially because of the insufficient southbound freight, the tug-barge service was unable to generate sufficient revenue to cover its costs. Initially, the limited success in attracting freight was attributed to the low service frequency. Hence, to bolster the service, the AMH program allocated $4 million to Port Manatee to assist SeaBridge with the construction of a second barge. The second barge was intended to increase the service frequency from once every 10 days to five days. Despite the availability of this grant, SeaBridge decided to terminate the service in 2011 after only one and half years of operation. According to an interview with its manager, other problems with the service, were: (a) the service speed was too low resulting in a trip time of five days (including port time); and (b) the tug and barge combination had a high fuel consumption due to high hydrodynamic resistance of the deck barge in the pull arrangement.

A somewhat similar service, between Houston, TX, and Tampa, FL, operated during 2005 by Osprey Line, part of Kirby, a large inland waterway tug and barge company. The service was provided by a converted tug-supply ship, Sea Trader, 87 x 19 x 4.8 m, 248 TEUs, and 12 k.

Colombia Coastal Transport (CCT) – Feeder

Unlike the short-lived service of SeaBridge, CCT had provided a weekly service along the North Atlantic Coast, between Newark, NJ, and Boston, MA, for about 20 years until terminated in 2010. CCT service was provided to international containers and only provided to shipping lines calling New York but not Boston. Therefore CCT service can be categorized as Feeder-Short.

CCT, like SeaBridge, operated a pull-barge and deck barge combination. The deck barge had dimensions of 91 x 22 x 3.6 m (length x width x draft), 5,000 dwt and a nominal capacity of 540 TEU; the tugs had 5 – 6,000 hp and an average speed of 8.5 k. Transit time for the 230 NM trip was 28 – 32 hours. However, flat-bottom barges, especially when being pulled, are sensitive to bad weather. Hence, the system suffered from delays, especially during winter. The barge was handled at both ports by STS gantry cranes, similar to those serving deep-sea ships. However, the barge service had a special arrangement allowing it to employ "short" or reduced-manning gang, resulting in lower port cost. Because of this arrangement, the barge had lower priority relative to large deep-sea ships. Hence, occasionally, the barge had to wait for a crane and a gang to be available, spending two or three days at the Port of New York. However, since the service frequency was only once per week, the rotation time had sufficient slack time to allow for such delays.

CCT's rates were reportedly similar to truck rates, but its level of service was much inferior. With only one departure a week and considering port delays, actual transit time was three days. This raises the question how the barge service could compete with truck services. One explanation provided by barge users was the reliability of the service and its large capacity. That is, shipping lines looking to move 50 boxes from NY to Boston immediately following the discharge of the mother ship at NY had difficulties in arranging it since NY truckers could not provide a sufficient number of trucks. The lines had to contract with several truck lines, which could not always provide the desired service on time. The rail service was not an option at that time since it involved draying the container to the South Kearney Intermodal Yard. Another reason was that, presumably, for international containers, adding three days to the transit time was not considered critical, since the local trip was viewed in the context of the entire trip time, which for Asian boxes was four to five weeks. A related explanation is that, in any event, boxes stayed in the terminal for several days until released and picked up by consignees, so the barge transport took place during this time. Eventually, the barge service's combination of cost and level of service (trip time and frequency) was proven uncompetitive with trucking and the service were terminated. The demise of the service is also attributed to a change in rotation of its main customer, COSCO, which added direct Boston call to its Asian service to NY. As noted previously, COSCO may reverse its decision following the expansion of the Panama Canal. Interestingly, CCT tried to extend its services to Portland ME, following the same route for which a new service is now under planning (see Main ATB).

CCT also was involved in another tug-barge feedering service, the Albany Express Barge along the Hudson River, between the Port Authority of New York/New Jersey terminals and the Port of Albany, a short route of about 150 miles. This service was part of Port Inland Distribution Network (PIDN) of the Port Authority. The PIDN was expected to divert 20% of the Port of New York inland distribution to water-based transportation systems, similar to the proportion handled by barges at the Port of Rotterdam. The Albany service was provided by a largest barge of CCT, Columbia Boston, 91 x 29 x 6.4 m, 9,450 dwt and 912-TEU. The service began in 2003 after receiving $5.3 million in federal, state, and local funding, allowing it to undercut the trucking rate by 10%. Despite the lower rates, the service failed to attract sufficient freight and was terminated after 3 years of heavy losses. The failure is attributed to the combination of longer transit time, 12 to 18 hours by barge versus three hours by truck. The service frequency, once per week, was also considered too low.

CCT still maintains a short barge feeder service in both the Chesapeake Bay and Delaware River, connecting Norfolk, Baltimore, and Philadelphia.

Tug & Barge vs. Self-Propelled Ship

Both SeaBridge and CCT services were provided by tug-barge combinations in a pull arrangement; both failed. From discussions with the industry, the authors gathered that the failure of the two barge services can be attributed to their usage of barges. Pull barges have high hydrodynamic resistance, resulting both in relative slow sailing speed and high fuel cost. Likewise, pull barges are difficult to maneuver, resulting in longer port time, and they also have relatively low seaworthiness adversely affecting their service reliability.

SeaBridge and CCT used a tug-barge system only because of the unavailability of suitable Jones Act self-propelled ships, and because of the low-manning requirements of tugs relative to self-propelled ships with similar capacity. This is not the case in this study in which exemption from the Jones Act and functional manning is assumed. Hence, the initial finding is that the tug-barge systems similar to those used in the past should not be considered for exempt coastal services. Accordingly, this study only considers self-propelled ships. This, indeed, is the European experience whereby coastal shipping is provided by relatively-fast self-propelled ships (see European Experience).

Still, the tug-barge system might have limited applications for Inland Waterways, as evidenced by the feeder services on the Columbia River. This system is based on trains of barges involving a mixture of cargoes. The Inland Waterways arrangement is based push barges, which is more efficient than pull barges. Likewise, the speed allowed in the Inland Waterways routes is limited.

Articulated Tug Barge (ATB) – Feeder and Domestic

On May, 2013, the Maine Port Authority declared McAllister Towing, a major tug operator, as the winner of a $150,000 grant for designing an ATB system, as part of MARAD’s AMH program. The ATB-based service was originally designed to provide a feeder service between New York and Portland, Maine. As noted above, a similar service was provided for a short time during 2009 by CCT before being terminated. Another feeder service, by

American Feeder Line, using Halifax as a hub port, also served Portland in 2012, before being terminated (see Selected Design). The new service is expected to have *en route* stop in Boston and, perhaps, an additional stop in one of the Rhode Island and Connecticut ports. Interestingly, unlike the previous services, the ATB service is intended to serve both international and domestic freight which, as noted above, might be operationally difficult.

ATB is a US invention, whereby the tug pushes the barge while placed at a notch in the barge's stern. The tug-and-barge are linked together or integrated throughout the entire navigation time and, in most cases, during port time as well. The linkage between the tug and barge reduces hydrodynamic resistance relative to the pull arrangement and provides for a higher sailing speed: 12 k for a typical ATB versus 8 k for a pull arrangement. Newer ATBs based on a more refined hull, such as the one discussed in the next section, can reach up to 15k. The integration also greatly improves the ATB's seaworthiness relative to the pull arrangement, making it more suitable for ocean routes. Despite the permanent link between tug-and-barge, ATB manning requirement is similar to the pull arrangement; it is based on the Gross Registered Ton (GRT) of the tug and therefore much it is smaller than self-propelled ships with the same capacity as the barge. Hence, ATB has low crew sizes. For example, ATB's typical crew size is 6 – 9 persons, considerably lower than the 20+ persons required for a self-propelled ship of similar capacity. ATBs are currently used mainly for transporting oil (tankers) but not containers.

A design of an ATB is included in the HEC study, with dimensions of 216 x 32 x 13.8 x 4.3 m (LOA x Beam X Depth x Design Draft), a total capacity of 886 TEUs, and a speed of 14 k, based on main engine with 12,000 hp. This design is considerably larger than current ATBs used for oil. The proposed configuration is RoCon with containers stacked 3-high on the weather deck and the barge equipped with a single side ramp. In terms of capacity, an HEC ATB could be suitable for Domestic-Long type service, except for its relative slow speed.

ATB vs. Self-Propelled Ship

The new ATB initiative does not contradict previous observations regarding the unsuitability of tug-barge systems for exempt coastal shipping. ATBs have higher speed and better seaworthiness than pull barges, but compared to a single-hull, self-propelled ship it has several important disadvantages:

- Higher construction costs than self-propelled ships since ATBs are based on two separate hulls and also require expensive connections between the two;
- Higher fuel consumption than self-propelled ships because of the difference between the shapes of the two hulls, which increases the hydrodynamic resistance and respective power consumption relative to single-hull self-propelled ships (For example, the engine on a 50,000 dwt product tankers is typically 9,000 kW, while the

new Crowley. Legacy Class ATB, with similar capacity, uses a tug of 12,000 kW. See: http://gcaptain.com/forum/marine-engineering/8388-large-atbs-product-tankers-comparissons-opinions.html);

- Lower maneuverability and need for tug assist for berthing/unberthing;
- Limited space on-board for installing LNG tankage (two recently-mentioned options are adding sponsons (side projections) to the tug or placing the LNG tanks on the barge); and
- Lower crew comfort.

The main reason for the popularity of ATBs in the US is reduced manning. The main assumption of this study is the ability to employ functional crew. Under this assumption, self-propelled ships are much preferable over ATBs. Hence, ATBs are excluded from further considerations in this study.

Emission Control Area (ECA)

The current Jones Act fleet of domestic lines, as noted in Objections From Offshore Domestic Lines, includes old and inefficient ships only being used because of the high cost of replacement by US-built newbuildings. The older Jones Act ships also do not comply with the international emission standards as defined by the International Maritime Organization in an amended International Convention for the Prevention of Pollution from Ships (MARPOL). The most stringent of the new emission standards apply to ship operating in designated Emission Control Areas, including along the North American coast. Figure 5, based on MARPOOL, shows the allowed sulfur content in marine fuels. Figure 6, based taken from the Regulatory Announcement of the US Environmental Protection Agency (EPA), shows the ECA area, which extends up to 200 nautical miles from the US coastline and also includes offshore US territories *[4]*. Similar ECAs have also been declared along the European coastline.

Year	Sulfur in Fuel (%m/m)	
	ECA	Global
2000	1.50%	4.50%
2010	1.00%	
2012		3.50%
2015	0.10%	
2020 or 2025		0.50%

Figure 5
Developments in sulfur content regulations

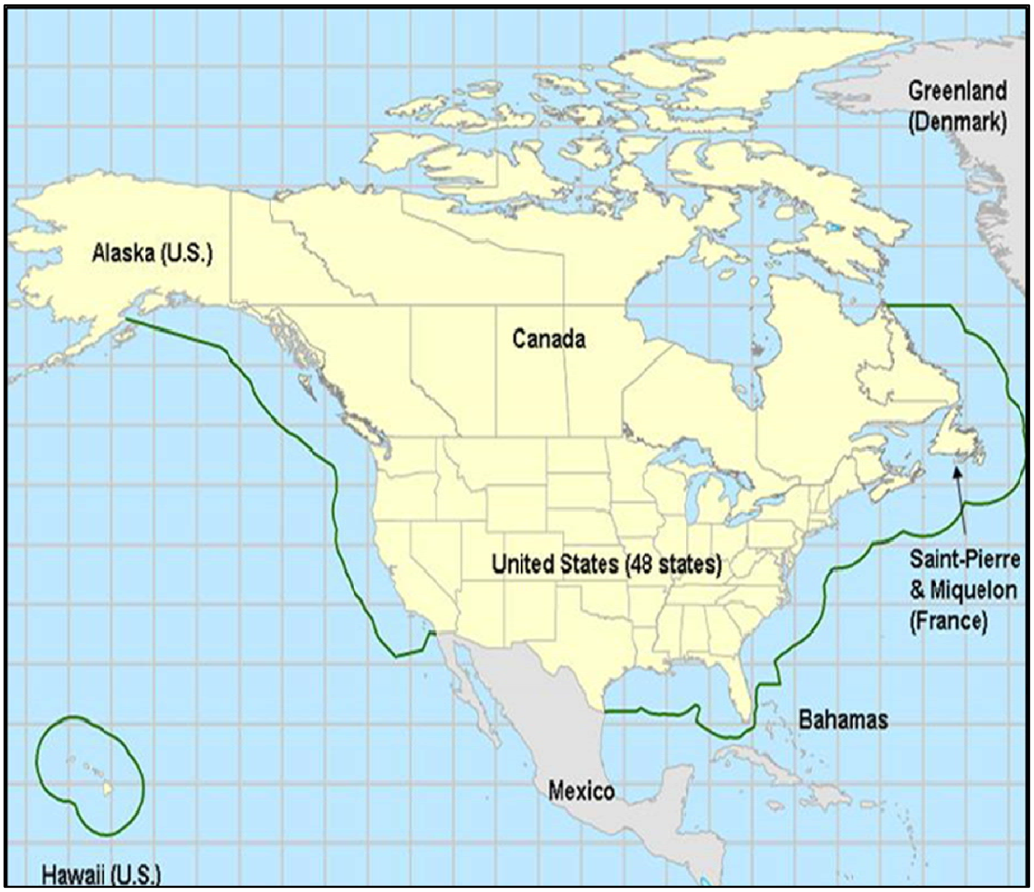

Figure 6
US environmental coastal area
(Source: EPA, 2013)

The main regulations, defined as Tier III, are expected to be enacted in 2015. From this time on, the sulfur content of marine fuels in ECA will be limited to 0.1%, reducing the emission of particulate matters and SOx by more than 85%. EPA expects that operators will be able to meet the new standard by ships switching to different fuels.

The common engine employed by ocean-going ships is based on the low-rpm, two-stroke design, which is considered the most economical since it burns heavy fuel oil (HFO), a low-cost residual fuel and, because of the slow-rpm, avoids an expensive reduction gearbox. This type of engine, however, is large and only suitable for relatively large ships. Smaller ships use a lighter, medium speed, four-stroke engine design, which burns the higher-cost, distilled fuel marine diesel oil or marine gas oil (MDO**,** MGO), and also requires a reduction gearbox. A third, more expensive option and therefore not discussed here, is diesel-electric propulsion, popular mainly in cases in which large auxiliary electric consumption is required (reefer, cruise, etc.). The medium-speed engine could use low sulfur marine gas oil (LSMGO) with

0.1% sulfur content to comply with the ECA regulations, resulting in very expensive fuel cost. For example, in August 2013 the price of Low Sulfur MGO (0.1% Sulfur) was $1,028/ton vs. $620/ton of HFO (IFO 380) *[5]*. There is low sulfur HFO, however. Fuel cost, as will be seen later on, accounts for the largest share of the voyage cost.

To comply with the new regulations in an economical way, shipping lines electing to continue using their existing ships have two options: (a) to install special devices for cleaning exhaust gas, defined as scrubbers; or (b) to install dual-fuel engines that can utilize low sulfur fuel, especially liquefied natural gas (LNG) which is expected to have similar cost to HFO. The dual-fuel engines allow adjusting the fuel type to the emission rules, burning low-cost HFO outside ECA and LNG within ECA.

Retrofitting Ships

About half of the routes of domestic shipping lines operating on the Mainland/Puerto Rico trade lane is within ECA. If these lines elect to continue with their ships, they have to choose among the two options discussed above, install scrubbers, or retrofit their ships with new dual-fuel engines. Both options are quite expensive and not always possible due to the lack of space. For example, the cost of installing scrubbers on DFDS ships, a major European short-sea line, is estimated at about $6.8 million per ship. The cost of retrofitting ships with dual-fuel engines could be two to four times higher and may require dry docking *[6]*. Such investments are only justified in the case of relatively new ships as evident by the case of DFDS and other European lines. These lines usually sell their older and non-compliant ships to operators in developing countries in which emission regulations are either non-existent or not enforced.

It is reasonable to assume that this will also be the case with US lines operating foreign-built ships on non-domestic trade lanes. Theoretically, these lines, if granted a Jones Act exemption as assumed in this study, could attempt to deploy their foreign-built ships on coastal services. For example, Crowley, a major US ship operator of Jones Act ships, also has several foreign-flag ships. Crowley has, among others, a small 2,080 lane-m RoRo ship, Stena Shipper, built in 1980. This ship could be employed on coastal services if the built-US requirement of the Jones Act is waived. However, retrofitting this ship would require a large investment, which would be cost prohibitive for a 33-year old ship considering that the typical economic life of ships is about 25 years.

Another possibility for potential operators of coastal shipping given an exemption from US-built would be to turn to the international market and either buy or time-charter foreign-built RoRo ships. The cost of an owned and chartered ship should be the same if the capital cost is amortized upon the economic life of the vessel. In reality, because of risk considerations, owned ships are more cost effective. Most of the RoRo ships available on the world fleet are custom built; their configuration, cargo mix, capacity, speed and hull shape are designed to suit specific routes and markets, which most likely would not suit the case studies defined in this study. Also, the world fleet of RoRo ships is relatively small with mostly old ships. In 2012, the relevant fleet of RoRo ships (>800 lane-m) included 421 ships, with an average age of 19.7 years. Because of advances in ship design, the fuel consumption of older ships is considerably higher than newer designs. The newbuilding of RoRo ships also is limited, averaging about 20 per year, all of which are tailor-built and therefore usually not on the charter market. Hence, the possibility of retrofitting older foreign-built RoRo ships, either currently in operation by US lines or available on the charter markets, and deploying them on US coastal services can be discarded for all practical purposes. Unlike the case with RoRo ships, the charter market for LoLo ships is quite developed, including newbuildings. However, in this case, the chartering cost reflects the cost of newbuildings. Altogether, for both RoRo and LoLo, this study assumes foreign-built newbuildings (see more below).

Tote's Newbuilding

The case of the recent newbuildings by Tote, a major US domestic line, also suggests that retrofitting its old Jones Act ships with scrubbers or dual-fuel engines is uneconomical. A more reasonable response to the EAC regulation, although expensive, would be to turn to newbuildings. Tote is one of major operators on the Mainland/Puerto Rico trade lane under the name Sea Star. Tote has recently announced a major ship newbuilding program to replace its old Jones Act ships, signing a contract with General Dynamic's NAASCO yard in San Diego to build two (with an option for additional three) LNG-powered (dual fuel), 3,100-TEU container ships (LoLo), defined as the Marlin Class. Tote's initiative is bold, since there are only 100 LNG-powered ships in the world. However, the trend is clearly toward LNG, especially in the US, which has an abundance of this fuel. The expectation is that LNG will cost about a third less than marine diesel. However, LNG-powered ships require large, specially-designed cryogenic tanks to keep the gas in a liquid state, resulting in a higher capital cost than conventional ships. Tote ships will be outfitted with a single, two-stroke 8L70ME-C8.2-GI with 25,000 kW engine. The engine can use either Heavy Fuel Oil (HFO), outside ECA, or LNG, with ECA. Construction cost is estimated at $175 million apiece. Following delivery in 2015 and 2016, the two ships will operate between Jacksonville, FL, and San Juan, PR. Figures 7 and 8 show renderings of the new Tote LNG-powered ship. The LNG tanks are shown (in yellow) on the aft deck of the ship with the engine underneath them.

