The 40-Foot CONTAINER

Industry Standard Faces Challenges and Change

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PHOTO: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Containers await transfer in the marshalling yard at Port Elizabeth, New Jersey.

The author, a consultant who works on port projects in the United States, South America, Asia, and Europe, has more than 40 years of experience in the maritime industry. He was president of the shipping firm Navieras–NPR and Vice President of Engineering for Sea-Land Service, overseeing the development of facilities, containers, and handling equipment, as well as related research. He recently was appointed to the new Crowley Chair in Logistics and Transportation at the U.S. Merchant Marine Academy, Kings Point, New York.

Are the days of the 40-foot container as the standard unit in international trade coming to an end? In the early 1960s, when containerization was still new, American and international standards committees held many meetings to develop and formalize the basic criteria to enable containers and cargo to move safely and efficiently between transportation modes and users. Standards were to be developed for specifications—including container sizes, geometry, and strength—as well as corner castings, testing, and markings. The meetings were intense, because substantial investments would be made based on the resulting voluntary industry standards.

A range of committees studied in detail the technical needs across all modes of surface transportation, examined international problems such as customs and security, and considered the future of shipping. The selection of a standard length for containers therefore should have developed from the data that were presented and from knowledge of cargo-density relationships, compatibility with pallet and packaging standards, and current and projected regulatory criteria.

Instead, the length selection was based on a simplistic building-block concept proposed by engineers from influential steel and aluminum industry suppliers. At meeting after meeting, many times as chairs, the materials industry representatives repeated the principle: "Two 10s make a 20, two 20s make a 40."

The International Organization for Standardization (ISO) accepted this premise and adopted as standards the 10-, 20-, 30-, and 40-foot length selections—although few 10- or 30- foot units were constructed. The industry then started to invest in containers with dimensions that had been selected arbitrarily, without consideration of transportation economics or projections of the industry's future.

Costly Choices

The choice has cost the transportation industry billions of dollars in increased operating costs and loss of cargo-carrying capacity. In the past 50 years, shippers seeking compatibility and interchangeability have made huge investments to comply with the ISO standards. Any change to the basic length of containers would send to the scrap heap mil-

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Highly productive 53-foot container units, common in U.S. domestic freight, are double-stacked on specially designed rail cars, enabling twice as much freight to be carried with marginal increases in cost.

lions on millions of containership tonnage and would make billions of dollars of equipment and infrastructure throughout the world useless or inefficient.

At the same time, ISO set the standard for the outside dimensions of containers at 8 feet or 8 feet 6 inches high by 8 feet wide. This decision also negatively affected the carrying capacity of containers. Only a few 8-foot-high containers were built—for the U.S. military—because even before the dimension was adopted, companies had realized that a higher unit would be a better fit for the developing systems. Today most newly constructed containers are 9 feet 6 inches high, and some units are 8 feet 6 inches wide.

The domestic container currently in widespread use in the United States is 53 feet long, 9 feet 6 inches high, and 8 feet 6 inches wide, with an internal capacity of 3,850 cubic feet. The ISO standard 40-foot unit is 8 feet 6 inches high and has an internal capacity of 2,390 cubic feet. Additional cubic capacity translates into sizable cost-efficiencies.

Sample Cost Breakdown

To quantify the operational savings that a larger unit offers, consider a typical move of a full container of freight from a plant in Chicago to a warehouse in Ponce, Puerto Rico. Industry experience would project the total cost of this intermodal move as approximately $3,000, including $250 in sales and administrative expenses.

First a trucker picks up the full shipment at the end of the manufacturing line in Chicago and moves the container across town to a railhead. This costs $150.

There it is loaded on a train for shipment to a port—in this example, to Elizabeth, New Jersey. The rail cost, including lifting onto the rail car, is $700.

On arrival in Elizabeth, the container is offloaded in the port, trucked to a terminal, and stored in a marshalling yard until the vessel is ready for loading. The total cost for offloading from the train, for processing and yard-holding, and for stevedoring onto the vessel is $500.

