CHANGING SHIP TECHNOLOGY AND PORT INFRASTRUCTURE IMPLICATIONS

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The Changing Face of World Trade

An anonymous seer once stated that world trade is the engine that drives civilization. How right he was! The closing 100 years of the second millennium have seen world trade grow astonishingly. With this growth, not only have trade patterns and the types of cargoes changed radically, but the ships that carry the goods have changed almost beyond recognition. Today's cargo-handling methods bear not the slightest resemblance to what had been there before. The key to the change? Containerization, intermodalism and globalization–interlocked concepts that are much more than fashionable epithets.

Before the advent of the container, world trade was a piecemeal undertaking, with the land and sea segments accomplished in isolation, with little coordination between the various independent operations. The shipowner accepted the cargo when it arrived at the pier. Shipper and recipient alike did not expect, nor could they even envision, so-called "just-in-time" service. That luxury was simply not available, and the en-route delays, which were a part of the transport system, were an unavoidable part of doing business internationally.

All of this has changed. Sea-Land's initial voyages over 40 years ago proved the feasibility of container transport, revolutionizing the movement of goods by allowing the land and sea portions to function as a system. Within these four decades, this technological and commercial breakthrough has resulted in the near demise throughout the world of the break-bulk ship, in which cargo was stowed virtually by hand, a practice which had existed almost without change for hundreds of years.

Today's container ship is the linch-pin of cargo transportation, but it is only a part of the total system which includes sophisticated shoreside terminals, intermodal extensions to inland points by rail and highway, and automated information systems that track a shipment throughout its journey.

The importance of this to the people of the world is that fully 90 percent of international trade is carried by sea. To and from the United States alone, the yearly waterborne foreign trade amounts to over 1 billion tons, having a value of more than $ 625 billion. Tankers, bulk carriers, container ships, and other vessels all share the enormous tonnage, using the same waterways, the same navigational aids, the same ports.

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Of the port users, the container vessel is the most time-sensitive. High value cargoes demand expedited handling, which requires coordinated actions by ship operators, port authorities, landside transport organizations, and regulatory and support agencies. Nearly 15 million TEU of container cargo is handled through American ports per year, over half of which moves through the five largest ports. The mandate of the American people to keep this cargo flowing is clear.

Trade and its Effect upon Ship Size

In addition to the radical change in the way cargo is handled, there is another evolutionary force that has significantly affected international trade over the past five decades since the end of World War II. World trade has escalated as the population of the world has risen.

The net effect of the market forces has been to challenge technology in the development of increasingly economic methods of moving cargo. In respect to this, engineers have responded by devising entirely new vessel types and expanding the frontiers of deadweight tonnage and speed. The result has been an ocean transportation system, that is able to carry the vastly increased amount of cargo swiftly and safely.

The pioneering container ships could carry only 59 containers having a length of 35 feet and stacked two-high on deck. Once this seemingly radical idea of carrying boxes by ship had been proven sufficiently in the coastwise trade, the first true container ships, having cellular holds into which containers were loaded by cranes came into being. Their capacity was around 200 TEU –the designation "TEU" (for twenty-foot equivalent units) being the standard measure of capacity adopted by the industry.

Through the 1960s and 1970s vessel capacity grew, individually and collectively, as European and Far Eastern ship operators, following the lead of their American counterparts, realized that the container revolution had indeed taken place. During the latter part of this period, container ships of around 2000 to 2500 TEU were becoming more prevalent on the major trade routes. Size gradually crept upwards over the next 10or 15 years as did the quantity of trade in container cargo. In the late 1980s the 4000 TEU barrier in ship size had been crossed. The next phase, the age of the mega-container ship, came rapidly once that point had been reached.

Around 7,700 TEU are carried on today's mega-carrier, which is about 1,138 feet (347 meters) in length—almost a quarter mile, or, in the popular idiom, "nearly four football fields"—and has a beam of 140 feet (42.8 meters).

The Mega-Container Ship is Unveiled

The definition of the mega-container ship has changed in lock step with the construction of larger and larger vessels. In the mid-1980s, when United States Lines built its "Jumbo Econ" container ships (now owned by Sea-Land as its Atlantic Class), their 4354-TEU capacity was classified in the "mega" region. Today, "mega-container ship" describes only those vessels having a capacity in excess of 6000 TEU and the definition changes as each new generation of vessels is delivered.