Figure 7
Tote new LNG ship
(Source: Tote Maritime, 2013)

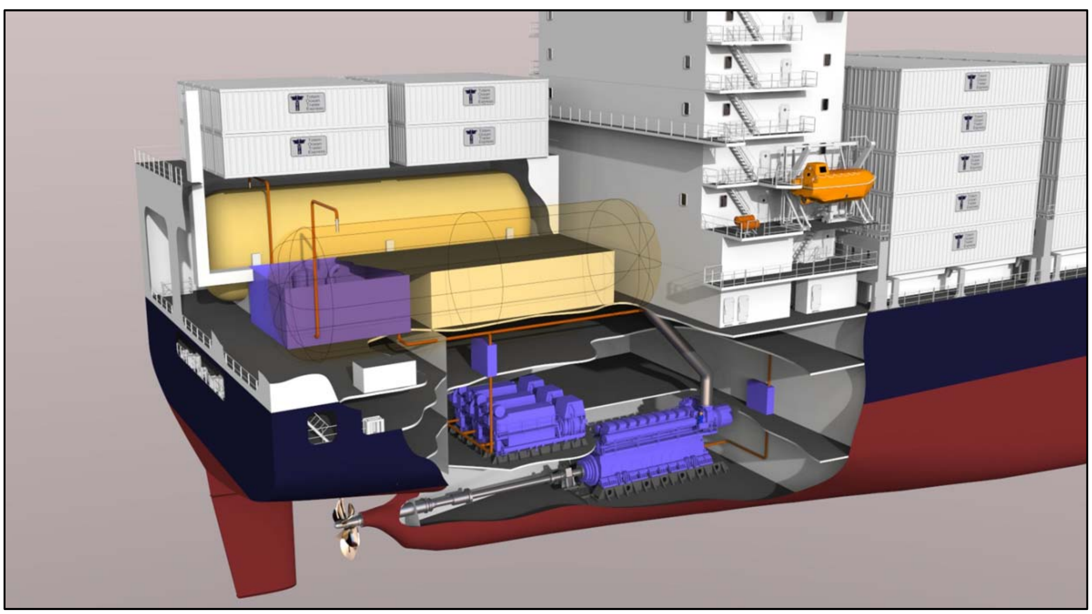

Figure 8
LNG storage tanks arrangement on Tote ship
(Source: Tote, 2013)

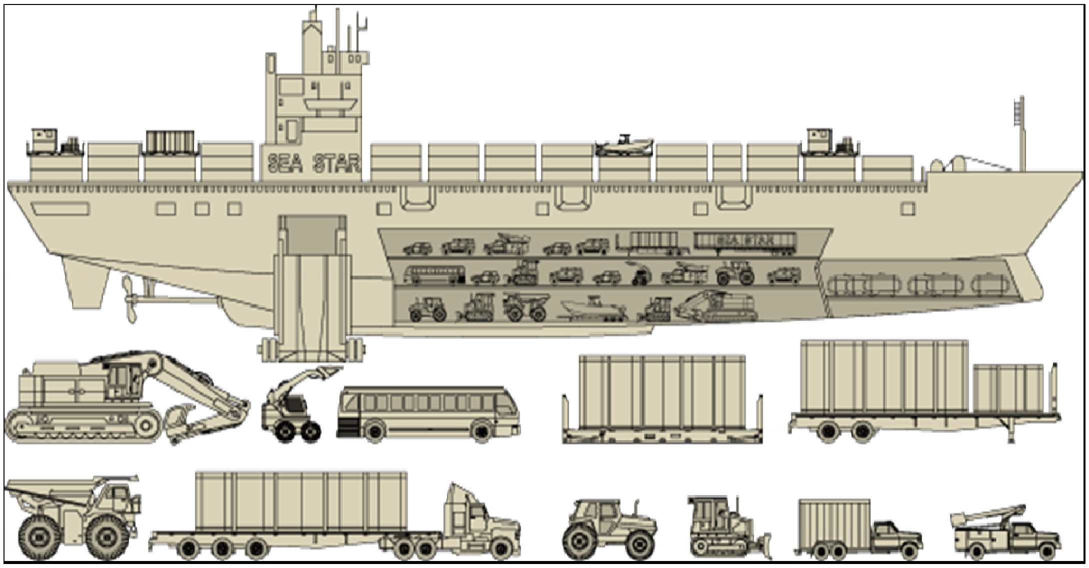

Figure 9
Tote (Sea Star) Ponce-Class ship
(Source: Sea Star, 2013)

The two new Marlin-class 3,100-TEU ships will replace the three older Ponce-class ships shown in Figure 9. The older ships, already mentioned, are combination LoLo/RoRo (also defined as RoCon) ships that were built by Sun Shipbuilders in Philadelphia in June 1974 and underwent reconstruction in July 1996.

In parallel to the new construction plan, Tote began a conversion program of its existing Orca Class ships to LNG at an estimated cost of about $40 million each. The Orcas are relatively new ships, designed and built by NASSCO in 2003 for $150 million each. They are large, 839 x 118 x 30 ft. RoRo ships, with capacity for 600 trailers and 200 autos. They are currently deployed on the route between Tacoma, WA, and Anchorage, AK. The vessels are twin-screw, diesel-electric with total installed power of 52,000 kW. Each vessel has four MAN B&W 9L 58/64 main engines and two MAN B&W 9L 27/38 medium speed diesels at 400 and 720 rev/min, respectively. The diesel engines are designed to operate on both HFO and Marine Diesel Oil (similar to MGO). Hence, theoretically, they could use LSMGO to comply with EAC. Still, Tote calculated that the high cost of LSMGO relative to LNG justifies the investment in conversion. More recently, LNG propulsion has been mentioned for coastal tugs, including ATBs *[7]*.

The other domestic lines on the Mainland/Puerto Rico trade are facing similar problems to Tote and, although not confirmed yet, there has been news that they are also soliciting proposals for new ships. It is reasonable to assume that the other lines will come up with designs similar to Tote's in terms of both size and configuration.

Mid-size LoLo ships, similar to Tote, even if they have a small RoRo capacity, are not suitable to these Domestic-Long and Domestic-Short case-studies, due to the high cost of handling LoLo ships especially since domestic containers may require special STS cranes. There is a wide consensus that coastal services should be mostly based on RoRo ships to avoid costly shore-side lifting, precluding Tote's new ships from the two domestic applications of coastal shipping. Tote's new ships will also not be suitable for the international application, or the Feeder-Short; they are simply too large and too fast. There are feeder services, especially in Intra-Asia trades, that already employ 3,000-TEU ships, but not on short rotations similar to that selected for our case study.

Newbuildings for Case Studies

The analysis above indicates that because of ECA, a potential operator of coastal shipping granted a waiver from US-built will prefer newbuildings over retrofitting and re-flagging second-hand, older ships available on the world market. Also, the secondhand market for RoRo ships is relatively small and therefore it is unreasonable to expect finding ships similar to those specified in the case studies. A related observation, drawing from Tote's recent experience, is that since coastal services will be routed entirely within ECA, the newbuildings are likely to be dual-fuel engines or, perhaps, solely based on LNG. This seems to also be the trend in Europe, whereby almost all new buildings are planned with LNG engines.

The preceding analysis also indicates that granting a Jones Act waiver from US-built, or allowing exempt coastal services, is not likely to face objection from domestic lines operating Jones Act ships. This is indicated by the fact that these lines are not presently providing coastal services because of their inability to compete with land-based coastal services. This situation is not likely to change in the future since, as seen in the case of Tote, newbuildings or retrofitted newer Jones Act ships are likely to be even more expensive than older ships. Moreover, future newbuildings are expected to be similar in size and configuration to Tote's Marlin-class ships, which will make them unsuitable for the three case studies selected here.

Altogether, an important preliminary finding of this report is that future operators of exempt ships are likely to employ newbuildings, much like present operators of Jones Act ships -- except that they will have the option to construct their ships in foreign shipyards. Accordingly, in this analysis of all case studies, newbuildings are assumed.

SHIP SELECTION AND CONSTRUCTION COST

Domestic-Long Ships – Herbert Midsize Ro-Ro

Selected Design

The suitable ship for this application of coastal shipping, as defined in the Summary Description of Case Studies, is a midsize and relatively fast RoRo, capable of carrying both unaccompanied trailers and domestic containers on a road chassis, or double-stacked on cassettes. The selection of this ship is based on the HEC study and a study by a potential operator, Intermodal Marine Lines (IML). Following a comprehensive study, IML has invested in the preparation of a preliminary design of an innovative RoRo ship, based on a new hull shape developed by one of the largest builders of off-shore supply vessels, STX. The STX design, defined as the “Enduro” series, has the dimensions of 192 x 26 x 7 m, with 3,803 lane-m, and capacity for 149 53-ft. trailers and 136 double-stack 53-ft. containers loaded on cassettes and stowed on the main deck, a total of 285 53-ft. units, or the equivalent of 755 TEUs. The design speed is 25 k provided by a dual-fuel engine with total power of 28.5 MW. Planned voyage speed is 20 k. Figure 10 shows the main design features of the Enduro series. Figure 11 shows a picture of cassettes parked nearby a RoRo ship and a Translifter, a special small-wheel chassis, which fits underneath the wheel-less cassette. The cassette system was developed by TTS, a Finnish manufacturer of cargo handling equipment. It is currently only used in Europe.

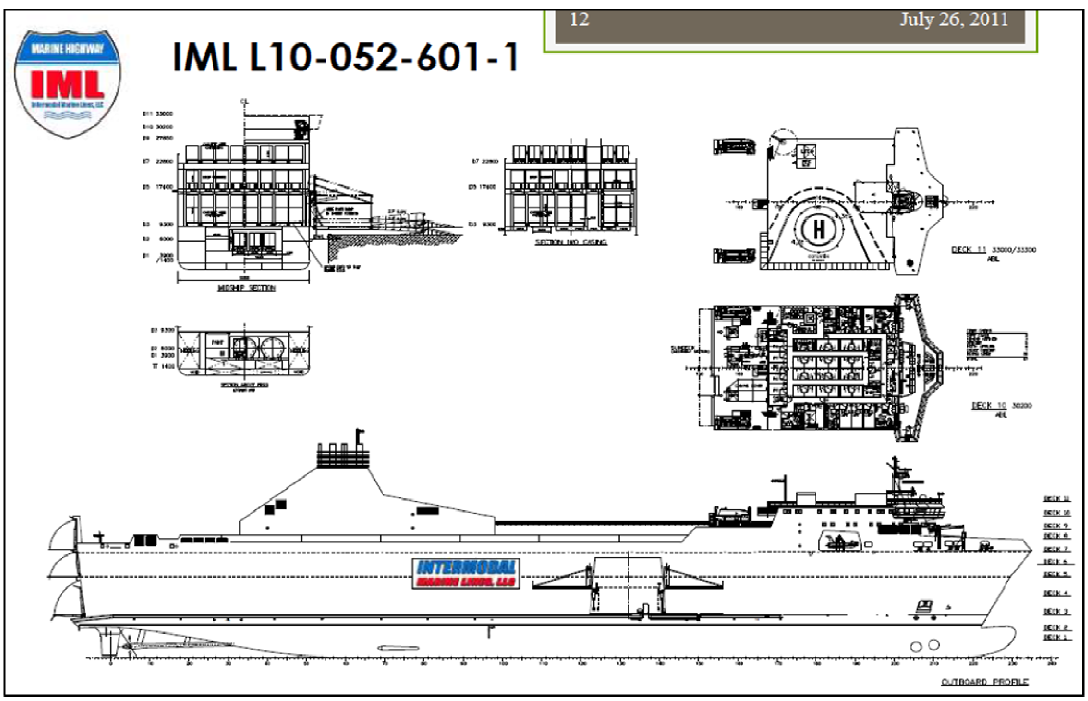

Figure 10
IML's Enduro RoRo ship
(Source: IML, 2012)

Figure 11
The cassette system
(Source: TTS, 2013)

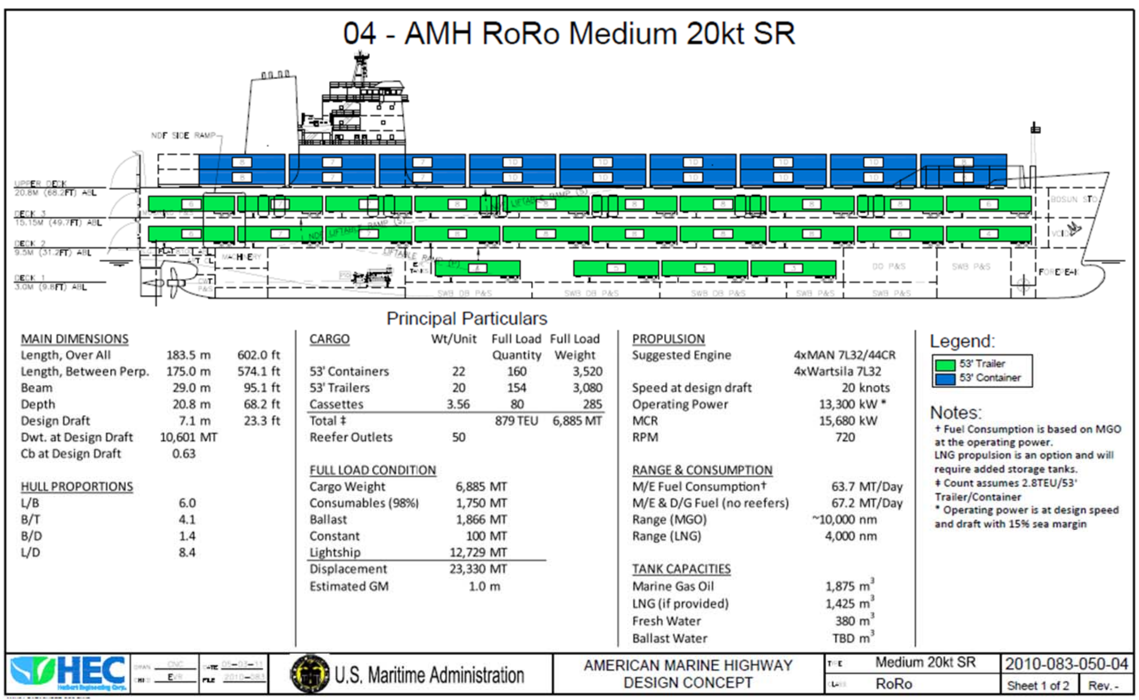

Figure 12
HEC 04 selected for domestic-long

Figure 12 shows the 04-AMH Ro-Ro Medium 20kt SR (HEC 04), the design selected for Domestic-Long. HEC 4 and IML's Enduro design have similarity in dimensions. The HEC 04 design has the dimensions of 183 x 20 x 7.1 m, with capacity for 154 53-ft. trailers and 160 53-ft. containers double-stacked on cassettes, or a total of 314 53-ft. units. The main difference between the IML and the HEC designs is that in the IML, the house is located in the fore and the cassettes are stowed on the main deck. HEC follows a more traditional design, with the house in the aft and cassettes stowed on the weather deck. Also, despite the somewhat shorter hull, the HEC design has a higher capacity by about 10% (314/285). A more important difference between the two designs is speed; the IML ship has a design speed of about 25 k and a respective engine of 28.5 MW vs. 20 k and 15 MW for the HEC ship. As a result, the HEC ship has lower fuel consumption, although at the expense of longer transit time. Another HEC design, HEC 03, was considered but not selected, because it had lower capacity and higher speed of 23.7 k.

Based on a review of previous studies and discussions with freight brokers, it seemed that a shorter trip time would not justify the considerable increase in fuel cost. Likewise, a faster ship also requires a larger engine as seen above, resulting in a higher capital cost as reflected in the initial estimate of $163 million for HEC vs. $185 million for IML. All ship construction costs relate to a series of 2 ships, based on the HEC study. In an interview, HEC professionals indicated that these cost estimates are on the low side since only scarce information is available on dual-fuel technology. The main competition for the coastal service would be by a rail intermodal service presently provided on a daily service and with a shorter transit time. Hence, the ship service is bound to compete mainly on cost and not on level of service.

Cost Adjustments for Commercial Use

Both the IML and HEC designs are geared toward dual use for commercial and military purposes. The military requirements mainly relate to minimum speed and range, number of ramps, and especially, strength of decks and side ramps. Besides having military features and allowing their ships to be available at times of emergency, operators would expect that some of their capital cost to be covered by the Federal Government. The case studies presented here are all related to "pure" commercial applications, with ships having no additional features and no expected financial support by the Federal Government to compensate for them.

In the selected ship design, HEC 04, a considerable reduction in construction cost can be achieved if the ship only handles commercial based on: (a) lighter deck loads and lower deck heights, estimated to save about $10 million; and (b) elimination of two side ramps estimated to save about $20 million. The above cost estimates of the savings are rough and, in line with the authors' approach to favor the water-based system, somewhat exaggerated. These estimates and others related to construction costs are based on extensive consultation with naval architects from Herbert Engineers, Spar Associates, and OceanEng. The total cost reduction amounts to $30 million or about 18% of the original cost estimate based on dual-use ship of $163 million. Accordingly, the US cost of construction of a commercial version of Herbert 04 design is expected to be $133 million.

Domestic-Short Ships – Robert Allan Coastal Ferry

Selected Design

The suitable ship for this service, as defined in the Summary Description of Case Studies, is a small and relatively slow RoRo, designed for handling unaccompanied trailers and containers on road chassis. The only design available in the HEC study which could suit this application is 01-AMH RoRo Small 18kt, with the dimensions of 168 x 27 x 6 m, has capacity of 71 53-ft. trailers and 71 53-ft. containers on cassettes (double-stacked) or a total equivalent capacity of 376 TEUs and speed of 18 k. The HEC design is too large and fast for the short route and the high-frequent service. It has 23 cabins and is geared to a much larger crew than that required under the functional crew assumption. Also, the cassette system is too cumbersome for this service.

Instead of the Herbert design (HEC study), the authors selected a design by Robert Allan (Allan), prepared for a potential operator of the New York/Boston service, Costal Connect. Figure 13 shows this design. As seen in this figure, the Allan design has dimensions of 135 x 26 x 6 m, providing 1,500 lane-m with capacity of about 100 units, based on a mixture of 53 and 40-ft. The proposed ship is equipped with a large quarter ramp, as well as a single internal ramp to connect the weather deck to the main deck. Both would not be needed if a port system based on fixed, two-level ramp installed at the terminals of call. Elimination of ramps along with a slight extension of the decks will increase the capacity by about 10 units, resulting in a total capacity to about 110 units, or the equivalent of about 250 TEUs. The construction cost of the Allan design is estimated at about $95 million.

The selected navigation route is mostly in protected waters. Therefore, there is no need for lashing the containers aboard ship, saving on port labor as well as port time.

