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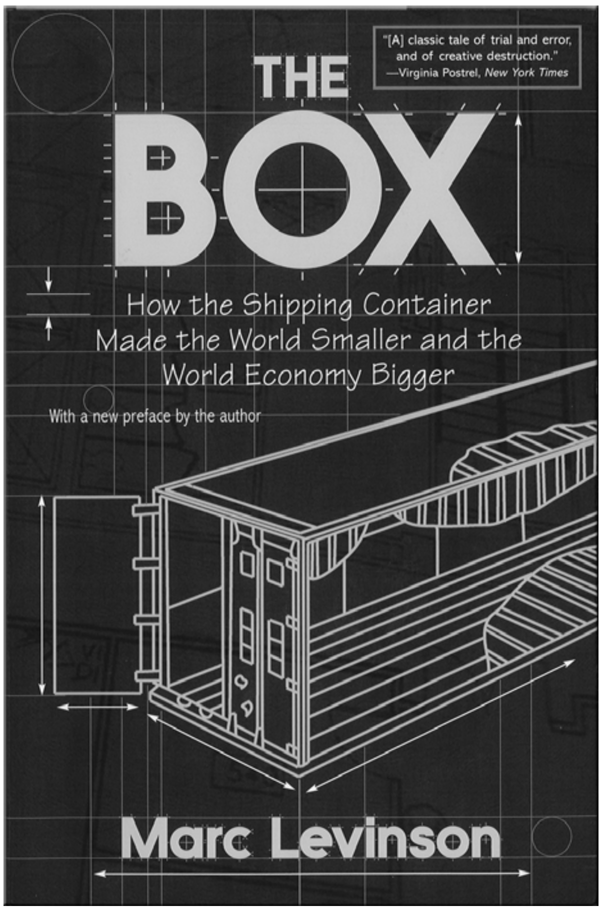
Reversals of Fortune in the Tea Industry

Part XXVII: The Evolution of Sea Freight



Front Cover of *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger* by Marc Levinson. Princeton University Press, 2008.

Before the container, transporting goods was expensive – so expensive that it did not pay to ship many things halfway across the country, much less halfway around the world.

What is it about the container that is so important? Surely not the thing itself. A soulless aluminum or steel box held together with welds and rivets, with a wooden floor and two enormous doors at one end: the standard shipping container has all the romance of a tin can. The value of this utilitarian object lies not in what it is, but in how it is used. The container is at the core of a highly automated system for moving goods from anywhere, to anywhere, with a minimum of cost and complication on the way.

- Marc Levinson

As steam replaced sail during the last half of the nineteenth century, a new era of maritime commerce emerged. Freight costs got cheaper and cheaper as steamship cargo capacities grew. At some point, however, the system began to self-destruct. Simply stated, there was a disconnect between the massive cargo capacities of the newest merchant ships and the antiquated process of loading and unloading the cargo itself. It was a full century after steam's preeminence that the problem was finally solved.

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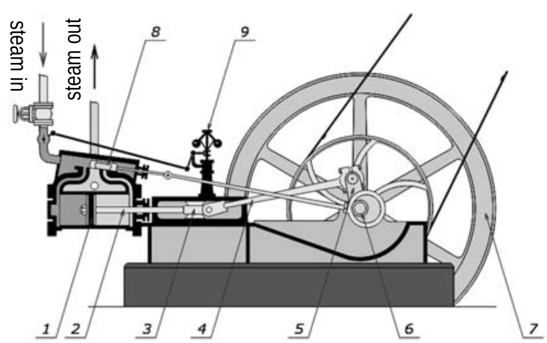
Reversals of Fortune in the Tea Industry, Part XXVII

Steamships were destined to capture all commercial maritime transport even without the opening of the Suez Canal in 1869. That event simply accelerated the process. The clipper ship had reached its ultimate refinement by 1869, just as advancements in steam power and large ship design were accelerating. The progression was inevitable.

The earliest steam engines were very inefficient. The basic principle of a steam engine is simple: pressurized steam is injected into a cylinder just after the piston within the cylinder has reduced the volume to its practical minimum. The expansion of the injected steam pushes the piston to the state, whereby the volume within the cylinder is at its practical maximum, at which time the steam is expelled. A rod connected to the piston transfers the energy generated in the process to a flywheel. The expelled steam is now cooler and at a lower pressure than at the time of injection. The mechanics of the process are controlled by valves and regulators, which are integrated into the design.