Already $1,350 has been spent on land before the container is ready to sail. If 60 percent more cargo is stowed in each container, the savings are approximately $800 per move. With 12 million containers projected to move through the ports of the United States annually, the savings can total $10 billion a year.

The vessel costs are $600 per container for the move from Elizabeth to the port of San Juan. The cubic capacity of vessels does not materially change according to the size of containers stowed on board, although some cubic space may be gained on a 40-foot configured vessel if oversize units are stowed on deck. Once the vessel arrives, the stevedoring and truck delivery from San Juan to the Ponce warehouse cost $800; a larger container would have saved $480.

Shippers prefer to move cargos in the larger units, because one lift or one road or rail move can handle more freight. On the typical move described from Chicago to Ponce, using a larger container translates into a savings of at least $1,280 per shipment. With 350,000 units yearly, the potential savings only in the domestic United States–Puerto Rico trade could exceed half a billion dollars. Worldwide, the savings would be staggering.

Back-Haul Considerations

The handling of back-haul cargos presents another opportunity for savings. After the container in the example is unloaded in Ponce, the shipping line looks to carry the container back to the United States loaded with cargo. Because of the imbalance of United States–Puerto Rico trade, most of the containers return empty. Back-haul cargos from Puerto Rico consist mostly of manufactured goods or agricultural products, which are moved more efficiently in a larger container because of their weight-to-cubic-space ratio.

When the empty containers arrive at ports in the United States, the operators solicit cargos mov-

ing inland. This repositioning puts the units in competition with truckers' high-cubic-space trailers, which almost exclusively are 53 feet in length. As a result, most 20- and 40-foot containers are repositioned empty at considerable cost.

In addition, shipping more cargo in one unit is environmentally responsible, cutting back on traffic volume and fuel emissions. Decreasing the number of units to be examined also enhances security.

The savings that back-haul and other factors generate are difficult to quantify but can be significant, with millions of units in use each day across the United States and in service around the world. One caveat is that some containers ship cargos at less than the total cubic capacity. Studies have shown that this occurs in less than 50 percent of cargos; moreover, lighter cargos generally have the greater value and command a greater freight rate. As Malcom McLean, the father of containerization, liked to say, "Any cargo that fits into a 20-foot container will fit into a 40-foot container." The same rationale applies to 53-footers.

Testing Larger Sizes

Sea-Land and other companies have designed and developed containers larger than the standard ISO unit and have tackled difficult technical problems to enable the units to be used with available ships, hardware, handling equipment, and infrastructure.[1] One of the most visible innovations is the double corner casting, a patent assigned to Sea-Land. This innovation allowed the stacking of oversized containers on the decks of vessels or on top of other containers in a marshalling yard and enabled cranes and other handling equipment to lift the containers. Other innovations include a special chassis design, vessel deck modifications, alternative layouts for container marshalling yards, and unique rail car designs.

A wide range of container and trailer lengths is in service in Puerto Rico, largely for domestic trade served by several innovative intermodal carriers under the Jones Act.[2] Puerto Rico long has been a place for establishing trends in freight transportation—it played a key role in the genesis of overseas containerization.