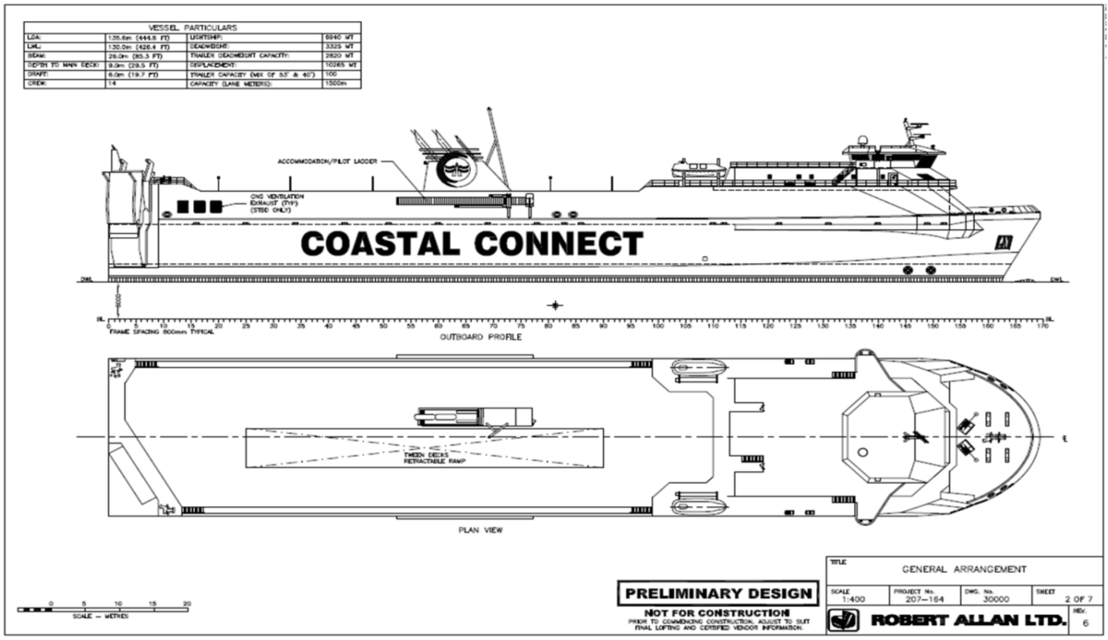

Figure 13
Robert Allan design selected for domestic-short

Cost Adjustments for Commercial Use

The first adjustment, already noted above, is the elimination of the side internal ramps, which is estimated to save about $5 million. Another adjustment relates to the speed. The original Allan design was for 22 k, which would require a main engine of about 9,000 kW. Reducing service speed to 18 k reduces the power requirement to about 5,500 kW and the cost by additional $10 million. Accordingly, the total cost of the adjusted Allen design is estimated at $80 million.

Feeder-Short – HEC Small Feeder

Selected Design

The suitable ship for this service, as defined in the Summary Description of Case Studies, is a small LoLo for international containers (no 53-ft. units). Herbert 21-AMH Lo-Lo Small 18kt seems suitable (HEC 21). HEC 21 design has dimensions of 152 x 25 x 7.6 m, with capacity of 826 TEUs. HEC design is somewhat smaller than the design developed by a potential operator American Feeder Line (AFL). AFL design, based on a common European feeder, has capacity for approximately 1,300 TEUs (992@14 ton/TEU). In both designs, boxes are stacked 5-high on deck and 4-deep below deck. Figure 14 shows the HEC 21 design; Figure 15 shows a picture of AFL design.

E.9 Vessel Design 21 – Container Feeder 18 kt

Length Overall	151.7 m (497.7 ft)
Beam (Barge0	24.8 m (81.4 ft)
Design Draft (Barge0	7.6 m (24.9 ft)
Design Speed	18.0 knots
TEU Capacity	826
Max Trailer Capacity	None
Typical Full Load Container & Trailer Capacity	392 Containers (mix of sizes)
RoRo Deck Area	None

Figure 14
HEC 21 selected for feeder-short

Figure 15
AFL design
(Source: American Feeder Line, 2011)

AFL planned a comprehensive network of feedering services along the US East and Gulf Coasts, consisting of three segments: from Boston and Portland, Maine in the north east to East Coast ports as far south as Norfolk, Virginia; from there to Miami, Florida; and a link into the US Gulf to New Orleans, Houston, and Galveston. AFL calculated that a weekly frequency would require a total of 10 LoLo ships, all Jones Act, built in US shipyards. AFL's longer plan included 30 – 40 ships. All AFL ships would comply with EAC. AFL intended to serve both domestic and international cargo.

AFL was declared eligible for funding assistance under the AMH program, since its proposed services followed the M-95 and M-10 routes of the program (Figure 2). In preparation for the larger service network, AFL started a trial feeder service between Boston, MA; Portland, MN; and Halifax, Nova Scotia, CN. The service employed a single chartered, foreign flag ship, the 700-TEU (100 reefer plugs) AFL New England. AFL service followed a previous one, by Hapag Lloyd, the Yankee Clipper, which has been operating during the 1980s and early 1990s, and several other, subsequent feeder services, including a more recent one by Eimskip -- all failed. Unfortunately, this also was the fate of AFL service after only 9 months of operation during 2011 and the beginning of 2012. The service suffered heavy losses, despite loans from the ports of Portland and Halifax and when AFL failed to pay its debts the ship was seized.

AFL service's core traffic was the export of forest products from New England, and import of consumer goods from Europe and Asia to Boston, with Halifax serving as a hub. Since AFL was using a foreign-flag ship, it could not transport containers between US ports. The ship was handled by a Mobile Harbor Crane (MHC) in Portland and gantry cranes in Boston and Halifax.

The expected cost of AFL ships was $75 million, based on estimates obtained from US shipyards. Accordingly, AFL was looking for a total investment of $750 million, which it was unable to raise and the project was terminated. The cost of construction estimate for HEC 21 is $84 million; HRC 21 is a slightly smaller ship than AFL's. Accordingly, the selected cost estimate for the HEC 21 is $75 million.

Cost Reductions Adjustments to Commercial Use
The HEC 21 ship is a common feeder, with no special features added due to dual use. Hence, there is no need to adjust its cost.

Comparison of US-Built Ship Cost

Table 1 presents a comparison table of the three selected ships, their dimensions, capacities, and original and adjusted cost estimates. The adjustments relate to military-useful features considered unneeded for pure commercial application, along with external and internal ramps, not necessary, if the RoRo ships are handled by a multi-level, shore-based ramps. The highlighted figures (in red) relate to three cost indices, the first two, cost per TEU (slot cost) and per TEU-NM relate to the ship's capital costs; the third, kW/TEU-NM, to the cost of fuel, the main component of the operating cost. The larger ship employed by Domestic-Long has slot cost, about half that of the Domestic-Short, although both are RoRos. This difference is partially attributed to the use of double-stack cassettes in Domestic-Long. Feeder Short, however, is considerably lower both in capital and fuel cost than the other two ships. The low cost is attributed to the LoLo configuration based on stacking containers one above the other, eliminating the need for costly structural support and resulting in better space utilization. The differences in fuel costs are not as wide as those in capital cost. Interestingly, despite the higher speed, the fuel cost of the Domestic-Long is similar to that of the Feeder-Short due to scale economies.

Table 1
Capital costs of US-built coastal ships

General Ship Particulars	Unit	Domestic Long	Domestic Short	Feeder Short
AMH Number	Unit	HEC 04	Allan	HEC 21
Type		Ro/Ro Cas.	Ro/Ro	Lo/Lo
Capacity	53, 40-ft Box	314	110	423
	TEUs	832	250	826
Dimensions (LOA x beam x draft)	m	183 x 20 x 7.1	135 x 26 x 6	152 x 25 x 7.6
Design Speed (90% MCR)	Knot	20	18	20
Rated Power, MCR	kW	15,800	5,500	14,800
HEC US Construction Cost	$	163,000,000	95,000,000	75,000,000
Savings in Design	$	30,000,000	15,000,000	-
Modified US Construction Cost	$	133,000,000	80,000,000	75,000,000
Construction Cost per Slot	**$/TEU**	**159,856**	**320,000**	**90,799**
Construction Cost per Slot-NM	**$/TEU-NM**	**7,993**	**17,778**	**4,540**
Fuel Cost Index	**kW/TEU-NM**	**0.95**	**1.22**	**0.90**

Foreign-Built Impact on Ship Cost

Constructing ships in foreign shipyards is considerably less expensive than in US ones. Estimating the cost differentials is difficult, however. It varies by country of construction and ship type. For this study, the authors selected as the foreign country South Korea, being the largest ship-building country worldwide. Regarding ship's type, RoRo ships are relatively sophisticated ships, especially the Domestic-Long. Also, RoRo ships are usually built in small series with their specifications tailored to fit a specific application therefore there are no universal standards against which cost comparison can be made. The comparison is somewhat easier in the case of LoLo, where the market is broader and cost standards, usually expressed by $/ slot-TEU, are more widely used.

Another complication in estimating the cost stemming from construction in foreign shipyards is caused by the recent ECA regulations. It is reasonable to assume that following ECA all ships deployed on US coastal services will have LNG propulsion, for which there is still limited information. Based on discussions with naval architects experienced in building ships both in the US and in South Korea, the authors estimate that the savings for RoRo ships would amount up to 40%. Interestingly, building these ships in European shipyards will cost the same or even more than in the US.

The savings in construction cost using South Korean yards in the case of the Feeder-Short are much higher, reaching 60%, meaning the US-built LoLo ships cost 2.5 times more than South Korea-built. The reason for such cost reduction is because the selected configuration is standard, similar to those used in many feeder and short-sea applications worldwide. Likewise, these ships are usually built in large series.

Table 2 presents a comparison table similar to Figure 13, but with adjustments to foreign construction costs. As seen in this figure, the Feeder Short slot cost of about $36,000/TEU is about one fifth of the $192,000/TEU of the slightly smaller (in terms of dimensions) Domestic-Short and about one third of the larger Domestic-Long. This cost ratio is kept for the cost per TEU-NM, which is a better descriptor of the capital cost.

Table 2
Capital costs of foreign-built coastal ships

General Ship Particulars	Unit	Domestic Long	Domestic Short	Feeder Short
AMH Number	Unit	HEC 04	Allan	HEC 21
Type		Ro/Ro Cas.	Ro/Ro	Lo/Lo
Capacity	53, 40-ft Box	314	110	423
	TEUs	832	250	826
Dimensions (LOA x beam x draft)	m	183 x 20 x 7.1	135 x 26 x 6	152 x 25 x 7.6
Design Speed (90% MCR)	Knot	20	18	20
Modified US Construction Cost	$	30,000,000	15,000,000	75,000,000
Foreign Built Multiplier	$	0.60	0.60	0.40
Modified Foreign Construction Cost	$	18,000,000	9,000,000	30,000,000
Construction Cost per Slot	**$/TEU**	**21,635**	**36,000**	**36,320**
Construction Cost per Slot-NM	**$/TEU-NM**	**1,082**	**2,000**	**1,816**

Title XI Ship Financing

The Maritime Administration manages several programs in support of the US domestic shipping and shipbuilding industries. For many years, the main program has been the Title XI Federal Ship Financing Program. The program is available to ship owners building ships at US shipyards, as well as to shipyards in need of capital investments to be able to build these ships. In this program, the U.S. government insures or guarantees full payment to lenders the unpaid principal and interest of mortgage obligations on ships, taken by ship owners. Because of this guarantee, funds for the debt obligations are obtained by ship owners in the private sector sourced from pension funds and other institutional lenders at low interest. Guarantees on the obligations are provided for up to 87.5% of the ship's actual cost. There are other support programs available to Jones Act ships, such as the Capital Construction

Fund, that, in case they are approved for coastal shipping, might further enhance the attractiveness of building in the US. Since Title XI is the most common plan, this discussion is only concerned with it.

The main advantages for ship owners eligible for Title XI financing compared to financing available on the international market are:

- ***Low Equity Requirements* –** Using the Title XI ship owners' requirement for upfront cash is only 12.5%, significantly lower than the typical 30-40% required when using international market financing;
- ***Low Loan Interest* –** Because of US government guarantees, the interest rate on the Title XI loan is similar to that on low-risk bonds, which is considerably lower than the international market rate; and,
- ***Long Term Amortization Period* –** Title XI loans are granted for 25 years, the entire economic life of ships, which is much longer than the typical 10-year loans available in the ship-finance market, resulting in a much lower annual payment.

Title XI also involves additional expenses usually added to the loan principal amount, averaging 4.9% of construction cost. In comparison, arranging financing in the international market involves origination costs estimated at about 2.5%.

Because of their favorable terms, Title XI financing has been used in most of the newbuilding programs for domestic shipping lines. The Maritime Administration currently has more than $2.5 billion in pending loan guarantee applications to build vessels worth more than $2.9 billion in U.S. shipyards *[8]*. Title XI financing is not available to US operators building ships at foreign shipyards. Hence, the financial advantages of Title XI may offset the lower construction cost that a foreign-built waiver provides, as discussed in the previous section. It is quite difficult to assess the value of Title XI financing short of arduous calculations addressing specific cases. Still, in order to get a rough estimate of the worth of Title XI, the authors assume a typical blended cost of capital for comparing Title XI financing versus international financing *[9]*. Table 3 provides a somewhat simplistic calculation of the difference in capital cost between Title XI financing and international financing. To make both financing plans comparable, the authors selected a 10-year debt instrument, typically used in the international market for ship financing. The authors assume that the required return on equity is 15%, in line with that typically required by ship owners and an interest rate of 500 points above that of 10-year treasuries for the guaranteed loan *[10]*. The resulting blended costs of capital for Title XI and the market financing are 4.9 and 10.8%, respectively. To estimate the value of this difference in financing cost, the authors assumed a 10-year amortization schedule and calculated annual payments for US (Title XI) and foreign costs of capitals. The results, as seen in the last column of Table 3, indicate that a ship owner using foreign financing needs to borrow 27.5% more than what he would need if used US financing. The higher cost of foreign financing offsets the lower cost of foreign shipbuilding. Table 4 provides a calculation of this effect. As seen, the adjusted reduction in cost of ships using foreign shipyard will be 23.5% for the RoRo and 49% for the LoLo.

Table 3
Cost of financing Title XI vs. international market

Option	Capital Composition		Rates		Blended Cost of Capital	PMT (Blended,10,1)	Loan Origination	Adjusted PMT
	Equity	Debt	Required ROE	Loan Interest				
US	12.5%	87.5%	15.0%	3.5%	4.9%	0.129	1.049	0.135
Foreign	40.0%	60.0%	15.0%	8.0%	10.8%	0.168	1.025	0.173
							Foreign/US	1.275

Table 4
US vs. foreign built adjusted cost of construction

Case Study	Construction Cost	Financial Cost	Adjusted Construction Cost
	Foreign / US	Foreign / US	Foreign / US
Domestic Long	0.600	1.275	0.765
Domestic Short	0.600	1.275	0.765
Feeder Short	0.400	1.275	0.510

The calculation above relates to shipbuilding in general, but not specifically to coastal shipping. Discussions with US ship owners familiar with the international market indicated that US coastal shipping appears to have two risk factors that may affect the cost of international financing: (a) US coastal shipping has a “spotty” past record, the result of many past failures; and (b) the international market for RoRo ships is quite limited since ships that are tailored-built for applications tend to have a low resale value. Both factors imply that coastal shipping would be a high risk project which, in turn, will have to be compensated by a high return on equity and high equity-to-debt ratio. This, in turn, will further reduce the difference in the cost of ship building in the US and abroad.

SHIPS' CREWING COST

Functional Crewing

The crew size of ships is generally determined by three factors: (a) operational (functional) requirements, or the number of positions that have to be manned in order to keep the ship running and well maintained; (b) safety requirements; and (c) legacy manning contracts with seafarer labor unions.

The operational requirements for operating and maintaining ships are generally a function of the size of the ship, usually defined by its Gross Registered Tonnage (GRT), or its enclosed space (roughly equal to length x width x depth) and, for engineers, the size of its engine (kW) and its level of automation (manned or unmanned). The safety requirements are related to ship size and sea states along its navigation route and the length and location of this route, especially whether it is coastwise or offshore.

Usually, the ship crew is divided into three departments: deck, engine, and staff services. Within each department the positions are further divided into those requiring licensed (officers) and unlicensed personnel (ratings). The various operational manning and licensing requirements are specified in Title 46 of the United State Code (USC 46). The safety requirements are specified in the US Coast Guard Marine Safety Manual, including definitions of the watch-standing system in terms of hours and composition in the deck and engine departments. The watch system is affected, among others, by the length of the voyage. A labor-saving, two-watch system is allowed only for voyages less than 600 NM. The watch composition consists of two individuals; at least one of them should be a licensed deck mate.

ATB Manning

Both USC 46 and the Coast Guard Manual manning regulations are quite general and refer mainly to minimums. In reality, crew size is determined on a case-by-case basis according to regulations and negotiations with seafarers' labor unions.

The manning scheme on which a functional crewing for coastal shipping can be based is modern ocean-going tugs and especially ATBs because: (a) most ATBs are deployed on coastal routes; (b) they have relatively small tonnage, similar to the coastal ships in these case studies; (c) their labor contracts are relatively new and do not follow legacy contracts of self-propelled ships serving on deep-sea routes; and (d) under the ATB operating model, some of the maintenance is performed by shore-based contractors, eliminating the need to do maintenance work while underway, reducing crew size.

The typical crew size of an ATB on a coastwise run with a tank barge is six: Chief Mate, Second Mate, Chief Engineer, two tankermen, and one Able Seaman (A/B) deckhand. In the case of non-automated engine room, an Assistant Engineer as added. The ATB crew members live on-board, since the ATB is typically operating 24 hours. Tankermen, specializing in handling hazardous materials, are unnecessary in the case of coastal shipping of containers. Accordingly, the most basic crew can consist of four persons, which is also the case in smaller ocean-going tugs.

Functional Manning of Coastal Ships

The Domestic-Short is a small, relatively-slow ship and its route, 170 NM, is much shorter than 600 NM. Also, the trip time is about 12 hours, so the shift system can be based on 2 x 6 hours. The suggested crew size is similar to ATB with the addition of two Able Seamen/Assistant Engineers for mainly line handling, cargo, etc. Accordingly, the total crew size deemed necessary is six persons, four licensed and two unlicensed. Since the entire trip is about 12 hours, there is also a possibility of day crews, whereby crews rotate at end ports each voyage, similar to airplane crews. This crewing system could further reduce crew size to five, or even four, persons also eliminating the need for most of the cabins. Since the day-crew system has never been tried on US ships, its impact is not discussed in this study.

The Domestic-Long ship is relatively fast and sophisticated; its itinerary is longer than 600 NM, mandating a 3-shift system, each with a licensed mate and engineer. Also, because of the length of the itinerary, there is a need for a staff department, taking care of cooking, laundry, cleaning, etc. Hence, the functional crew size here is much larger than Domestic-Short, including seven licensed and eight unlicensed, or a total of 15 persons. HEC manning for this ship was slightly larger, consisting of six licensed and 11 unlicensed, or a total of 17. The salary level range at HEC was slightly lower, however.