A simple steam engine is started by opening the injection valve when the piston (1) is in the proper position. That position depends on whether the flywheel (7) is intended to rotate clockwise or counterclockwise. The piston rod (2) connects to the flywheel by means of a crosshead bearing (3), via the connector rod (4), which attaches to the flywheel at flywheel crank (5). The valve (8) that controls the timing of the steam injection and release is activated by an eccentric connector (6) on the flywheel. A centrifugal regulator (9) governs the speed of the engine by adjusting the steam injection valve as needed.

One of the problems with the basic (single-piston) steam engine is that the expelled steam still has a great deal of stored energy, which is simply lost upon expulsion. A dramatic example of this lost energy can be observed in classic movie scenes depicting a steam locomotive departing a railway station. With each piston stroke, a burst of steam is expelled with a percussive burst.

By the middle of the nineteenth century, a compound (double-expansion) steam engine was developed, whereby the expelled steam from the first cylinder is released into a second cylinder of larger volume just after its piston has reduced the internal volume of the second cylinder to the practical minimum. Just as the first cylinder is "compressing" to prepare for another injection of steam, the second cylinder's piston is adding mechanical (kinetic) energy to the flywheel. The double-expansion steam engine runs smoother and uses substantially less fuel than the simple steam engine.

By 1881, the triple-expansion engine was developed, followed by the quad-expansion engine in 1894. All during this time, the sizes of steamships and steam engines were steadily increasing. An excellent animated illustration of a triple-expansion steam engine can be found at the website, *http://liberty-ship.com/html/topics/engine.html*. On the same page is a picture of a 19-ft. tall, 270,000-lb. triple-expansion steam engine.

Steamships transported significantly more cargo and required far smaller crews than sailing ships. Moreover, larger steamships required basically the same crew as smaller steamships. Consequently, steamship owners found that new, larger steamships could compete more effectively and return larger profits than older, smaller ships. Predictably, steamships rapidly grew larger and larger as international commerce increased throughout the latter half of the nineteenth century.

As merchant ships increased their cargo capacity, an unexpected problem surfaced. The time and labor required to load a ship at the port of origin, and to unload the ship at the destination, increased out of proportion to the cargo capacity of the ship. Savings in transport time and expenses realized by the economies of scale were largely lost in the loading and unloading of the cargo.

The problem was not solely the tonnage of freight. Adding to the high tonnage problem was the vast mix of goods that were consolidated for the shipment in order to utilize the full capacity of the larger ships. Unlike the early nineteenth century *Tea Clippers* that transported only tea, the vast steamships often transported hundreds of mixed items destined for hundreds of recipients.

In *The Box, How the Shipping Container Made the World Smaller and the World Economy Bigger*, Marc Levinson presents a bleak portrait of Transatlantic shipping as late as 1954. As example, he describes a shipment of goods aboard the *Warrior*, a typical cargo ship of the period. The cargo included a mixed array of cases, cartons, bags, boxes, bundles, packages, pieces, drums, cans, barrels, wheeled vehicles, crates, transporters, reels, and 1,525 pieces of "undetermined" goods, for a total of 194,582 pieces of freight, weighing in at 5,015 tons. In all, there were over a thousand separate shipments from 151 cities consolidated for the shipment. Some goods were waiting on the dock for over a month before being loaded.

It took six days to load the freight in Brooklyn, and another four 24-hour days to unload the freight at its destination port in Bremerhaven. Some of the unloaded freight did not reach their final destination until 33 days after the *Warrior* docked! Add the expected pilfering and damage to the mix and it was obvious that significant changes had to be made. But, according to Levinson:

> ... despite all the demands for change, and despite much experimentation, most of the industry's efforts to improve productivity centered on such timeworn ideas as making drafts heavier so that longshoremen would have to work harder. No one had found a better way to ease the gridlock on the docks. The solution came from an outsider who had no experience with ships.

Levinson's outsider was a self-made trucking mogul by the name of Malcom McLean. Born in 1913, McLean bought his first truck in 1934 at the height of the Great Depression. It was a used dump truck that cost him $3 per week in installment payments. A WPA (Works Progress Administration) contract afforded him the opportunity to hire a driver and purchase a new truck, thereby doubling his fleet in less than a year.