Around 7700 TEU are carried on today's mega-carrier, which is about 1138 feet (347 meters) in length–almost a quarter mile, or, in the popular idiom, nearly "four football fields"– and has a beam of 140 feet (42.8 meters). The container stack is 17 wide.

Future Trends in Ship Size

For several years, designs have been available for vessels with capacities of up to about 8700 TEU. The design and construction of such vessels is well within the state of the art. In fact, a consensus among shipbuilders and ship operators is that a container ship able to load 15,000 TEU may well be a possibility. For such a ship to become a viable reality may require a complete rethinking of the way containers are handled to– and from the ship as well as to and from–and within the shoreside terminals.

Although the ship may be technologically feasible, there must be a level of trade sufficient to support such a vessel. Of equal or greater importance, there must be shoreside facilities to match its capacity. The major problem is the need to minimize port time (There is a truism that a transportation asset, whether ship, aircraft, rail car, or truck must be in motion to assure its economic survival) In addition, and of great importance, the harbor waters, berths, and approach channels must be of sufficient depth and the berths themselves must be large enough and properly equipped to handle the larger (longer, wider, and deeper) vessel.

In the case of this mega-container ship, the terminal must have sufficient area to accommodate the larger number of boxes that will accumulate before the ship arrives and as she is being discharged and loaded; crane capacity (in terms of both the number of cranes and their cycle time) must be sufficient to minimize port stays; and, needless to say, the requirements for sufficient water depth and appropriate vessel berths must be considered.

We believe that we have not seen the practicable upper limit of container ship size in the 7000-TEU plus vessels now in existence. An eventual ceiling might be found around the 10,000 to 12,000 TEU level. Market forces will continue to influence the evolution of the system as long as it moves in a way that continues to provide improvements in cost, reliability, and speed and customer satisfaction.

The Question of Water Depth

One aspect of the mega-container ship, that must be faced by ship operators and port authorities alike is the water depth required to permit these vessels to operate efficiently. In the Far East and Europe, the problem of water depth is not a serious one at most major ports, and where controlling depths are marginally satisfactory, steps are taken to ensure that a safe environment is available for the ships serving the ports concerned. Under-keel clearance of not less than one meter (slightly more than 3'-3") is available, at any state of the tide.

A 50-foot deep channel would accommodate nearly all container ships now in existence. As ship capacity increases to 8000 and 10,000 TEU, the required water depth will not increase proportionally. This is due to other changes in the configuration of the vessels. For example, they will be wider–up to 22 containers from the current maximum of 17 and they will be longer.

The question of how to achieve sufficient water depth is a vexing one for many U. S. ports, particularly on the East Coast. There must be found a way around the fiscal, environmental, and other roadblocks that are thrown in the way of port progress. To do otherwise is to steer the nation irrevocably towards second-class statehood.

Environmental Impact of the Mega-Carrier

Much has been said of the economic superiority of the mega-container carrier in terms of cost of transportation per TEU-mile. The mega-carrier also displays an increasingly important characteristic which may directly affect air quality. In an operational environment in which the contribution to atmospheric pollution by marine sources is coming under closer scrutiny (even though the total release of exhaust gases from all marine sources accounts for a small percentage of the worldwide total release), the operation of a mega-carrier will result in a measurably lower release of pollutant gases than from an equivalent transportation capacity in smaller ships.

Given the much improved fuel efficiency of modern ships, the relatively small contribution to air pollution from marine sources, and the continuing research to improve engine performance, we believe that the shipowner is doing his part to keep the spectre of fouled air under reasonable control.

In the other significant marine environmental concern–the discharge of oil into navigable waters–a continuing effort by all players is resulting in measurable improvement.

What Is Intermodalism?

The term intermodalism is heard with increasing frequency in the 1990s, but the concept has been a driving force in container transportation since the beginning. Intermodalism may be defined as the ability of a transportation system to move freight from source to destination over a number of modes without intercession by shipper or consignee. In other words, a container may originate in an inland point in the United States, travel over road and rail to a port, then by ship to a port, perhaps on another continent, and thence by rail and road to the final destination, all without touching the cargo within the container.

The concept is simple, its execution, difficult. The container must move swiftly and connect at each modal change point speedily, but of even greater importance is for the transportation company to assure that the sometimes complex and burdensome paperwork which follows the box is processed with dispatch. This is of importance with any domestic shipment involving road and rail modes only, but the value of true intermodalism is tested in international shipments, where customs documentation adds another layer to the complexity of the process.