The Feeder-Short ship stands between the above two in terms of size, speed, and sophistication. Accordingly, its functional crew size should include six licensed and three unlicensed or a total of nine persons. For comparison, the Sea Trader, a modified supply ship converted to a containership, 87 x 19 x 5 m, 248 TEUs, and operated by Osprey Container Line in 2005 on the route Tampa, Houston and Brownsville, also had a crew of nine, including one chief mate, three mates, three engineers, and two AB. Similar manning is also found in European short sea ships of similar size.

The functional crew sizes above are considerably smaller than those of present Jones Act ships which, based on union contracts, is typically 18 – 20 persons, with older ships operating between the US mainland and Puerto Rico having much larger crews. For example, the 1973 Horizon Trader, with dimensions of 248 x 29 x 9.1 m (LOA x beam x draft), 31,495 dwt and 2,139 TEUs, with a steam-turbine engine, has a 30-man crew; the

1974 Sea Star's El Faro, reconstructed in 1992/2006, with dimensions of 241 x 28 x 8.5 m, 17,300 dwt and 1,200 TEUs, has a 26-man crew. The larger crews can be partially attributed to the low level of automation in older ships.

Table 5 shows the crew composition and daily cost of the three selected coastal ships. The salary level is based on actual union contracts in the New York harbor, job listings on ATB want-ad websites, and discussions with ship operators. The daily cost excludes fringe benefits and provisions. The salaries of the Domestic-Long and Feeder-Short crews are assumed 20% higher than Domestic-Short due to the larger size of ship and the longer itinerary. Despite the lower daily labor cost of the Domestic-Short, its labor cost index, expressed in $/TEU-NM, is the highest among the three ships selected for the analysis of coastal shipping.

Table 5
Crew size and cost in coastal ships

Case Study	Unit	Domestic Long	Domestic Short	Feeder Short
Design		Herbert 04	Allen	Herbert 21
Type		Ro-Ro Cass.	Ro-Ro	Lo-Lo
Capacity (53-ft)	53-ft	314	110	--
	TEUs	832	250	826
LOA x beam x draft	m	183 x 20 x 7.1	135 x 26 x 6	152 x 25 x 7.6
Crew Composition				
Officers	Number	7	3	6
Unlisted	Number	8	3	3
Total Crew	Number	15	6	9
Total Crew Salaries	$/Day	7,320	2,650	4,680
Fringe Benefits (35%)	$/Day	2,562	928	1,638
Provisions ($30/day)	$/Day	450	180	270
Daily Cost	**$/Day**	**10,332**	**3,758**	**6,588**
Labor Cost Index	**$/TEU-NM**	**0.62**	**0.84**	**0.40**

Administrative Cost

In addition to direct costs (those associated with ship operation) each of the services has administration and management costs (overhead). This cost depends, to a large degree, on the type of shipping services that each of the coastal services provide. The Domestic-Long and Domestic-Short services will be provided mainly to shippers and truck lines. Hence, these services require having a marketing department, to sell the services and maintain contacts with customers, and a finance department, to issue invoices and collect them. The Feeder-Short will provides its services only to lines calling New York, which may only include 5 - 10 customers. Hence, the administrative cost of this line will be limited.

The investments in ships and terminals do not include any provision for working capital and start-up cost. Both are estimated as a percentage of revenues and added to the administrative cost after being annualized.

PORT SYSTEM AND COST

Alternative Port Systems

An operator of either a Domestic-Long or Domestic-Short service has two principal options regarding its terminal system using:

- ***Public Terminal* –** The ships would be handled at an existing terminal, using portable Ro-Ro ramps (bridges); or,
- ***Dedicated Terminal* –** The ships would be handled at a specifically designated waterfront area either within an existing port (Domestic-Long) or outside it (Domestic-Short).

In the first case, the line will pay the local port authority port dockage/wharfage and other facility-usage charges, along with paying a local stevedore for ship and terminal handling. In the second case, the line will lease the area and invest in fixed ramps, yard equipment, terminal building, gate, etc., and employ its own labor for ship and terminal handling.

The advantage of the first option is its simplicity and flexibility. The ship owner can change terminals if unsatisfied with terminal services. Likewise, the ship owner is not required to invest in port facilities. Its disadvantage is a lower level of service of ship handling services. A public terminal can only offer preferential berthing but cannot assure work on arrival. The latter is critical to both domestic ship services, since both are based on a tight schedule intended to provide for high ship utilization. Also, a dedicated terminal is the selected port system by domestic services between the mainland and Puerto Rico (Crowley and Tote RoRo services also use dedicated terminals. Likewise, Crowley employs its own labor.). Hence, it is reasonable to assume that this would be the preferred port system of coastal services and the system selected in this study for calculation of port cost. Accordingly, the authors assume that each service will have dedicated terminals at each port of call operated by the respective shipping line.

Unlike the operators of domestic coastal services, an operator of a Feeder-Short has no choice of port systems. The mother ship calls at a hub port, which is a deep-sea container terminal. Likewise, the feeder port would most probably call at a deep-sea container terminal in a regional port, whereby the direct call by mother ship is substituted by a feeder call. Hence, port cost in this case is calculated based on existing tariffs at deep-sea terminals which, in this case study, are the ports of New York and Boston.

Pilotage and Tuggage

For all case studies and ships, it is assumed that the ship captain (chief mate) has a US pilot license and that because the ship is repetitively navigating the same route, there is no need for an outside pilot for accessing or departing ports.

Likewise, since all ships are designed with thrusters, there is no need for tug assistance for channel maneuvering or berthing/de-berthing.

RoRo Terminals

Terminal Components

A marine terminal typically is comprised of three main facilities:

- ***Dock*** **–** The marine structure to which the ship is tied and on which ship-handling equipment is positioned;
- ***Yard*** **–** The near-dock area in which containers and trailers are stored before and after loading/unloading ships; and,
- ***Gate*** **–** The connection to/from outside the port where incoming and outgoing trucks are processed, including pre-gate parking.

In addition, the terminal needs to have a water-access channel and a turning basin for ships, and a land-access road for trucks. Coastal terminals usually do not have rail access.

Figure 16 shows an aerial photo of a European RoRo terminal. As seen in this figure, the RoRo ship is moored perpendicular to the shoreline, often defined as "Mediterranean style" mooring. Accordingly, the shoreline required for the terminal is small, only slightly wider than the ship beam. This would be a critical advantage in places where the shoreline is limited. The connection between the ship and the shore is via the stern, using a shore-based RoRo ramp. The yard, seen behind the ship, is essentially a parking lot for trailers; it has no lifting equipment. The gate, seen at the upper end of the picture, is relatively small, since the gate processing in case of domestic cargo is limited – or none. To save time, the booking can be done ahead of time and the actual processing (physical checking) performed after the trailers have been parked.

The yard in the European terminal is adjacent to the berth. However, since all cargo is on wheels, the yard, or the place where trailers are staged, can be provided off dock, 1 – 2 km away from the water, assuming the connection does not require crossing public roads. The possibility of remote yard is critical in cases where waterfront land is scarce or expensive.

Figure 16
European RoRo terminal

RoRo Ramps
If the ship is sailing between the same terminals, the terminal system could be based on a fixed multi-level bridge, similar to the system used by Crowley and TrailerBridge for their multi-level barges. Accordingly, the coastal ship could avoid having internal ramps and lifts, which in turn saves on their construction cost as shown in previous section on ship selection. Eliminating side or quarter ramps and using stern access via fixed multi-level bridges also saves on the required length of waterfront since ships can be moored in perpendicular to the shore line.

Figure 17 shows a Google aerial photo of the ramp at Crowley's terminal in San Juan, while handling its barge. Crowley has similar ramps at its terminals in Pennsauken, PA, and Jacksonville, FL. Crowley handles its triple-deck barges in these terminals, the largest of which have the dimensions of 222 x 32 x 17 m (length x width x depth) barge, with capacity to carry 480 trailers and 240 cars, or about 50% larger than the selected ship for Domestic-Long coastal service. As in the European terminal, the RoRo barges are served entirely from their stern; Crowley's barges have no side or stern ramps. The handling process is done through a triple-level bridge, which also provides a turning area for trailers. In Figure 17, a tractor trailer can be seen while turning on the bridge upper deck. As also seen in Figure 17, the length of the waterfront taken by the bridge is limited to the width of the bridge. In cases where the traffic channel is close to the terminal resulting in the barge inferring with traffic, barges can be moored in parallel to the shorelines as is the case in Crowley's Pennsauken terminal. Parallel mooring requires longer shoreline.

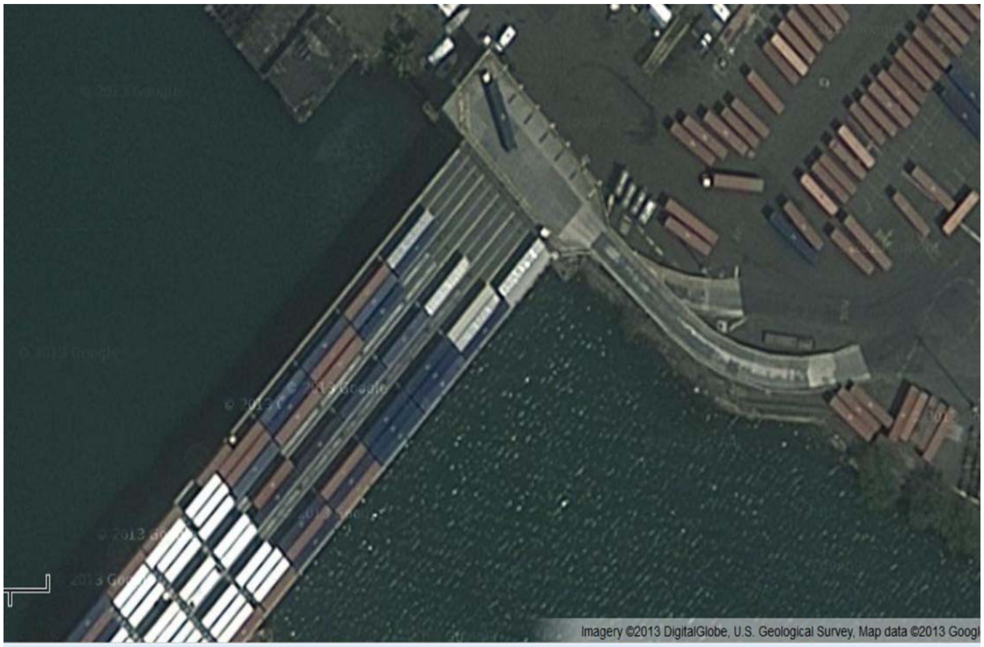

Figure 17
Crowley RoRo bridge and barge

Figure 18 shows a Google aerial photo of the ramp structure in the Trailer Bridge terminal in Jacksonville. The fixed structure along with short flaps provides limited height adjustments. This arrangement is suitable in the cases of both Philadelphia and Jacksonville since the tide range in both places is quite limited. The three-level bridge structure required for handling Domestic-Short should be heavier than Crowley's because of the double-stack cassettes. In the case of the Domestic-Long, the cost is estimated at $10 million, based on standard costs of dock structures. In the case of Domestic-Short, the required structure is much smaller, since it only supports road trailers (no cassettes), and the ship is smaller and with only two decks. However, there is a need for hydraulic lifts to handle the wider tide range that can reach 2 m, pending on location. The estimated cost of the ramp structure in this case is $6 million along with $5 million for the hydraulics.[1] In both cases, these costs are notional; a more detailed engineering design is beyond the scope of this study, which focused on the Jones Act. Also, as will be seen later, a higher level of accuracy is not considered critical for supporting or rejecting the research questions.

[1] Cost estimates where prepared based on extensive consultation with port engineers with experience in designing RoRo terminals in the US and abroad.

Figure 18
Trailer bridge RoRo bridge

Size Terminal Yard and Terminal Equipment
The yard in the case of RoRo terminal is simply a paved, fenced, marked, drained, and lighted area. The required size of the yard is based on the storage density and the dwell time of the cargo. The entire ship loading/unloading process is performed by terminal tractors with an elevating fifth wheel and a swiveling driver seat allowing change in steering direction. This type of RoRo tractor, seen in Figure 19, is often called “Mafi,” the name of its manufacturer. In the case of Domestic-Short, the yard is similar to that shown in Figure 16. As noted before, since the entire cargo is on wheels, the yard does not have to be located adjacent to the ship, but can be located further away in the backland. This option is important in case of a shortage in waterfront land, as expected in the case of New York Harbor.

Figure 19
Yard tractor for RoRo terminals
(Source: Mafi, 2013)

In the case of Domestic-long, in order to save ship space and increase capacity, about half of the cargo consists of boxes staged two-high on cassettes. Handling these double-stack cassettes is cumbersome and requires a special gooseneck trailer referred to as a translifter by ITS, the developer of the system. The ITS system is shown in Figure 11. Because cassettes are expensive, they are not used for storing containers in the terminal yard, except for special cases (e.g., outsize cargo). Accordingly, there is a need to lift the boxes off the cassettes and stage them on the ground upon the discharge of cassettes from the ship and vice versa prior to ship loading. These extra “lifts” are usually performed by reachstackers (RS). As a result of the box grounding, the terminal has a small container yard (CY), similar to the CYs in LoLo terminals. Based on preliminary calculations, we estimate that the land requirement of the Domestic-Long terminal is about 25 acres, including a 5-acre CY; the requirement for the Short-Domestic is 10 acres.

The terminal equipment required for Domestic Long is limited to yard tractors (Figure 19), relatively standard and inexpensive machines. For the Domestic Long, in addition to yard tractors there is need for translifters, cassettes and RSs. It should be noted in this respect that the cassettes system is not in use in the US and even in Europe it is only used in a few terminals.

Terminal Operation
The terminals of both RoRo services are dedicated to these services. Accordingly, the labor force in both terminals also is assumed to be dedicated or permanent. The number of positions is determined according to operational requirements and is not based on gang sizes specified in various legacy union contracts. The determination of the number of operational people is designed to allow simultaneous handling of all decks and lanes, to expedite the ship loading/unloading process. For example, in the case of Domestic-Short, it is assumed that six tractors will be serving each of the decks, with each deck accommodating about 55 trailers. Assuming 10 minute cycle time, the entire loading/unloading process requires three hours (110 moves/6 tractors x 10 min per move = 183 min), way below the planned 4 hours allocated in the voyage plan.

The ship loading/unloading process in Domestic-Long is similar to the Domestic-Short, but the process is slower. First, about half of the moves involve translifters, which usually travel at slow speed; second, the Domestic-Long ship is much larger than the Domestic-Short. Accordingly, the allocated time for the entire handling process is 8 hours. In addition to ship handling by tractors (Mafis), there is an additional lifting, by RSs. For example, in the inbound direction the cassette system involves two lifts: (a) from cassette to ground; and (b) from ground onto truck (and vice-versa in the outbound direction).

Port Labor Cost
As was the case with ship crewing cost, the authors assume functional labor in the RoRo terminals and salary level similar to that common in the present terminals of the domestic lines on the Mainland/Puerto Rico trade lane. It is also assumed that most of the labor is permanent.

RoRo Port Cost
Table 6 shows a summary table of the port cost of the RoRo terminals dedicated to handling the Domestic Long and Domestic Short ships. It should be noted that since, in both cases, the terminal investments are by the ship operator, there are no additional charges by the local port authority for dockage, wharfage or other facility usage costs. The charge for land rental is based on current charges in US ports. The calculations are based on the assumption that both terminals handle full ships. Accordingly, the costs shown in Table 6 are slightly different than those taken in the operation/cost model.

As seen in Table 6, and as expected in RoRo terminals where there are no cranes, the cost of labor is the larger cost factor (43%, 47%) of the total port cost, followed by the cost of land (36%, 33%). The annual cost Domestic-Long is about 40% higher than Domestic-Short, reflecting on the difference in terminal system and size. This cost differential is widened when divided by the terminal throughput, since the Domestic-Short terminal handles about twice the number of boxes. As a result, the total cost per lift of the Domestic-Long is almost 3 time that of the Domestic-Short ($167 vs. $58). The cost of the Domestic-Long can be reduced if the service frequency increases from 2/week to 3/week.

It is also interesting to note that the “market price” for handling RoRo at non-ILA terminals using ships’ ramps is estimated by the industry at $140/move. To this price, the cost of the 2 lifts by RS, estimated at $50 and costs of cassettes and translifters must be added. Ship-handling productivity in non- dedicated terminal with casual labor would be lower than in dedicated terminal. Hence, the use of dedicated terminals is much preferable over public terminals.

Table 6
Port cost and investments in RoRo terminals

Description	Unit	Domestic Long	Domestic Short	Domestic Long	Domestic Short
Land Rental	$/Year	3,750,000	2,500,000	36%	33%
Buildings	"	74,943	46,839	1%	1%
Ramp Amortization	"	1,101,681	1,211,849	10%	16%
Equipment Amortizatin	"	1,012,349	198,222	10%	3%
Fuel	"	100,000	100,000	1%	1%
Labor	"	4,468,500	3,604,500	43%	47%
Total Port Cost	$/Year	**10,507,473**	**7,661,410**	100%	100%
Throughput	53-Units/Year	**62,800**	**132,000**		
Cost per "Lift"		**167**	**58**		
Investments					
RoRo Ramp	$	10,000,000	11,000,000		
Buildings (office, shops)	"	800,000	500,000		
Equipment	"	5,720,000	1,120,000		
Total Port Investment	$	**16,520,000**	**12,620,000**		

LoLo Terminals

Selected Terminals and Equipment

In this case study, the selected ports of call for the Feeder-Shorts are New York and Boston; both are equipped with modern container terminals with gantry, shore-based cranes, often defined as Ship-to-Shore (STS) cranes. The Feeder ship is relatively small, with capacity of 826 TEU. This ship, and even larger ships, can be handled by Mobile Harbor Cranes (MHC), which are less expensive and may therefore save on handling costs. Handling of this ship, with about 500 moves, requires at least 2 MHCs. The Port of Providence has a single MHC, which was used for handling AFL’s ship. MHC can be used for handling other cargoes (e.g., bulk when equipped with a grab). However, as will be seen below, the envisioned terminals of call for the NY / Boston feeder service are not presently equipped with MHCs, and would probably not invest in them for feeder services but prefer using the more productive STSs.

Port New York Terminal
The Port of New York/New Jersey has five main container terminals. Accordingly, the terminal system in NY could be based on:

- Multiple calls, with the feeder ship moving between terminals; or,
- Calling at one, specialized feeder terminal with containers drayed by land to/from this terminal; or,
- Single call at the terminal generating most of the traffic.

Multiple calls in NY was practiced in the past by CCT feeder services, with the barge moving between two to three terminals, spending up to three days in NY. A multiple-calls system is considered impractical for the envisioned feeder service. Shifting the ship between terminals would require additional time, coordination with the harbor master, and additional line handling and dockage charges. It will also require additional berthing windows, which may not be available, and would add to the port time. With multiple calls, the single-ship will be unable to provide the 2/week departure level of service considered necessary to compete with the present daily rail service and on-demand truck service.

A dedicated terminal with a single call was used by the Albany feeder service. Such a system would be operationally convenient in terms of ship operation. However, the drayage from other terminals would add considerably to the cost. Moreover, "live loading" from truck to ship is operationally impractical. Hence, the drayed boxes will have to be grounded prior to ship loading, adding two lifts and the respective charges to the cost of feedering.