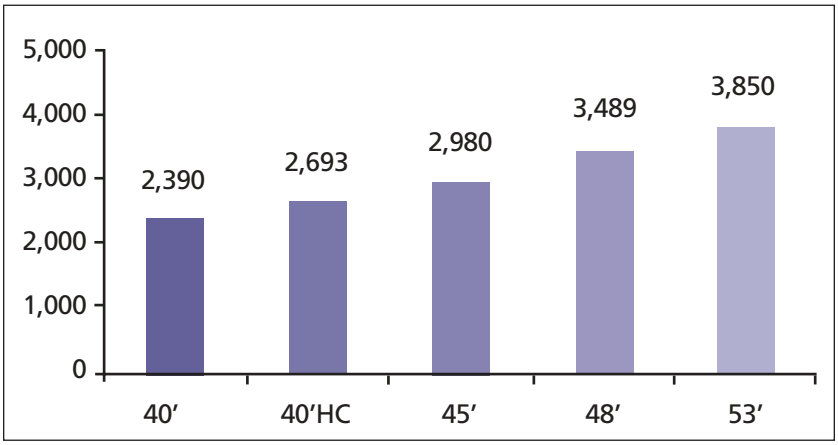
The port of San Juan receives 12,000 TEUs of domestic cargo every week. Service levels are high. Domestic vessels arrive with on-time rates exceeding 95 percent. More than 50 percent of freight is delivered to users within 12 hours of a vessel's arrival, and the commodities include anything that can be containerized. It is a true intermodal market with the carriers offering complete pickup and delivery service to and from the United States.

Containership in the Port of San Juan, Puerto Rico.

In addition, foreign container vessels arrive regularly, bringing all types of goods to a population of more than 4 million with the highest per capita income in Latin America. Although not a major hub, Puerto Rico hosts a brisk transshipment trade to the other islands and nations in the Caribbean.

The competitive and intermodal nature of the United States–Puerto Rico trade has forced carriers to offer shippers equipment longer than the 40-foot ISO standard. This is what the customers demand, to control the costs of the internal handling of cargo and the rates paid to carriers.

A walk through the marshalling yards of the various operators in Puerto Rico highlights the trend



Containers in the Puerto Rico lane: total cubic feet inside.
Source: Trailer Bridge, Inc.

[1] The author was involved in many of these research and development projects as an employee of Sea-Land Service and as a consultant.

[2] The Jones Act requires that vessels carrying cargo between U.S. ports be built in the United States, owned by U.S. citizens, and documented under U.S. laws.

Photo: Maersk Line, Ltd.

Changes in container sizes will require adjustments in port infrastructure.

toward larger equipment. Outnumbering the 20- and 40-foot units are 45-, 48-, and 53-foot units, with all of the sizes designed for roll on–roll off or lift on–lift off equipment, or both. To be competitive, all five domestic carriers offer big-box capabilities. One carrier, however, operates only 53-foot units in both a roll on–roll off and lift on–lift off configuration, stating in reports to investors that the system is "a vastly superior business model" and that the "assets provide tangible competitive advantage." Simply translated, bigger is better.

Delays and Pressures

If this trend to bigger boxes in the United States–Puerto Rico trade extends to other trade routes, international carriers with huge investments in vessels and infrastructure will attempt to oppose or delay the change. The start-up of containerization encountered a similar opposing strategy. Only after Sea-Land expanded from Puerto Rico and developed services to Europe and Asia did international carriers make the leap to the new technology. The inability of developing countries to accept containerization was highly touted but proved short-lived—today containers of various sizes are deployed in almost all global trade.

Some carriers in international trade already have taken steps to satisfy customer demands for larger equipment. The decks of many vessels are loaded with 45-foot containers and sometimes with 48- or 53-footers. Some carriers are forced to transfer cargos from 40-foot standard containers to domestic standard containers or trailers at transfer stations near the ports. In this way shippers can benefit from the economics of a larger box for a portion of the move.

These are half-way measures that lack the efficiency of a standardized complement of same-size units. Shippers will continue to exert pressure on the transportation providers to change to the larger units. Operators will make more and more space available but will not easily abandon the ISO 40-foot length.

Preparing for Change

Some time soon, an entrepreneur will invest billions of dollars to construct a fleet of vessels designed to handle only 53-foot equipment to match the U.S. domestic standard. The economics of this intermodal service will be far superior to that of all competitors.

Operators need to consider vessels, equipment, terminals, trucking, and rail for this future system. Installing the new system and providing a transition from current operations will require a major technical effort. Yet the big box is the future and is technically doable—carriers, ports, and terminals should prepare for the inevitable changeover.