For intermodalism to have existed in the former regulatory climate in the United States was nearly impossible. Dating back to the mindset of the “robber baron” days of the late 19th Century, it was not possible under law for a transportation company to operate in more that one mode. For this reason, when the Founder of Sea-Land Service, Malcolm McLean, started his marine container business, he was forced to divest himself of his extensive trucking interests, which, of course, could have formed an important part of an early intermodal system.

This and similar cases are typical examples of existing regulatory processes being unable to recognize and adjust to innovative change and, more importantly, not being able to ameliorate the legislative morass that is encountered when innovative change is encountered.

Seamless Transport Ashore and Afloat: The Intermodal Pipeline

An intermodal cargo transportation system between continents may be likened to a pipeline. To run at peak efficiency with maximum throughput, the pipeline must offer minimum resistance to flow. This is accomplished by utilizing proven design and construction practices. It must also be free of operating constrictions such as partially closed valves.

In the intermodal case, the features designed into the system include ships of a size, seakeeping ability, and speed properly considered for reliable operation, logically located ports; efficient rail and highway transport; and efficient and unobtrusive regulatory formalities. In the ideal operation of such a system, the cargo will flow into the source location and be carried to the final destination through several changes of mode (e.g., truck to rail to ship to rail to truck) as if, in a manner of speaking, all valves were fully open.

But in actual operation, the intermodal pipeline is susceptible to the partial closing of too many valves, at least one of which may be present–and poised all too ready to close–at each change of mode. What valves are likely to close?

- The first valve is accessibility of the port from the open sea. Can the port terminals be reached without the need for a long inland passage by the ship?
- Next, is the port appropriately located for transfer of cargo to the rail or highway mode? Do these connections have easy access to remote destinations? Is there a significant local market? Is there a ready source of personnel to man the terminals?
- Of significant concern is the question of terminal expandability. Can this be accomplished, considering the probable expansion of world trade in the future?
- Has the port sufficient water depth, in channels and alongside the berths, to permit the safe and efficient movement of the largest ships which are likely to enter the port? What are the prospects for future increases in water depth? Of much greater importance, can the ship operator be assured that the water depths can and will be maintained over the long term?
- Is there sufficient length of berthing area fitted with container cranes to accommodate the perceived normal maximum throughput without causing an inordinately long queue of vessels waiting to berth?
- Is all necessary documentation and information existing, accurate, and available when needed?

The Ideal Container Port

Commercial waterside land is increasingly under pressure as the beautifiers of the world lay claim to more and more of this valuable commodity through gentrification, preservation, zoning changes, designation as wildlife areas, and other artifices. Elsewhere in the world, land reclamation has been used with great success to provide port acreage. In this country, such an approach would likely be greeted with dismay, anger, and no small measure of "not in my backyard" attitude.

Where, then, can and should a port be located? Ideally, the time-sensitive nature of container-based liner services, where departures are regulated by the clock, calls for the landside terminal to be as close to the open sea as possible, but with easy connections to the rail and highway portions of the system. The container port need not be in the middle of a metropolitan area as was the case in the 19th Century, but it should not be too far distant from significant local markets.

Finally, the container port should have its own support infrastructure, should be distant from residential areas (but not so far away as to create manning difficulties), and should not result in unduly great competition with other vessel types for access channels, anchorage, and support facilities.

The Protection of Local Waters Through Ballast Water Exchange

An increasingly important problem in ship operation is the possibility of introducing foreign animal species into an area in ballast water, that has been carried from another part of the world and discharged. This was first noted on the Great Lakes with the zebra mussel, but other species have appeared in various locations around the world.

A number of solutions have been proposed, all of which have positive and negative features. One of the most promising is ballast water exchange, in which water taken aboard in one port is discharged into the open sea and replaced with deep-ocean water as the ship proceeds to her destination. The key to the success of this practice is to ensure that the safety of the vessel in terms of stability is not compromised at any time during the transfer.

Other ideas include chemical treatment aboard the vessel and the discharge of ballast into holding tanks ashore, both of which appear to have significantly greater operational challenges. The former would require additional equipment and an additional task aboard the ship and the latter a complex shoreside installation.

The problem of rogue species is solveable, but the implementation of a workable way to avoid the problem will take dedication on the part of all parties concerned.

Competition within the Port

Competition within a port between various types of vessels must be given consideration, particularly when the mega-ship is a regular visitor. We have dwelled above on the mega-container ship, but there are other vessels, in the "mega" category, and some of these do compete within American ports.