It seems that the only practical solution is the third option, calling at the terminal generating most of the traffic. In this case, it seems that this terminal should probably be the terminal complex consisting of Maher and APM terminals. Maher Terminal has a section at the northern end of Elizabeth Channel that could be dedicated for handling the feeder ships, since it is too shallow and the adjacent dock too narrow for handling large, deep-sea mother ships. This will avoid conflicts in berthing and respective delays for the feeder ship which, commonly, is assigned lower berthing priority than mother ships. Calling at the Maher/APMT terminal complex will eliminate expensive double calling for the feeder but will also reduce its traffic potential, eliminating the traffic generated at the 3 other major terminals of the New York Harbor: PNCT, Global and NYCT.

The existing IM rail service to Boston is also calling only at the Maher / APMT terminal complex in Elizabeth, NJ.

Port of Boston
Unlike New York, Boston has only one major terminal, Conley Terminal. The terminal has 2,000 ft. of berthing space, with depth alongside of 45 ft. and a terminal area of 101 acres.

The entrance channel is only 40 ft. The terminal is equipped with six post-Panamax gantry cranes and 12 RTGs. It currently handles deep-see mother ships and therefore capable of handling the selected feeder ship with existing facilities and equipment. The terminal also handled the past CCT feeder-barge service. Figure 20 shows an aerial photo of Conley Container Terminal in Boston. A large gate system including pre-gate parking is seen on the right side of the photo. The four gantry cranes are seen on the left side. As clearly noticeable, these cranes are low-profile and their height is not sufficient for handling large post-Panamax ships.

Figure 20
Port of Boston's Conley Terminal
(Source: MPA, 2013)

LoLo Port Cost

The most difficult assignment in this study was to get a reliable estimate of port cost at the container terminals in New York and Boston. Although both ports have published tariffs, these are only designed to provide for maximum (ceiling) rates. Actual charges are based on negotiations with lines, which are kept confidential. Still, based on industry contacts from past studies, the authors believe realistic cost estimates for both ports were obtained.

Table 7 shows an estimate for the port cost of the entire feedering process. The process, in the case of import box, involves loading the feeder ship in NY and unloading it in Boston, or two lifts. In the case of NY, the lift is not complete, since there is no gate processing; the discharged box from the mother-ship, remains inside the terminal CY until loaded onto the feeder-ship. Hence, the shipping line is exempt from paying the full “assessment,” a special per-container tariff imposed by the New York Shipping Association intended to cover the International Longshoremen Association’s (ILA) benefits cost. It is assumed that, like the on-dock IM rail, the feeder will only have to pay a partial assessment. The calculation assumes that the feeder line will also be exempted from paying an assessment in Boston, since Boston will be eager to attract this traffic (see later discussion in Potential Traffic). As seen in Table 7, the total port cost is $327 per box. This cost estimate is on the low side – consistent with the overall thrust in this study.

Table 7
Port Costs for Feeder-Short in New York and Boston

Description	Unit	Charge
New York Handling	$/Lift	220
Boston Handling	"	180
New York Assessment		21
New York Discount	"	-94
Total	**$/Lift**	**327**

PORT-TO-PORT (PP) TRIP COST

Operation/Cost Model

The methodology applied in this study for calculating Port-to-Port (PP) trip cost is similar to that applied by commercial ship owners and, with minor differences, to that applied in previous studies. The operation/cost model consists of the following modules:

- ***Operations* –** Calculating trip times, including ships' times for sailing the unrestricted, restricted, port access legs of its rotation based on distances and speeds, and times required for port handling; determining the number of ships required for desired frequency (departures per day and week);
- ***Ships' Capital Cost* –** Calculating the required investment in ships, amortizing it at the blended cost of capital, and determining daily and one-way slot cost;
- ***Ships' Operating Cost* –** Calculating the crew size and composition, labor cost, adding provision, maintenance, repair, dry-docking and insurance costs, and determining daily and one-way slot cost;
- ***Ships' Fuel Cost* –** Calculating fuel, lube, and stores per trip, and determining daily and one-way slot cost;
- ***Administrative Service Cost* –** Calculating the cost of managing the shipping service along with working capital;
- ***Total Berth-to-Berth Ship Cost* –** Adding the aforementioned costs and determining ship's daily and one-way slot cost;
- ***Port Cost* –** Calculating capital and operating costs for the RoRo services and expected charges for the LoLo service and determining lift cost; and,
- ***Total Port-to-Port Cost* (*Required Freight Rates)* –** Adding Total Ship Cost and Port Cost and determining Required Freight Rates based on slot utilization.

The model itself, as already noted above, is based on a standard methodology. Hence, the discussion below only highlights some of the peculiar assumptions underlying this model.

Total Port-to-Port Cost

Table 8 presents a summary table with the major cost components and total port-to-port cost for each of the case studies. The port-to-port is calculated by adding the annual costs of each cost category and dividing them by the annual slots with the exception of Feeder-Short, where the port services are purchased from terminal operators on a per-box basis. As seen from this table, the Feeder-Short has a lower Berth-to-Berth cost than Domestic-Short, despite the shorter route of the latter (see next Chapter). The lower cost is attributed to the much higher stowage density of the LoLo system and the lower administrative cost of the service which is geared to shipping lines. However, when port cost is added, the Port-to-Port cost of the Domestic-Short turns to be much lower than that of the Feeder-Short. It is interesting to note, again, that the port cost of the Domestic-Long is the highest, reflecting the additional handling for the cassettes and the relatively low throughput of the dedicated terminal.

Table 8
Port-to-port slot costs

Cost Category	Description	Unit	Domestic Long	Domestic Short	Feeder Short
Capital	Construction Cost	$	79,800,000	48,000,000	30,000,000
	Annual Slots	OW Boxes /Year	62,800	132,000	42,300
	Daily Cost	$/Day	28,258	16,997	10,623
		$/Day-TEU	33.96	67.99	12.86
	Trip Cost	$/OW-Box	315	135	88
Crew	Daily Cost	$/Day	10,332	3,758	6,588
	Trip Cost	$/OW-Box	115	30	55
Fuel & Related	Daily Cost	$/Day	13,041	4,154	6,875
	Trip Cost	$/OW-Box	308	88	59
M, R, I, DD	Annual Cost	$/Day	3,563	2,143	1,339
	Trip Cost	$/OW-Box	40	17	11
Total Ship	Annual Cost	$/Year	48,873,441	35,706,716	8,995,240
	Daily Cost	$/Day	55,193	27,051	25,426
	Trip Cost	$/OW-Box	778	271	213
Administration	Annual Cost	$/Year	3,080,793	2,124,254	1,517,630
	Trip Cost	$/OW-Box	49	16	36
Berth-to-Berth	Annual Cost	$/Year	51,954,234	37,830,970	10,512,870
	Trip Cost	$/OW-Box	827	287	249
Port	Annual Cost	$/Year	21,014,946	15,322,821	-
	Trip Cost	$/OW-Box	335	116	327
Port-to-Port	Trip Cost	$/OW-Box	1,162	403	576
	Slot Utilization		0.8	0.8	0.8
	Adjusted Trip Cost	$/OW-Box	1,452	503	638

Total Equity Investment

Tables 9 and 10 present summary tables of the total and equity investments required for each of the case studies. The total investment in ships are based on the number of ships required for each service by ship cost included in Table 2 and the investment in terminals specified in Table 6. In Domestic-Long and Domestic-Short the service operator requires equity capital of about $100 million, suggesting that only established operators can attempt such ventures. Also, in both cases the investment risk is high since much of investment might be lost in case of business failure. This is not the case with Feeder-Short, whereby the ship can be sold or chartered on the international market in case of failure.

Table 9
Total investments in ships and ports

Description	Domestic Long	Domestic Short	Feeder Short
Ships	159,600,000	144,000,000	30,000,000
Terminals	16,520,000	12,620,000	-
Total	**176,120,000**	**156,620,000**	**30,000,000**

Table 10
Total equity investments in ships and ports

Description	Domestic Long	Domestic Short	Feeder Short
Ships	63,840,000	57,600,000	12,000,000
Start-Up	12,722,536	9,248,686	6,940,064
Terminals	33,040,000	25,240,000	
Total	**109,602,536**	**92,088,686**	**18,940,064**

LAND TRANSPORT COMPETITION AND DOOR-TO-DOOR COST

Land Competition for Domestic-Long

Intermodal (IM) Rail vs. Coastal Shipping

The economics of an IM rail service is different than that of a coastal shipping one. In the case of ships, most of the investment is in the cargo-carrying vehicle, the ship itself. The “roadway” is provided for free, except for the end portions of it, the access channels to ports, which the charge for using it is considered part of the port cost. In the case of rail, most of the investment is in the roadway, both the right-of-way and trackage. But the same roadway that serves IM freight also serves other types of freight as well as passengers. This investment is sunk, however, which is not the case with ships that can be deployed on other routes. Hence, the marginal cost of IM rail is relatively small, making the rail service very competitive.

A second difference between IM rail and shipping is their terminals, the sea port, and the IM yard. As seen above, port cost is about $167 per box for the ship-to-shore transfer (“lift”) in a RoRo terminal. An investigation of railroads suggests that the equivalent cost of a rail IM yard is about $40 per box. More important, “ship exchange,” or transshipment (moving boxes between ships), requires handling each box individually. Therefore, the cost of transshipment is roughly equal to that of two lifts. In IM rail system, “block exchange” does not require lifting boxes; the train can simply add or drop the entire block.

A third difference relates to capacity. Unlike a ship, which has a fixed capacity, an IM train can adjust its capacity according to demand by varying the number of railcars and locomotives. The coastal service could reduce capacity by lowering its frequency or simply cancelling voyages, but it will hurt its level of service and marketing potential. This flexibility is critical especially in case of wide variations in traffic flows during the days of the week and between seasons.

Multiple Stops and the Rail Network Effect

The lower IM terminal cost allows IM services to use a “multiport” service pattern, with the train stopping at intermediate points, unloading or loading containers and trailers. There is also the possibility of dropping and attaching short blocks of cars originated not along the main route. In this way, the IM train can serve a wide “catchment area,” generating large volume traffic, resulting in high equipment utilization. Moreover, the costal rail service is not limited to serving cargo along the coast but has the advantage of being part of a nationwide network. Hence, in case there is not enough traffic to justify a unit-train, which may be the case in the Philadelphia / Jacksonville service, the rail can add blocks underway. The “network affect” of rail will be elaborated below.

IM Rail Rate Structure
US railroads provide IM services under 4 common service contracts:

- Door-to-Door, consisting of:
  - Origin Dray
  - Rail Linehaul
  - Destination Dray
- Door-to-Ramp / Ramp-to-Door
- Door-to-Port / Port-to-Door
- Ramp-to-Ramp

In addition, a shipper can either use his own equipment (containers, trailers, chassis), often defined as private equipment, equipment owned by a truck line or by the railroad. For comparison purposes, we selected the most used service contract, door-to-door (DD), and private (trucker or shipper owned) equipment. A similar assumption was made in the case of the shipping line by not including equipment cost in the operation/cost model.

Drayage
Drayage services are an integral component of the DD transportation process. The “dray” is a truck service, transporting a trailer between the marine or rail terminal and the premise of the shipper or consignee, usually a warehouse. In most cases the dray is provided on a basis of round-trip and “live” stuffing/destuffing. That is, in the case of inbound load, the driver remains with the container/trailer until being destuffed and then returns the empty unit to the IM or marine terminal, or to an empty depot. Sometimes, a trucking company or a large shipper can match two loads, but in most cases, especially in case of relatively short dray, the common dray cycle includes an empty backhaul. Accordingly, the shipper has to pay for a round trip.

The cost of drayage varies according to the distance, region and type of terminal. Longer distances and more congested regional roads usually result in higher rates. Likewise, drayage rates from/to marine terminals where the gate process also involves Customs and longer waiting times are higher than those to/from IM rail terminals.

This investigation indicated that a typical IM terminal drayage charge is $200 per box for cargoes within a 20 to 30 miles radius, including two hours for stuffing/destuffing. For the sake of analysis, it could be assumed that domestic marine terminals are similar to the IM yard in terms of drayage cost. The rate is much higher for marine terminals handling international containers, reaching $600 per box in the case of the Port of Boston as will be discussed later.

CSX Intermodal Service

Figures 21 and 22 shows the rail maps of the two main eastern railroads, NS and CSX. As seen in Figure 21, NS service between Jacksonville and Philadelphia is indirect and requires routing the Jacksonville train through Atlanta. Hence, although NS has the option of introducing such a service, NS does not offer IM services between the two cities. Since NS does not have a direct coastal route, it also does not offer other north/south services between coastal port cities. The NS main corridor is its Crescent Corridor, a DS rail route, which runs along I-81.

As seen in Figure 22, CSX has a coastal route that runs along the I-95 and calls at almost all the coastal ports. The entire CSX north/south route now is DS, except a short access track to the Port of Baltimore. The main competition for the Domestic-Long coastal service would be from a daily rail intermodal service provided by the CSX Railroad, which has IM ramps in Jacksonville and Philadelphia. This CSX service is part of a longer coastal service between Miami and South Kearney, NY, connecting all the major Atlantic Coast ports.

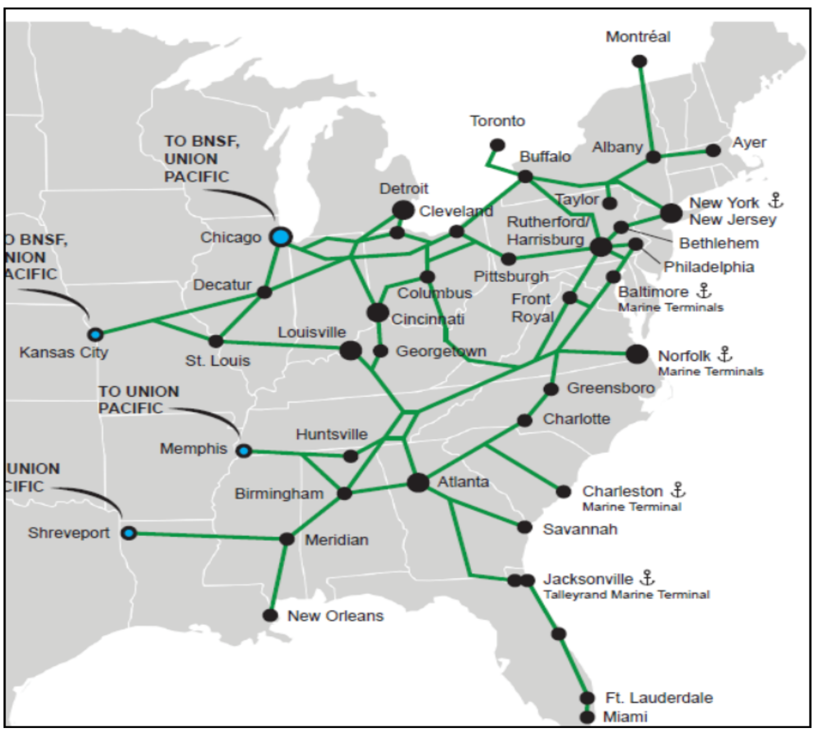

Figure 21
NS rail map
(Source: Norfolk Southern Railroad, 2013)

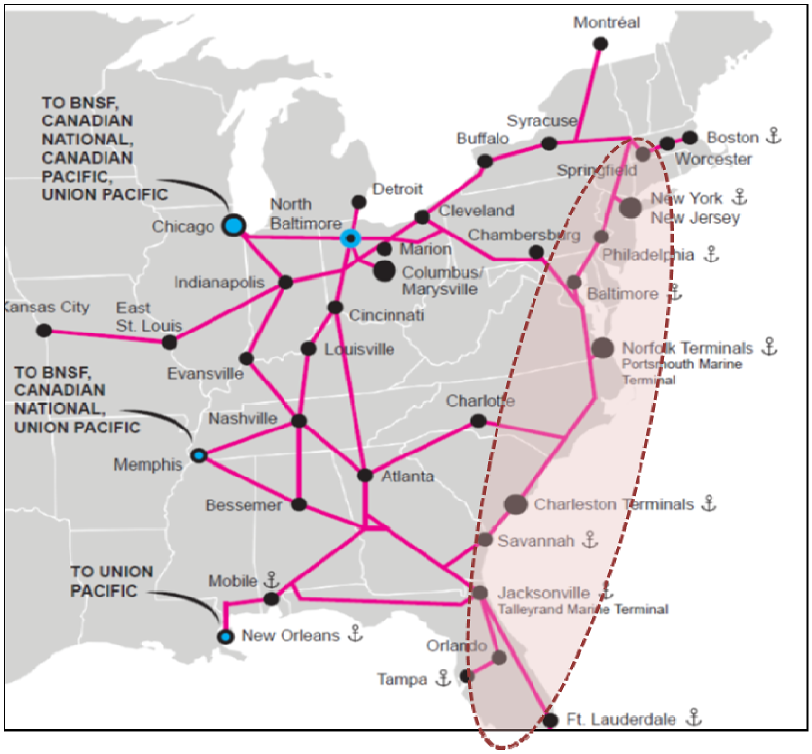

Figure 22
CSX rail map
(Source: CSX Railroad, 2013)

Figure 23 shows the CSX IM rail map and main routes. As seen in this figure, the coastal route is part of a triangular service pattern that connects the Midwest, Northeast and Southeast regions. The coastal route, the one of interest here, connects the main port cities from Boston (Worcester, see later) to Miami with a daily service. It is interesting to note that Philadelphia is not on the main route of this service. Nevertheless, CSX provides a service to this city using its large IM yard there and linking Philadelphia to the main rail services via block exchange.

The train moving from Jacksonville to Philadelphia can include blocks from Miami, Tampa, Savannah, Atlanta, New Orleans, Mobile, etc., providing accumulation of traffic and creating scale economies unavailable on the point-to-point shipping system. Being part of a nationwide network is a critical advantage for the IM rail service since even if coastal shipping develops and offers more ports of call, it can only provide pure north/south services. A combined rail/ship transportation system, in which the rail provides the east/west leg and the ship the north/south one, is impractical because it would require two additional terminal handlings for the rail-to-ship transfer. Once the box is on the rail system, it is reasonable to expect it to remain on rail till its final destination, meaning the IM yard closest to it.

It is interesting to note that CSX has another north/south express service between Jersey City, NJ, and Bradenton, FL, with 5/week frequency. The service is based on refrigerated boxcars, with its main cargo Tropicana juices. This train, although not IM, offers freight services on the north/south corridor.

Figure 23
CSX IM rail map
(Source: CSX Railroad, 2013)

CSX Long-Term Plans

Figure 24 shows CSX long-term strategy for serving its territory. The main freight flows in the US are east/west, for which the CSX (and NS) link with the western railroads (shown in red arrows) at several points along the Mississippi. CSX service system for the area east of the Mississippi is based on hub and spoke, with the main hub in Northern Ohio, shown with a star. The "spokes" radiating from this hub reflects the main traffic corridor – which does not include the flow along the coast. Presumably, this flow, the target of the Domestic-Long service, is secondary in importance to the main flows.