The United States currently has large numbers of 53-foot containers, as well as compatible rail cars, chassis, and handling equipment. Transporting 53-foot units across Europe, however, is a problem, because the European Union limits the length to 45 feet, although the size restriction does not apply to movements of units within a port area or on barges. In addition, an effort is under way to change the regulations.

Asia and particularly China also will influence change. China manufactures almost all of the 53-foot container units, and many are dispatched loaded with cargo. If China decides to adopt the 53-foot unit as the standard for its own internal transportation system, to serve the commercial interests of trade between China and the United States, the freight transportation map of the world will change. China will select and promote standards that support its position as the world's leading exporter of manufactured products. China and other Asian nations will favor lengths that meet shippers' needs and that move cargo in the most cost-effective way.

Are the days of the 40-foot container as the standard unit in international trade coming to an end? The answer is yes, and the change from the current, arbitrarily selected length will be made based on economics and experience.

Can Intermodal Freight Terminals Handle Supersizing?

ROBERT HARRISON

Containerization is the driving force for global trade in nonbulk commodities, and shippers, transportation companies, and terminal operators are constantly searching for ways to reduce costs and increase output. In recent years, each mode has undergone significant changes that affect intermodal economies of scale.

The intermodal services of U.S. Class 1 rail offer efficient schedules for 40-foot international and 53-foot domestic and transloaded traffic via mile-long trains to a variety of terminal types. Some—like the terminal in Alliance, Texas—are located in inland ports and offer other related services such as free trade zones and light manufacturing plants. Air freight, an important sector in terms of international freight value, is served by a variety of large fuel-efficient craft, and even larger planes are coming—such as the Airbus Industries A380 double-deck freighter.

In the maritime sector, the rate of change is fast and furious. From 1970 to 1990, the Panamax vessel—designed to pass through the Panama Canal locks—was dominant, with a container capacity of approximately 4,400 20-foot-equivalent units (TEU). As naval architecture and diesel engine technologies made larger designs possible, steamship companies ordered larger ships with limits around 5,500 TEU. In the 1990s, a new vessel class entered service—the megacontainership or S Class, with capacities starting around 6,600 TEU and reaching up to 8,000 TEU. The S Class of the Orient Overseas Container Line, for example, carries up to 8,063 TEU; 10 of these vessels are now in service.

The latest development in vessel size is the L203 design SX Class commissioned by the A.P. Moller–Maersk Group and built by the Odense Steel Shipyards in Denmark, with a capacity of around 11,000 TEU, expandable to 14,800 TEU. The large containerships that now dominate global shipping lanes store containers in cells that conform to the International Organization for Standardization measures; none is designed to accommodate the domestic 53-foot container.

The TRB Intermodal Freight Terminal Design and Operations Committee works to share information on the ways that terminals worldwide serve the variety of modes and sizes in service. Large terminals capable of serving the biggest vessels, aircraft, and trains are few, because economies of scale require only a few key load centers or hubs. A range of technologies, equipment, storage, demurrage policies, and labor productivity is necessary to handle the large container volumes carried by the new modal equipment. In addition, environmental programs are being instituted to reduce the social costs of large terminals—particularly the effects on air quality.

Terminals are facing new and challenging programs to increase the security of operations from terrorism. The implementation of the Transportation Worker Identification Credential system is the issue currently under debate, to be followed by consideration of the ongoing debate over how best to secure containers. The Intermodal Freight Terminal Design and Operations Committee is monitoring these developments to help inform the freight transportation community in supporting endeavors to move the nation's freight efficiently and safely.

The freight carrier version of the new superjumbo Airbus 380 will carry 150 tonnes of cargo in standard containers plus pallets.

PHOTO: MAERSK LINE, LTD.

L203 vessel Emma Maersk, *one of the world's largest containerships, with a capacity of 11,000 TEU, awaits final fitting out in the Odense Steel Shipyard, Denmark, August 2006. The ship's hull is covered with environment-friendly silicone paint below the waterline, reducing water resistance and fuel consumption.*

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