The original mega-ships–tankers and bulk carriers above 250,000 dead weight tons (ships which have a length of more than a 1,000 feet and a beam of 140 feet or more–are not a factor in the United States, but a proliferation of mega-cruise ships is being seen in American waters, primarily in the Southeastern ports which serve the Caribbean region. Some of these vessels approach the largest of the tankers and bulk carriers in physical size.

Not to be forgotten are the smaller ships which traverse the waters of many ports, including recreational and fishing vessels, towboats, and flotillas of barges, ferries and other vessels which must also use these waterway. The question of competition is not so much one of priority as of having a common right of way, much as exists on the landside highway system.

A Plea for Safe Navigation

From the shipowner's viewpoint, the safe operation of a container port is built around three issues: an efficient vessel traffic control system, regular maintenance dredging of berths and channels as the need arises, and unfailing accuracy in the charting of all waters from the open sea to the berth.

Vessel traffic control schemes are expensive and require continuing dedication on the part of the system operators. Not only should the marine community take a cue from the air traffic control system, but the marine system itself should be a free-standing operation in which the persons who man a local system should be marine professionals intimately familiar with the area's needs and not subject to periodic replacement.

Regular maintenance dredging must be carried out as necessary. We hear too frequently of areas, that have become shoaled in the wake of competition for the appropriation of funds. This problem must be removed from the political arena.

The charting of waters throughout the port and its approaches must be undertaken with unfailing accuracy. Again, we hear the shipmaster's horror stories about uncharted obstacles, obsolete charts, and similar impediments to safe navigation. The advent of electronic chart displays makes the problem of keeping up-to-date charts a simpler one, provided that the argumentative discussion of electronic chart standards is solved.

The litany of concerns about in-port menaces to navigation includes a variety of hazards, typical of which are the following:

- Competition with other vessel traffic on a crowded waterway.
- Narrow and / or tortuous waterways.
- Channels with insufficient water depth.
- Extreme tidal variations or local current problems.
- En route physical hazards on the surface, such as the presence of bridges.
- En route submerged man-made hazards, such as the presence of pipelines or underwater cables.
- Limited overhead clearance (air draft).
- Local regulations prohibiting night arrivals and departures.
- Frequent weather-related delays caused by fog or ice.

Some of these hazards are to be found in every port. Some ports have more than their fair share. The Houston Ship Channel and the lower Mississippi River, for example, offer challenges to any ship visiting the ports at those waterways' ends.

Although not directly a part of the port challenges, another concern relating to navigation is the question of protection of marine mammals. The maritime community is keenly aware of the importance of this issue and will, I am sure, continue to monitor these environmental concerns.

The Port: Commonweal or Private Preserve?

A port serves much more than the ships that call there or population that inhabits the local area. Even those persons who will never smell saltwater—from the hard rock miner in Vanadium, New Mexico, to the general store owner in Ida Grove, Iowa, to the black dirt farmer in Issaquena County, Mississippi—are direct beneficiaries of the international trade which passes through any port. In actual fact are they and nearly 275 million others not the real owners of the American port system?

The provision and maintenance of facilities for the common carriage of freight has long been a responsibility of government. Although it is realized that the user has his own responsibility in respect to this–his own terminal and facilities, whether owned or leased, for example–the fact remains that, because the port itself is there for the commonweal, an equitable method of public funding on behalf of the real owners must be considered.

Those persons in New Mexico and Iowa and Mississippi are the owners of the national parks, the monuments and activities in our nation's capital, and untold other aspects of life, and they benefit in an intangible way from all of these. They, too, benefit from the ports in a much more discernable manner.

Concluding Remarks: The Challenge

The challenges facing the shipowner and the port operator are certainly real. For the nation to ignore the needs of the ports in this increasingly competitive, globally oriented world of commerce equates, as I mentioned earlier, to the acceptance of second-class statehood.

We sincerely believe that with a continuing dialogue among the port users, the operating authorities, the support and regulatory organizations (be they local, state or federal–such as customs authorities, pilots, police and public safety groups), and government, solutions will be found to the problems and the challenges that confront us. The road ahead may present a difficult journey, but the goal of building a cargo pipline, with fully open valves, will be reached.

My closing thoughts turn to a parable totally unrelated to maritime commerce: the metric system. The United States is one of three nations, which, after nearly a century of domestic debate, does not use metric measurements. The others are Liberia and Myanmar. Question: Is this where we belong?