Figure 25 shows the CSX IM Terminal in Northern Ohio, based on wide-span, rail-mounted gantry cranes. The terminal is equipped with four such cranes, allowing it to transfer boxes between trains. In addition, the terminal also can provide for block exchange. Hence, the new terminal system provides for "total connectivity" required to handle the increased traffic density expected in this region in 2020 as shown in Figure 26.

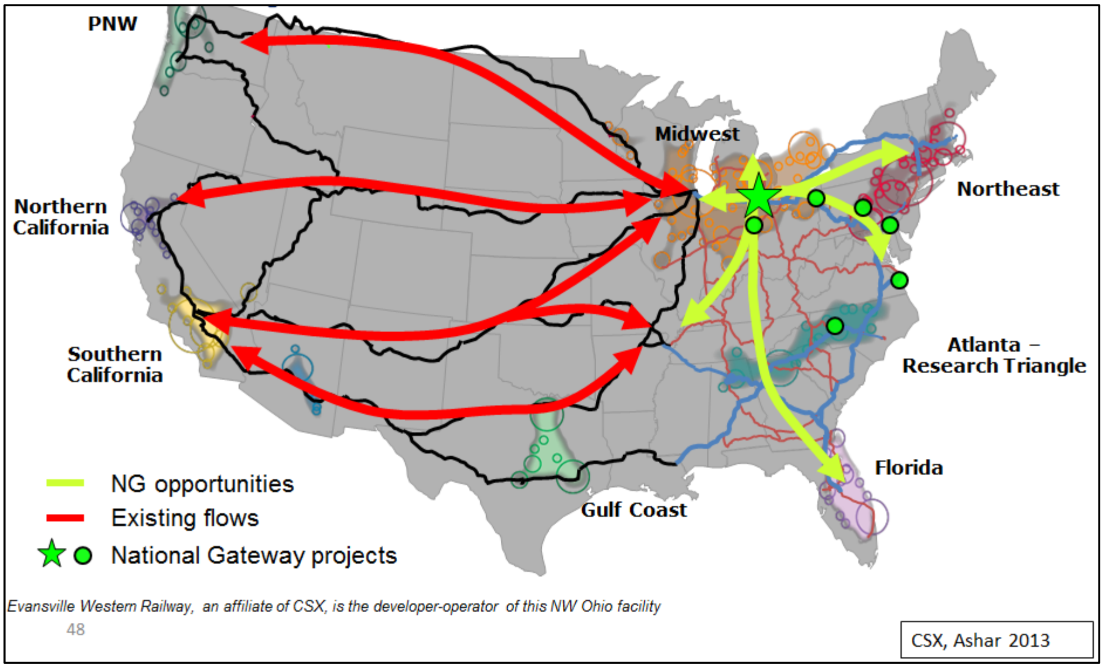

Figure 24
CSX development plans

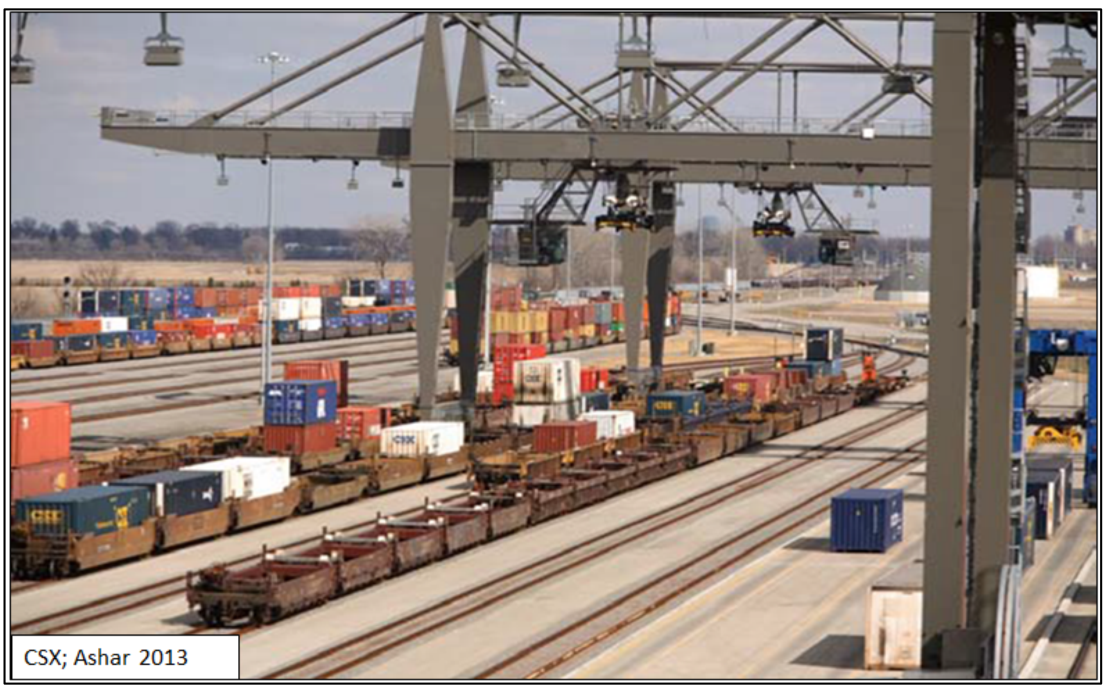

Figure 25
IM yard with wide-span overhead cranes

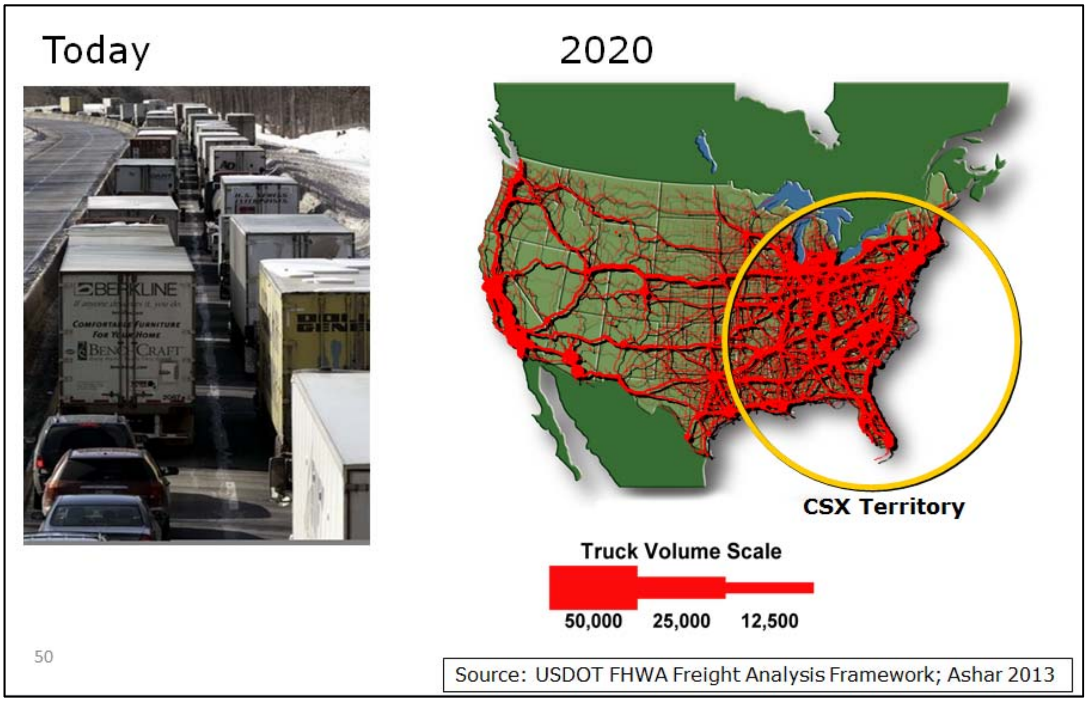

Figure 26
CSX territory

IM Rail Rates

This investigation with CSX, IM truck lines, and Intermodal Marketing Companies suggests that the larger users of IM rail are large truck lines. These truckers use their own equipment and tractors for the drayage on two ends, so the customer is provided with a seamless DD service. Some shippers, mainly the larger ones, contract directly with the CSX and even provide their own equipment.

IM rates are constantly fluctuating, reflecting the relationship between supply and demand which, in turn, is mainly affected by seasonality. All rates are adjusted to the fuel cost using a commonly accepted formula. The average rate (July 2013) was around $1,500/53-ft. box for dry box, legal weight and non-hazardous materials. The northbound rate is slightly higher than southbound. The all-truck rate was twice the IM rate, at about $3,000/box. Transit time was four days. It would be only two days for the Baltimore/Jacksonville run since Baltimore is located on the main CSX coastal route.

Third-Party Equipment

The domestic coastal services are envisioned to operate in a similar fashion to the current IM railroad services. The operator of the shipping service is expected to offer its services mainly to truck lines and large shippers, using trucker or shipper-owned boxes and trailers, commonly referred to as “equipment.” Accordingly, the coastal service provider, shipping lines, are not expected to own their equipment, avoiding substantial investments. Using third-party equipment also simplifies operations, avoiding the need to register, store, manage, maintain, and repair a large number of pieces of equipment.

While railroads mainly market their services to truckers and large shippers who have their own equipment, railroads still have their own equipment, so they can offer DD services which may be attractive, especially to smaller shippers who might not have equipment. Availability of equipment and the facilities and management structure to handle it provide the railroad with an advantage over the envisioned coastal service. It should also be noted that the two RoRo lines serving the Mainland/Puerto Rico trade, Crowley and Trailer Bridge, mainly use their own equipment.

Harbor Maintenance Tax (HMT)

Harbor Maintenance Tax (HMT) is a general levy on the value of cargo moving through any US port with federally financed channels. It is essentially a user fee intended to cover the cost of channel maintenance and other expenses related to the channel. HMT is paid by cargo owners, based on 0.125% of the value of their cargo. A recent FMC study on diversion of US cargoes from US Pacific Northwest to Canadian Pacific ports estimated the HMT at $109 per box *[11]*.

There is no similar ad-valorem tax on cargo owners when utilizing land-based transport modes. Most of the taxes on land-based modes are imposed on fuel – but this is also the case with coastal shipping. The thrust of this study is to examine whether the water-based transport mode can compete with land-based modes on coastal routes under the assumption of a “level playing field.” Accordingly, a reasonable assumption here would be to grant coastal shipping a waiver from HMT. In this respect, it should be noted that ships employed in the three case studies are relatively shallow-draft and the amount of traffic and the respective tax loss would be negligible. It is also interesting to note that the Port of Boston offers 100% credit on HMT for Massachusetts companies.

Coastal Shipping vs. IM Rail Door-to-Door Cost

The IM rail costs, as seen above, is commonly quoted on the basis of DD cost, the underlying assumption is that the shipper door is within a 30-mile radius around the IM rail terminal. Also indicated is that the drayage cost for this range is typically about $200 per box, and it is typically provided on a load/empty basis. Accordingly, for comparison, the drayage charge of $200 has to be added on each end to the calculated Port-to-Port RFR to arrive at a DD rate. As a result the calculated coastal service DD cost is $1,852 per box, or about 23% higher than IM rail. The higher rate suggests that coastal shipping is not competitive with IM rail. Table 11 shows the cost (rate) comparison between the coastal shipping and IM rail service.

Table 11
Door-to-door comparative costs (rates)

Cost Category	Description	Unit	Domestic Long	Domestic Short	Feeder Short
Port-to-Port	Trip Cost	$/OW-Box	1,452	503	638
Door-to-Door	Drayage	$/OW-Box	400	400	300
	Door-to-Door	$/OW-Box	1,852	903	938
	IM Rail or Truck	$/OW-Box	1,500	950	700
Comparison	Ship/IM Rail, Truck	$/OW-Box	1.23	0.95	1.34

Potential Traffic

The main advantages of the IM rail service over coastal shipping are lower cost, higher frequency, and the ability to generate more traffic due to being part of a nationwide network. Another related advantage is the ability to funnel cargo from a wider catchment area beyond the immediate one included in the DD cost calculation for the coastal service. For example, in the case of Jacksonville, draying cargo from to the port from the Orlando area, 140 miles away, could cost $500 (round-trip). CSX, however, could use its IM yard in Orlando for this cargo, as well as other cargoes located closer to Orlando than to Jacksonville. Another example is Savannah, located 140 miles north of Jacksonville. Draying Philadelphia traffic generated in the Savannah area to the Port of Jacksonville instead of to a local Savannah IM yard adds both to the cost and time of the shipping service versus the rail service. Put differently, the potential traffic for the coastal shipping service is essentially limited to a relatively small area around the ports of call, say up to 50-mile radius. There is no reliable data about the freight in containers/trailers that move between such small areas. Nevertheless, AMH came out with an estimate suggesting that the traffic southbound, which is larger than northbound, is about 300 loads per week. This volume is insufficient to fill the 314-unit Domestic-Long ship operating a 2/week service schedule. Discussions with the industry suggest that this estimate could be on the high side. In any event this traffic volume is quite limited; it is insufficient to support two weekly departures considered as necessary minimum to be competitive with IM rail services.

Prospects of Domestic Long

The envisioned Domestic-Long coastal shipping service would have significant disadvantages in competing with the IM rail service on the Philadelphia /Jacksonville route because:

- The coastal service is about 20% more expensive, despite the employment of foreign built ship with functional crews and no HMT;
- The coastal service frequency is 2/week versus 6/week for IM rail;
- The coastal service's potential traffic and catchment area is limited to the coastal area while the IM rail is part of a nation-wide rail system;

- The coastal service serves the two end-ports while IM rail can also serve intermediate points between them; and,
- The coastal service has limited flexibility in adjusting its capacity to changes in traffic flows.

Hence, under current conditions, the Domestic-Long service is considered unviable.

Possible Adjustments of Coastal Shipping Costs

The future cost of LNG is unknown. It seems however that it will be lower than Low Sulfur MGO assumed in the fuel cost. HEC assumed a 30% cost reduction which, based on the cost model would amount to a reduction of about $100/box in the DD cost of the coastal shipping service. Such reduction is not sufficient to change much the prospects of the Domestic Long coastal shipping.

Land Competition for Domestic Short

CSX IM Service for Domestic Traffic

Figure 27 shows the rail network of CSX, the only railroad that could provide such service. As seen in this figure, the rail route that CSX uses for its freight trains both to the Midwest and to Boston follows the Hudson River to the north and crosses the river near Albany turning southeast toward Boston. A much shorter rail route along the coast, parallel to I-95, is mainly used by passenger trains. The CSX IM rail service terminates not in Boston but in Worcester, about 50 miles to the west. Figure 28 shows a comparison between the rail, truck and water routes between New York and Boston. As seen in this figure, the proposed port for the shipping service is at Providence, shortening the water route by about 60 miles, most of it in protected waterways. In addition to the shorter water distance, the advantage of calling at Providence is that developing a terminal in Providence is likely to be more economical than in Boston.

As seen in Figure 28, the rail route is much longer than the truck route. Realizing the geographical disadvantage of its rail service, CSX declared policy is not to offer IM rail service between New York and Boston. Still, CSX offers such a service for international containers (discussed in a later section). Hence, presently the competition for the envisioned Domestic-Short coastal shipping between New York and Boston is only from truck.

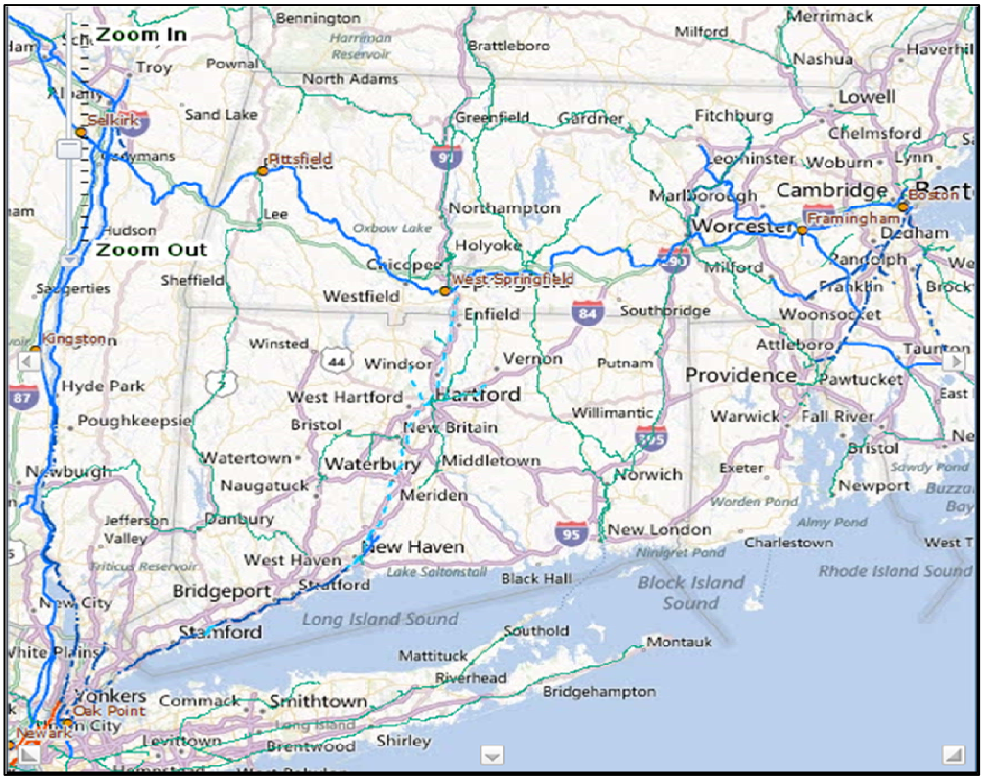

Figure 27
CSX rail map in the Northeast
(Source: CSX Railroad, 2013)

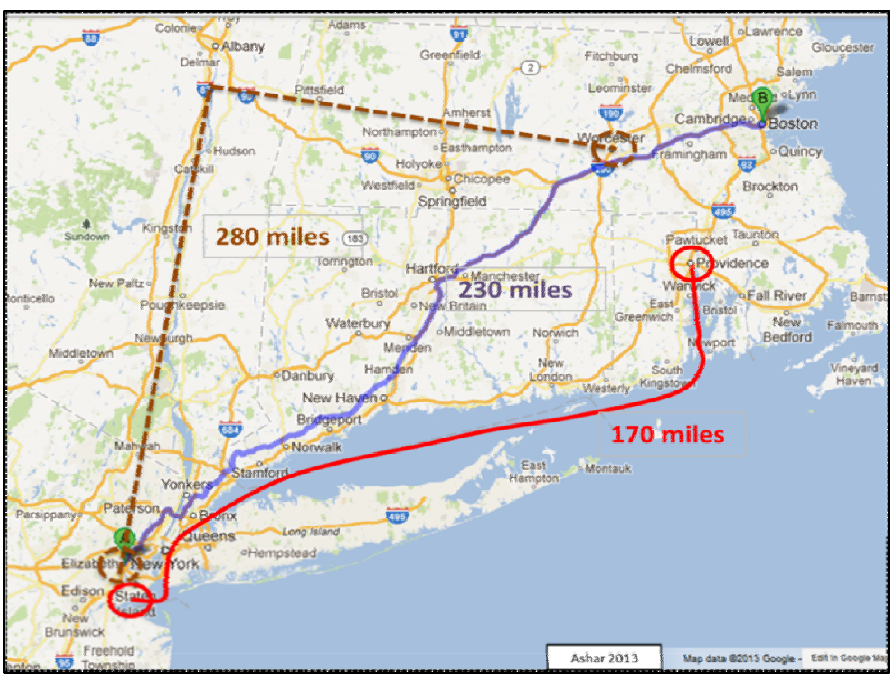

Figure 28
Water, rail, and road routes between New York and Boston

Direct Truck Service

Truck services between NY and Boston are mainly provided by local, relatively-small trucking companies. The large, national truck lines are more interested in long-haul services whereby they can take advantage of their terminal-based system and/or IM rail services. In the terminal-based system, there is a division between inter-region long haul and intra-region short haul trucking, with the exchange between them performed at truck terminals. Local trucking companies do not use the terminal system; the 250-mile distance between the two cities is simply too short to justify specialization. Hence, most of the trucking services are provided on the basis of direct, DD round-trips, mostly using trailers. Domestic containers are mainly used in long-distance IM route, especially when the rail service is DS.

In a typical direct DD trucking system, a driver brings an empty trailer to the shipper's warehouse in the New York area, waits until it is stuffed (vanned), drives it all the way to the receiver's warehouse in the Boston area, waits until the trailer is destuffed, and either drives it back empty to NY or, in about half of the cases, gets another job for the backhaul. The origin and destination points in NY and Boston are not necessarily near the port area, although this area has a relatively large concentration of freight. The further these points are from the port, the higher advantage that a DD truck service has over potential, port-to-port shipping (or rail) service. Another, and more critical, advantage of the truck service is that it can also serve intermediate points between NY and Boston, including points that require deviations from the main route. For example, a trucker returning from Boston can use I-84 as his southbound route, although it is far away from the shoreline and pick-up a load back to NY from places along this route (e.g., Hartford, CT).

Structural Change in the Trucking Market

The introduction of the Domestic-Short service system would require a structural change in the present DD, direct trucking system. The coastal shipping requires local truckers to drop their trailers at the ship terminal in New York and arrange for drayage at the other end, in Providence. Alternatively, the shipping line operating the Domestic Short could offer dray services to/from its terminals on the two ends, providing a full DD service similar to that offered by CSX on the Domestic-Long route. However, owning (leasing) equipment, providing maintenance and repair and hiring drivers would add substantially to the complexity of the operation. Hence, this option is ruled out.

Truck Rates

Trucking in the New York and New England region is difficult. The region has numerous geographical obstacles; the first and foremost of them is the George Washington Bridge over the Hudson, with many tolls, congested highways, often under construction, and strict law enforcement, often resulting in drivers paying fines. Nevertheless, trucking services proliferate and their rates are quite competitive as demonstrated by the failure of the Albany barge (see CCT – Feeder).

This investigation with industry indicates that the typical one-way rate for 53-ft. dry trailer, legal weight and no hazardous materials for the New York/Boston trip is around $950. The rate includes two hours on each end for vanning/devanning with a trip time of 5 – 7 hours, pending on traffic. However, the overall round-trip is usually two days, especially if there is a backhaul load which also requires vanning/devanning. The northbound rate is usually higher than southbound, reflecting an imbalance in traffic flow.

Coastal Shipping vs. Truck Rates

The Port-to-Port rate for the Domestic-Short is calculated at $503. Assuming that the Domestic Short will mainly serve traffic generated within a 30-mile radius, drayage on each end will be $200 per box and the total DD trip cost $903, slightly lower than the $950 per box truck rate.

Potential Traffic

The current system of data compilation by FHWA cannot provide a reliable base for estimating traffic flows between relatively small regions. In a previous 2003 study of this corridor, the authors conducted their own independent estimation, based on actual counting of the number of trailers moving on I-95 *[12]*. However, we were unable to differentiate between traffic moving between NY and Boson and through traffic. Hence, to reach better traffic estimates in this study, discussions with the trucking industry and CSX were held, from which the authors understood that there is not much traffic generated in Northern New Jersey and destined to the Boston area and vice versa. Most of the truck traffic along I-95 is generated south and west of New Jersey (e.g., Baltimore, Philadelphia, Pittsburgh, etc.). Likewise, the traffic crossing the Hudson River toward New England is distributed over a wide area, way beyond the 30-mile radius assumed as the catchment area for the coastal service.

Unlike the traffic between northern New Jersey and Boston, for which the CSX does not offer IM services, CSX offers IM services to the through traffic generated outside northern New Jersey towards New England, using its IM yard in Worcester. More important is that, as was the case with Domestic Long, the faraway points of traffic generation already have IM yards. Indeed, unlike the case of northern New Jersey, CSX does offer services between these points and New England, as seen clearly in Figure 29. Figure 29 shows the rail connections in the area west of New York. As was the case with the Domestic-Long, having sufficient traffic volume is critical to maintaining the minimum required frequency of 2/day which, in turn, is considered critical for the competitiveness of this service on-demand truck services. As noted above, CSX currently does not offer IM rail service between NY and Boston.

Figure 29
Port of New York's rail connections

Prospects of Domestic Short

The envisioned Domestic-Short coastal shipping service would have significant disadvantages in competing with the all-truck service on the NY/Boston route, although the coastal service has similar cost to the present trucking service:

- The coastal service's potential traffic and catchment area is limited to that generated in close vicinity to the end ports;
- This traffic is not sufficient to provide for the 2/day service frequency considered the minimum required for being competitive with trucks;
- Trucking services will have to undergo transformation in their service system in order to use the coastal shipping service; and,
- The coastal service has limited flexibility in adjusting its capacity to changes in traffic flows.

Hence, under current conditions, the Domestic-Short service is considered unviable.

Possible Adjustments of Coastal Shipping Costs

As with the Domestic-Long, the authors assessed the impact of HEC's assumption of a 30% cost reduction on the DD cost. Such reduction in the case of Domestic-Short would only amount to about $30 per box – insufficient to meaningfully change the prospects of the coastal service. Another possibility is for the shipping line to provide drayage services to/from ports to smaller truckers to reduce the drayage cost. However, drayage is a complex operation, involving taking responsibility for equipment and cargo, as well as owning a fleet of trucks and chassis. Likewise, since the drayage is provided "live," and the truck staying with the trailers until vanning/devanning completed, the savings of a centrally-controlled drayage system would be limited. The problem is that the demand for drayage is not constant; there is a surge immediately upon ship arrival.

Potential Competition

Truck traffic on the northeast corridor is expected to increase in the future along with congestion and respective truck rates. Presumably, at one point in the future, the higher volume of traffic could provide sufficient potential with the high congestion to cause truck rates to be sufficiently high to make the Domestic-Short viable. It is quite plausible that at this point CSX could offer a competitive IM rail service.

Presently, the CSX railroad only offers IM services between NY and Boston to ISO containers, using an on-dock IM yard in New York (see below). Offering such service to domestic traffic is not feasible for the short distance between New York and Boston. However, CSX offers IM service to domestic containers to Boston for traffic generated outside the NY area, as seen in Figures 23 and 27. CSX has a large IM yard for domestic containers and trailers in South Kearney, northern New Jersey as well as a large IM yard in Worcester, in the Boston area. Altogether, CSX already has a service and core traffic on the NY/Boston route as well as developed IM yards in the two cities. Hence, it is reasonable to assume that following an increase in truck rates, CSX could offer a domestic service for containers and trailers between New York and Boston. If this is indeed the case, the IM rail service will have many advantages over Domestic-Short coastal shipping service for reasons already elaborated in the section on Domestic-Long.

Land Competition for Feeder-Short

CSX IM Service for International Traffic

The competition in the case of New York / Boston feedering of ISO containers is from both IM rail and trucks. The main advantage of the IM rail service is that the IM yards in New York are located "on-dock," or inside the main marine terminals in Elizabeth and Newark, NJ and Staten Island, NY. CSX provides a daily service between its New York IM yards and Stackbridge Yard, a private yard located in Worcester, MA, specializing in handling ISO containers.

New England is an important market for CSX, which is reflected by this railroad's massive investments in improving its regional network in recent years. In January 2013, CSX converted its route from Syracuse, NY, to Worcester from single to double stack by increasing the vertical clearance at 31 locations, giving the region the ability to link with the nationwide DS IM service. Previously, double-stack intermodal trains coming to New

England from the Midwest or from Western origins had to stop in Syracuse NY and the boxes had to be transferred from single to double-stack equipment.   The reverse occurred on Westbound routes from New England, adding time, cost, and complexity to these freight flows

The IM rail service for ISO containers from New York to Worcester is not direct and involves "block exchanges" with the train arriving from the Midwest near Albany. Because of the longer route and the underway stop, the service has "next day" availability in Worcester (and vice versa). In addition, there is a dray service to/from the IM terminal in Worcester. The service is provided every day except for Sunday. In comparison, the transit time for truck service is typically 5 – 7 hours, the service is DD and the service frequency is "on demand."

New York On-Dock Intermodal Terminal

As noted above, the main advantage of CSX IM service is the on-dock location of its New York IM terminal. The NY/NJ Port Authority has constructed on-dock IM yards on all its major container terminals as part of the ExpressRail program. The $600-million program initiative began in 1991and was aimed at attracting discretionary, mainly Midwest, traffic by eliminating the costly drayage between marine terminals and off-dock IM yards. A related objective was to reduce truck traffic on access roads to these terminals. Similar on-dock IM yards are available at all major US ports.

The only on-dock IM yard that serves the Boston traffic is the Millennium Yard located at a port-owned area located between Maher and APMT marine terminals in Elizabeth, NJ. The yard, operated by Maher is quite large, with 18 working tracks with over 44,000 ft. of trackage. The assembly of trains is performed at the nearby Corbin Street yard.   Figure 30 shows the Millennium Yard with DS trains, yard cranes serving these trains and, in the background, ship-to-shore gantry cranes on the terminal's dock.

As seen in Figure 28, the IM rail-bound container does not have to be processed through the terminal gate, a major advantage over truck services. Another, perhaps more important advantage, is that IM containers are assessed only $21 per box while truck-carried containers are assessed at $94 per box. The assessment is a special tax collected by the NY Shipping Association to fund pensions, vacations and other longshore worker's benefits. The reduced assessment is only provided for "discretionary" traffic originating or terminating beyond a 260-mile radius from the port. The main discretionary traffic, toward which the ExpressRail program is aimed, is to/from the Midwest and West Coast. The Port of NY competes on this traffic with the Ports of Baltimore and Norfolk.

Figure 30
Port of New York on-dock IM yard

Boston Intermodal Terminals
The CSX has two IM yards in the Boston area: Franklin Street and Stackbridge, both located in Worcester, about 50 miles to the west from the Port of Boston. A third yard in South Boston has been terminated, with the route between Worcester and Boston converted for passengers. The Franklin St. yard is by far the larger of the two, handling more than 100,000 lifts annually, both containers and trailers (COFC, TOFC). The yard, however, mostly handles the traffic from the Midwest but not the NY international one.

The block of DS railcars with ISO containers generated at the Millennium Yard in New York is handled at Stackbridge, located on the Worcester and Providence Railroad trackage about 1.5 miles south of Franklin Yard. Stackbridge is not operated by CSX but by a private trucking company, ICI. The IM yard in Stackbridge is also functioning as a "dry port", where consignees can keep their uncleared (bonded) boxes for a longer time and conduct the Customs clearing process there instead of at the marine terminals in NY. ICI also provides destuffing and in-bond storage and drayage services. The Stackbridge Yard is, in fact, an extension of the Port of New York located in the Boston area, functioning as a remote container yard (CY).

IM Rail Traffic
Despite the large difference in assessments, the IM service to Boston seems to barely survive in its competition with trucking. In 2012, the total number of boxes that used ExpressRail's CSX Worcester service was only 10,010, equal to about 40 boxes per day or 20 boxes in each direction. This volume is about 2.5% of the total of 433,481 boxes that ExpressRail program handled in 2012.

Discussion with the Port Authority of NY and NJ indicated that the CSX IM rail service is mostly used by shipping lines (not by shippers), offering a Through Bill of Lading to Worcester to heavy containers that cannot be transported over the road. It is estimated that CSX only handles about 10% of the NY/Boston traffic with the rest trucked.

Direct Truck Services

The structure of truck services for international marine containers (referred to as ISO) is similar to those for domestic containers and trailers; both are based on direct DD. There are however two differences between trucking domestic trailers and ISO containers:

- ***Load/Empty Cycle* –** The typical truck service for ISO containers includes, in the case of import container, picking-up the load at a container terminals, driving to the receiver place, waiting while the container is destuffed and returning the empty to a depot or the marine terminal; and
- ***Lift On/Off and Gate Processing* –** The typical truck service at the marine terminal includes two lifts (on/off) at and gate in/out processing, which may take several hours.

In comparison, in the case of domestic containers and trailers, in about half of the cases there is at least partial revenue backhaul and no terminal lifting is involved.

The load/empty cycle is inherent to the truck distribution of ISO containers. From discussions with shipping lines and truckers, the authors understood that only in rare cases could the shipping line match import and export loads, so the backhaul mostly involved empty containers. Regarding the time spent at marine terminals, the published statistics on truck turnaround time indicates short terminal times for truck pick-up or drop-off service. However, these statistics do not include pre-gate waiting, which often extends to several hours. Also, the process has recently become more complicated following shipping lines' termination of a chassis supply. Currently, truckers have to stop first at a nearby off-dock depot to pick up chassis prior to traveling to the marine terminal to pick up a box. Then, the truckers have to drop their chassis after dropping off the container at the marine terminal. Hence, the trucking time required for ISO is longer than that for domestic cargo in the case of Domestic-Short. Altogether, the truck service for ISO containers is similar to drayage services from IM yards as described in the Domestic-Long case study, except that it involves a marine terminal, whereby the handling process usually takes a longer time and involves higher cost than IM yards.

Some shippers prefer transloading ISO containers to domestic trailers near the ports to take advantage of the higher volumetric capacity and save the empty return. In this case, ISO containers are stripped near the marine terminal in New York and their content transferred to trailers. It is reasonable to assume that while transloading reduces cost it adds to the transport time and also may result in damage to the cargo. No estimate of the cost reduction and the share of the cargo using transloading is available.

New York / Boston Truck Rates

This investigation yielded that most of the trucking to the Boston area of ISO containers is provided by shipping lines offering "door" rates. Shipping lines usually have a larger volume of traffic than shippers and, therefore, can negotiate lower rates. Part of the reason for the lower rate is that lines have special departments that arrange for the trucking services with terminals and better utilize trucks. Also, in some cases, lines can avoid the empty backhaul. Truck rates fluctuate, reflecting changes in supply/demand in relation to the trucking market and in fuel cost. In the summer of 2013, when this study was conducted, the market rate for the NY/Boston round-trip for ISO containers was around $1,400/box, inclusive of chassis. It is interesting to note that rates are commonly quoted per box, suggesting that most of the ISO containers are 40-ft. and that matching two 20-ft. containers destined to the same point is not common. Usually, truckers can perform the round-trip to Boston, including stripping (or stuffing), within one long day, assuming 5 – 6 hour drive in each direction and two hours at the consignee's premise, which are also used for driver rest. Some truckers pull boxes from the NY marine terminal the night before and keep them in their yard and begin driving to Boston at 3 a.m. to avoid traffic congestion and be able to return the empty early in the afternoon, and pull out a box for the trip the next day.

The truck rate for ISO containers is lower than domestic cargo, although trucking of ISO containers includes time spent at the marine terminal. The difference can be attributed to the fact that in the domestic case, the shippers uses the trucker's equipment (trailer) and the market power of shipping lines. Also, as will be discussed below, the trucking market for ISO containers is much larger than that for domestic containers and trailers.

Boston Drayage

ISO import boxes brought by feeder ship from NY to Boston and discharged at Conley Terminal have to be drayed to their final destination (and vice versa for export boxes). Boston's warehouses and industries are not concentrated around the port and the origin/destination points for these boxes are likely to be distributed within a wide radius from the Port of Boston resulting in costly drayage services. This investigation with the industry, especially with truckers serving Boston's two IM yards, indicates that a typical dray would cost about $600 per box and in most cases will be load/empty. Hence, the drayage cost that had to be added to the ship cost to estimate one-way trip cost is half of that, or $300 per box.

Coastal Shipping vs. Truck Rates

The previously introduced Table 8 presents the summary cost of the feeder service. As seen there, the berth-to-berth cost is low, at $249 per box, but adding to it the port cost, $327 per box assuming slot utilization of 80% and adding drayage, $300 per box results in a total one-way cost of using the feeder reaches $938 per box, 34% higher than the $700 per box of trucking cost.

Potential Traffic

From discussions with the Port Authority of NY and NJ, the trucking industry and CSX railroad, the authors understood that about 10% of the boxes handled at the port are destined for the Boston area (This estimate appears to be on the low side: the 2010 population of the Metropolitan Statistical Area (MSA) of New York is 19.6 million vs. 4.6 million for Boston's MSA, or 19% of the total NY + Boston population. Population serves as a common proxy to import traffic since it consists mostly of consumer goods.). Since the port handled about 5.5 million TEUs in 2012, Boston's 10% share amounts to about 550,000 TEUs. Since only 10,000 boxes or 15,000 TEUs are presently moving by rail, the potential for feedering is more than 500,000 TEUs.

The Port of Boston is currently handling about 200,000 TEUs, of which it is estimated that about 60% or 120,000 TEUs are handled by COSCO's Asian service, the only Asian service of Boston. This service, as discussed in International Short-Distance (Feeder-Short), may quit its direct call in Boston following the Panama Canal expansion – adding to the feedering potential. Altogether, the potential for feedering traffic on the NY / Boston route is large, probably 4 – 5 times the required 60,000 boxes for the envisioned feeder service.

Prospects of Feeder Short

The NY / Boston Feeder coastal shipping service would have significant disadvantages relative to truck services presently offered on this route:

- The coastal service is about 30% more expensive than trucking, despite the employment of foreign built ship and functional crews;
- The coastal service frequency is 2/week vs. on-demand for trucks and its transit time is much longer;
- The coastal service calls only at one terminal complex (Maher/APMT), having access only to about 65% of the entire traffic of NY terminals; and,
- The coastal service has limited flexibility in adjusting its capacity to changes in traffic flows.

Hence, under current conditions, the Feeder-Short service between New York and Boston is unviable. The authors already drew a similar observation regarding the viability of the Domestic-Short service between New York and Boston. The main difference between the two services is that, in the case of the Feeder-Short, the main reason is cost, and in the case of Domestic-Short, it is lack of traffic potential.

Possible Adjustments of Coastal Shipping Costs

The future reduction in fuel cost due to the use of LNG is estimated by HEC at 30%. This will result, according to the cost model, to a reduction of about $16 per box in the total DD cost, which is not enough to change the above observation regarding the unviability of Feeder-Short.

The port-handling rates assumed for the feeder service are already on the low side, assuming that it would be in the interest of both NY and Boston to support the envisioned feeder service. One example, described above, is the lower assessment for rail-bound containers in NY terminals. The official justification for the reduced assessment is to reduce road congestion especially around these terminals; the unofficial one is competition on Midwest traffic that could be handled by other North Atlantic ports. Another example is the loans that the ports of Halifax and Portland gave to the AFL defunct feeder service. The two ports may offer additional support to the feeder by providing further cost incentives. For example, facing the risk of losing most of its traffic, the Port of Boston, the main interested party, could develop a special drayage program to lower the cost of trucking containers from/to its Conley Terminal, or offer free long-term storage for both loaded and empty containers. The Port could even convince the state of Massachusetts to provide tax incentives to Massachusetts importers and exporters using the state's port. US ports have a long history of intervening with market forces to support services considered by them to be critically important to their survival.

There is another future development that may impact the prospects of the NY/Boston feeder service. The 2015 expansion of the Panama Canal may give rise to a transformation of the current service pattern based on direct call into a hub-and-spoke pattern, based on foreign hubs in Canada and the Caribbean Region (see International Short-Distance (Feeder-Short). In an unrelated study on the impact of the Panama Canal's expansion, the authors found that transshipment cost in these hubs is about half that in US ports *[13]*. Hence, altogether, it seems that even if granted financial incentives, the prospects of this service are dim.

SUMMARY OBSERVATIONS AND CONCLUSIONS

Domestic-Long – Unviable

The Domestic-Long application of coastal shipping is the focus of the AMH initiative and is the most widely discussed in previous studies. The shipping cost (RFR) in the case of Domestic-Long even when provided by foreign-built ships, functionally manned and exempted from HMT is considerably higher than IM rail. In addition to its cost advantage, IM rail service has the advantages of having larger traffic potential by being part of a nationwide transportation system in contrast to the shipping service, which is limited to a narrow coastal area. IM rail also has the advantage of being able to adjust capacity to demand. Hence, under current conditions the Domestic-Long coastal shipping is unviable.

The authors do not foresee changes in favor of coastal shipping in the Domestic-Long application in the future. On the contrary, IM rail services are still in the midst of an ambitious development program aimed at diverting more truck traffic by offering improving level of service (see Figure 26).

Domestic-Short – Unviable

The Domestic-Short application of coastal shipping is intended to bypass congested coastal areas and, as such, it depends on the specifics of each area, especially the situation of coastal roads in this area and respective trucking rates. In the current traffic situation in the NY area, the most congested area on the East Coast, trucking rates are only slightly higher than the required freight rates (RFR). However, the difference between the two is not sufficient to induce a transformation of the trucking system from the present direct DD to a terminal-based system, without which truckers cannot use the coastal (and rail) service. In addition, it seems that present traffic volumes between the two port areas do not warrant the desired 2/day service frequency. Hence, under current conditions the Domestic-short coastal service is unviable.

It could well be that in the future, when the traffic volume increases along with congestion and trucking rates, the service would be viable. However, in the specific case of NY, the increase in truck rates is likely to induce the introduction of an IM rail service. Because the same rail system also handles ISO containers and through traffic, it is reasonable to expect that the rail IM service will be superior to the coastal shipping one.

Feeder-Short – Dim Prospects

The Feeder-Short application of coastal services is considerably more expensive than both trucking and IM rail. Trucking, which is quite expensive in the congested Northeast corridor between NY and Boston, is still cheaper than IM rail, although IM rail is using the marine terminal's on-dock yard in NY and enjoys a substantial discount in terminal cost (assessment). Hence, based on the wide cost difference between coastal shipping and trucking and the superior level of service of trucks, Feeder-Short is unviable.

The Feeder-Short viability is highly dependent on port costs in NY and Boston along with the drayage cost in the Boston area. A concerted effort by the Ports of Boston and New York to induce such a service could result in substantial cost savings that could bring the cost of coastal feedering down to the level of trucks or, perhaps, below it. Likewise, as noted above, trucking cost may increase in the future. In this case, the feeder service may have some prospects to succeed in spite of the strong competition from trucking and IM rail. The question, however, is if a service based on incentives, which are in fact subsidies, can be considered commercially viable.

The NY / Boston feeder could face competition from foreign-flag feeder services based on low-cost foreign transshipment hubs in Canada and the Caribbean Region. Hence, altogether it seems that the prospects of the Feeder-Short service are dim.

Summary Observations

The study assesses exempt coastal shipping, defined as those exempted from the US-built stipulation of the Jones Act, operating with functional crews and exempted from HMT. The study focuses on two research questions: (a) the impact of the US-built exemption on the cost of coastal shipping; and (b) the competitiveness of exempt services. The assessment is based on three typical case studies, the first two involving domestic cargoes (containers and trailers), referred to as Domestic Long and Short; the third involving international cargo (ISO containers), referred to as Feeder Short.

The preliminary qualitative analysis indicates that due to soon-to-be-enforced environmental regulations, only newbuilding should be considered for coastal services. Accordingly, the authors reviewed a wide range of the ship designs developed in previous studies and for recent business ventures and consulted with ship operators and naval architects. The selected ship designs included RoRo for the domestic and LoLo for the Feeder case studies. It was found that building the selected ships in foreign yards could save about 40% of the capital cost of the RoRo ships for the domestic services and 60% for the LoLo ships for the feeder services. However, due to favorable financial terms available for ships built in US shipyards (Title XI), the actual reduction in capital cost would only be 24% for RoRo and 49% for LoLo ships. The capital cost of ships accounts for 17, 15, and 7% of the total DD costs of the Domestic-Long, Domestic-Short, and Feeder-Short, respectively. Accordingly, the impact of the reduction in capital cost would amount to 13, 11, and 4% reduction in the DD cost of these three case studies, respectively. Hence, the response to the first research question is that the impact of a Jones Act US-built waiver on coastal shipping is quite limited.

In order to address the second research question regarding competitiveness of coastal shipping with competitive land-based services, the authors conducted a survey of the present IM rail and truck services systems relevant for these case studies. It was found that IM rail dominated the long-haul transportation of containers and trailers, especially on routes with double-stack capabilities, which also included the coastal rail route. It was also found that IM rail had substantially lower rates than trucks as well as coastal shipping in the Domestic-Long case study. Trucks dominated the short-haul transportation routes such as those included in the Domestic-Short and Feeder-Short case studies. Altogether, the results of the comparison between envisioned water-based and competing land-based services are:

- ***Long Range Domestic Coastal Services***– Unviable due to a significantly higher cost and a much limited scope of services than IM rail;
- ***Short Range Domestic Coastal Services***– Unviable due to an insufficient port-to-port traffic volume, although the shipping cost is slightly lower than trucking; and,
- ***Short Range International Feeder Services*****–** Unviable due to a significantly higher cost, stemming mainly from high port costs.

The authors' summary observation is that exempt coastal services are not competitive with existing IM rail and truck services in the three case studies analyzed in this study. While this observation relates to specific case studies, the authors believe that it can be generalized: commercial coastal shipping of containers and trailers in the US has dim prospects, regardless of the Jones Act. Short-range, domestic services cannot compete with trucks; long-range, domestic services cannot compete with IM rail; and short-range feeder cannot cope with high port cost.

Future escalation in road congestion around urban areas would favorably affect the prospects of Domestic-Short and Feeder-Short, but not Domestic-Long case studies. However, in this case Domestic-Short and Feeder-Short may face competition from IM rail, utilizing its existing system of rail routes and IM yards. Feeder-Short also may be granted financial support by ports perceiving feedering as critical to their survival after losing direct calls, especially following the 2015 expansion of the Panama Canal. But, feeder services based on US ports may have to compete with those based on low-cost, foreign hub ports in Canada and the Caribbean Region and provided by foreign-flag ships. Hence, the authors do not expect the exempt coastal shipping service to be commercially viable in the foreseeable future.

EUROPEAN EXPERIENCE

Proliferation of Short Sea Services

As was noted at the outset of this report, the presumed reason for the past failure of coastal shipping in the US is inadequate ship technology; these services used slow and inefficient barges instead of the fast, self-propelled ships used in Europe capable of providing a truck-like level of service. The US usage of barges has been attributed to: (a) the excessively high cost of building self-propelled ships in the US mandated under the Jones Act; and (b) the excessively large crews and high salaries for self-propelled ships mandated by legacy labor contracts. This study indicates that allowing foreign-built ships and functional crewing could lower the cost of European-like shipping in the US – but not sufficiently to turn such services viable.

It was also found during the investigation that most European ships employed in coastal trades, often defined there as *short sea*, are built in European shipyards, which are as expensive as US shipyards. The European Union members grant cabotage rights to each other but not to non-European countries. Likewise, European crew sizes and their salary level are in line with those in the US. Still, the European short sea system has more than 1,000 ferry routes employing 1,350 RoRo ships, and handling 28 million trucks and trailers annually *[14]*. In addition, Europe has developed a large LoLo system of short-sea ships, integrating intra-regional with feedering of deep-sea trades. The question is, why do short sea services proliferate in Europe, especially those handling domestic freight? A comprehensive investigation of the European short sea industry is beyond the scope of this study; hence the following section only discusses the main differences between the European and the US short-sea / coastal systems.

Different Geography

Figure 31 shows a map of the main short-sea services in North Europe. The map is clear evidence to the proliferation of short-sea shipping in Europe, as noted above. The map also clearly demonstrates that, unlike the US, the European geography includes many internal seas that separate between trading countries. Accordingly, most European short-sea services are "off-shore" or involve crossing bodies of water, where there is no meaningful competition from land-based transport system. Some of the services have coastal legs, but these only serve as collection points for the cross-water legs. For example, a service between the UK and the continent may stop at several ports along the coast on both sides, but the service will not offer connections between ports on the same coast, focusing instead on the UK / Continent leg. This situation is similar to the US Mainland / Puerto Rico services which have more than one port of call in the Mainland.

There are a few European services that are “pure” coastal, or entirely along the same coast line. A case in point is the service between southern Italy and Spain. However, the success of this service can be attributed to the much shorter water route following a diameter instead of a circumference route, and the congestion on the coastal road that goes through the French Riviera.

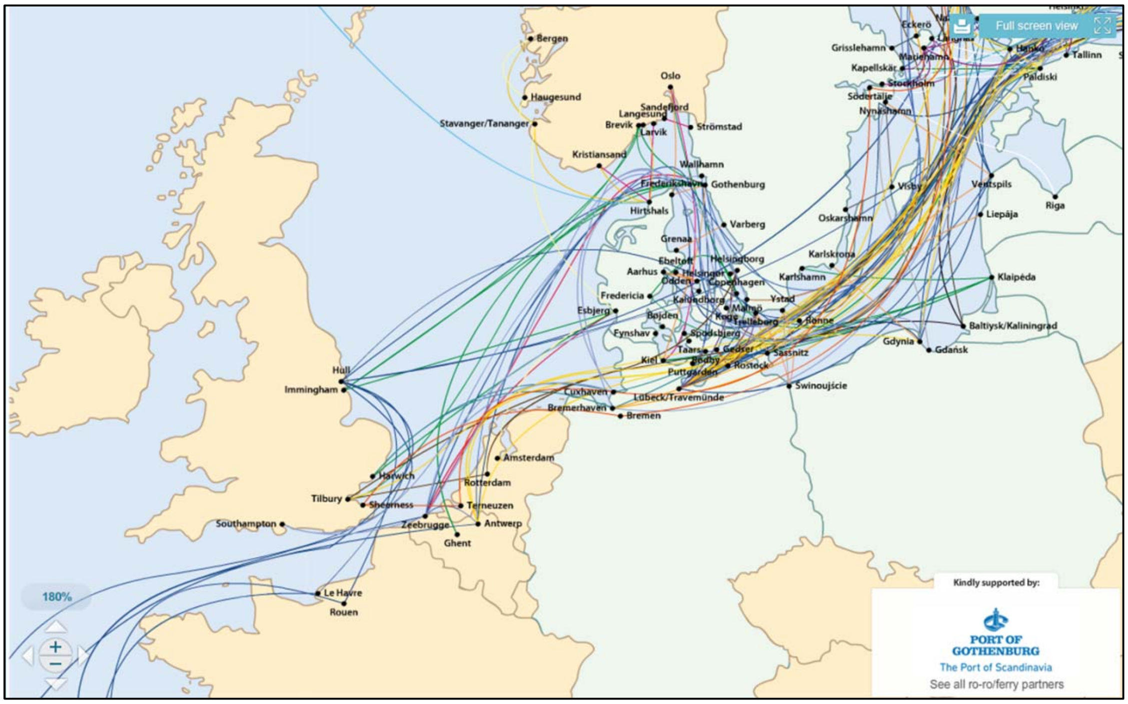

Figure 31
North Europe Short-Sea route map

Congested Roads and Less-Developed Freight Rail System

Europe is a much more densely populated than the US and its highways more congested than the US. All European rail infrastructure and the main railroads are government owned and operated, and the preference for using the limited infrastructure is given to passengers. Freight trains in Europe are much shorter than the US and railcars are single-stack. Europe also has strict environmental regulations regarding trucking, including limitation on the usage of major highways during weekends.

Still, the European short-sea shipping, especially the RoRo segment, is vulnerable to competition from a land-based transportation system. For example, a recent report indicates that shipping services on the busy U.K.-France route have been losing market share to railroads and trucking companies using the cross-channel tunnel *[15]*.

Different Shipping System

Most of the European short-sea services handle a combination of accompanied trucks and passengers with and without cars (walk-in). There are very few services in Europe which are "pure" freight, only handling unaccompanied trailers. More commonly, the driver stays with his truck for the entire trip. For example, a U.K.-based driver transports a load all the way from London to Milan, taking a ferry to cross the English Channel underway. The combination services in Europe employ ships with both decks for stowing trucks and autos, and cabins for passengers and drivers, defined as RoPax**.**

In many cases the purpose of the trip for passengers' on-board ship is leisure, similar to a trip on a short cruise. For many short-sea services, these passengers account for most of the revenues, since passengers (and drivers) also spend money on-board ships, on necessities and entertainment.

In addition to the RoPax services, Europe has a highly developed system of intra-European shipping based on LoLo services handling a combination of intra-European and feeder freight. The LoLo system includes 40 lines, operating 160 different services calling at 134 ports and handling 9 million TEUs annually *[16]*. Rotterdam, the largest European container port has more than 100 sailing per week of these services.

Government Support

The European Union and its member countries are actively promoting short-sea shipping, including several initiatives that provide direct and indirect support to new and existing services:

- ***Marco Polo*** – Established in 2003 and now in its second 10-year phase, with a budget of about €20 million provided by the European Union; involved mainly in new services;
- ***Motorways of the Sea*** **–** Began in January 2009, focusing on several sea corridors intended to bypass land bottlenecks by simplifying administrative procedures;
- ***Econombus*** – An Italian program that offers direct subsidies to truckers opting for a maritime alternative in heavily congested corridors (presently under consideration by other countries); and,
- ***Research and Promotion Centers*** **–** Currently available in 22 countries that support Short Sea Shipping Inland Waterway Promotion Centers (SPC), public-private outreach programs conducting marketing and promotional research.

Europe is Different

The overall observation based on the short review of the European short-sea system is that Europe is fundamentally different than the US, in geography, shipping system, competition from land modes of transportation and public support. Hence, one should not infer from the success of European short-sea shipping, a probable success for US coastal shipping.

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AFL	American Feeder Line
Allan	Robert Allan
AMH	American Marine Highway
ATB	Articulated Tug Barge
CCT	Colombia Coastal Transport
CSX	CSX Corporation
CY	Container Yard
DD	Door-to-Door
DS	Double Stack
ECA	Emission Control Area
FHWA	Federal Highway Administration
FMC	Federal Maritime Commission
GAX	Gulf Atlantic Service
GRT	Gross Registered Ton
HEC	Herbert Engineering Corporation
HFO	Heavy Fuel Oil
HMT	Harbor Maintenance Tax
IM	Intermodal
IML	Intermodal Marine Lines
ISO	International Standard Organization
DOTD	Louisiana Department of Transportation and Development
LED	Louisiana Economic Development
LNG	Liquefied Natural Gas
LoLo	Lift On Lift Off
LTRC	Louisiana Transportation Research Center
MARPOL	International Maritime Organization in an amended International Convention for the Prevention of Pollution from Ships
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
MHC	Mobile Harbor Crane
NPX	New Panamax Ship
NS	Norfolk Southern
NSA	National Shippers of Americas
PIDN	Port Inland Distribution Network
PP	Port-to-Port
RFR	Required Freight Rates
RoCon	Roll On Roll Off Containers

RoPax	Roll On Passengers
RoRo	Roll On Roll Off
RS	Reachstacker
STS	Ship-to-Shore Crane
UNOTI	University of New Orleans Transportation Institute

REFERENCES

1. Ashar, A., McKesson, C., “Inland Waterways Containership.” Center for the Commercial Development Technologies (CCDoTT), 2012.
2. Bonney, J., “Can the Jones Act be Protected?” Journal of Commerce, December 5, 2011.
3. Port of Boston Website, http://www.massport.com/port-of-boston/Conley%20Terminal/OceanCarrierInformation.aspx
4. Emission Control Area, United States Environmental Protection Agency, Office of Transportation and Air Quality, EPA-420-F-10-015, March 2010.
5. See: Natural Gas for Marine Vessels, US Market Opportunities, American Clean Skies Foundation, April 2012.
6. http://www.bunkerworld.com/prices/port/us/hou.
7. Crowley, T., “Maritime Executive Commentary.” 2013 Annual Review & Outlook, The Journal of Commerce, p. 70. Tom Crowley is Chairman, President and CEO of Crowley Maritime Corp.
8. Committee on Transportation and Infrastructure, H.R. 2847, The “Jobs For Main Street Act, 2010”, December 16, 2009, http://www.asce.org/uploadedFiles/Government_Relations_-_New/HR2847Summary%281%29.pdf.
9. Esber, B., Title XI Financing for Vessel and Shipyards Improvement Projects, 2004. http://www.marinelink.com/news/article/title-xi-financing-for-vessel-and-shipyard/322695.aspx
10. SPAR, Return on Equity for Marine Transport, 2012.
11. Study of U.S. Inland Containerized Cargo Moving Through Canadian and Mexican Seaports, Federal Maritime Commission, July 2012. http://www.fmc.gov/assets/1/News/Study_of_US_Inland_Containerized_Cargo_Moving_Through_Canadian_and_Mexican_Seaports_Final.pdf
12. High Speed Ferry and Coastwise Vessels: Assessment of a New York / Boston Service, National Ports and Waterways Institute, University of New Orleans, , for Center for the Commercial Deployment of Transportation Technologies (CCDoTT), April 2003
13. http://www.dredgingtoday.com/2013/08/30/dredging-key-factor-for-us-container-port-call-strategies/#.UiJgw2lhEt8.gmail
14. Short Sea Shipping, George Mason University and a group of US experts, May 2011.
15. Bernard, B., “Growth in European Ro-Ro Industry Won’t Be Stopped.” Journal of Commerce, 5/12/2012.
16. Dynamar, “Intra-Europe box traffic will grow 8%.” 3/4/2013. http://www.shortsea.info/731-news.html.