In 1935, he added a tractor-trailer rig and hired nine drivers that owned their own trucks. Five years later, his fleet totalled 30 trucks, and by 1945 it swelled to 162. His territory ran all along the eastern seaboard, throughout Florida, and on to Texas. By 1954, McLean Trucking was the eighth largest trucking company in America by gross revenue, and the third largest in net profit.

McLean was the sort of entrepreneur who was constantly attempting to improve operations, while at the same time trying to understand his competition even to the point of predicting the future. One concern was the rivalry between coastal maritime ships and the trucking industry along his primary routes. Coastal shipping had largely died off by the 1950s, as faster trucks were able to cut days off transit time. Here again, loading and unloading cargo was one of the problems that trucking companies avoided.

Suddenly it occurred to McLean that a ship could be converted to haul loaded trailers from one port to another. At the destination port, local trucks could haul the trailers to their final destination. No loading and unloading would be required, saving half the cost and half the time of coastal shipping.

The concept was fairly simple, but there were several details to address. As first envisioned, the entire trailer, wheels and all, would be loaded onto the ship. It was not long before McLean considered removing the "box" from the trailer frame, possibly allowing the boxes to be stacked. But tractor-trailer boxes were not built to withstand the weight of stacking. Moreover, traditional trailer boxes were not designed to be repeatedly removed and reattached to the trailer frame.

McLean's solution was to design a system from scratch. Rugged boxes, capable of being stacked, were designed for easy attachment to custom-designed trailer frames. A surplus World War II tanker, purchased on the cheap, was modified to carry the stacked boxes. Cranes were designed to move the boxes swiftly and safely between the tanker ship and the trailer frame. The challenge was huge, but in time it all worked, pretty much as planned.

In estimating the potential cost savings of his container concept, McLean analyzed the cost of shipping Ballantine Beer from Newark to Miami. Estimates for freight costs by conventional coastal ship came to $4.00 per ton. Shipping via McLean's container ship was estimated at 25 cents per ton!

Container shipping had been used prior to McLean's success, but early containers were relatively small and handled at the docks like ordinary boxes, cases, barrels, etc. McLean designed and implemented a fully integrated concept that included custom trailer frames, custom boxes, and custom cranes at dedicated docks, all designed to move nothing but containers, and to do so quickly and safely at minimum cost. His system was the first to dramatically reduce the cost of sea freight.

It took several years for the shipping industry to adopt an international standard for containerized shipping. McLean's original containers were 33 feet long, and later standardized at 35 feet, the maximum truck box length allowed on New Jersey highways at the time. But that length was considered inefficient for certain kinds of freight, and trucks could not always navigate narrow, winding roads with a 35-ft. box.

In March 1961, the International Standards Organization (ISO) defined four standard container sizes. Each would be 8 feet wide and 8 feet tall, and the allowable lengths would be 10, 20, 30, and 40 feet. But the height of 8 feet proved to be difficult to unload with a forklift, so many shippers defied the standard by constructing containers with a height of 8½ feet.

Today, there are three sizes of shipping containers. The primary (40-ft.) container has external dimensions of 40 feet long, 8 feet wide, and 8½ feet high. A half (20-ft.) container has width and height of a 40-ft. container. A "jumbo" ("high cube") version of the 40-ft. container is one foot taller.

The efficient purchasing unit for international trade is a 40-ft. container. While the product content value of a 20-ft. container is half that of a 40-ft. container, the shipping, customs clearance, and ground transportation charges for a 20-ft. container is nearly the same as that of a 40-ft. container. The result is that the transport cost per unit for the smaller container is twice that of the larger container.

Today, tea companies that purchase what would be considered inexpensive "commodity" teas, purchase their teas in 40-ft. container increments, thereby minimizing the cost of import and transportation.

The same concept applies to all goods shipped by sea. Containerized shipping favors the larger operations (such as the proverbial *Big Box* stores) for all imported commodity products. Smaller operators survive today by specializing in non-commodity products (such as specialty teas) that are produced in limited quantities and simply put, cannot be purchased in container quantities.

The period between the opening of the Suez Canal and the era of container shipping was an exciting time for the tea trade in both Great Britain and the United States. During this time, the "romance" of tea shifted from its transportation on record-breaking clipper ships to its manufacturing and marketing. Almost all of the tea companies that started importing tea during this time have long since closed. A few exist in name only.

Our series on *Reversals of Fortune in the Tea Industry* will continue this topic in the next issue of the *Upton Tea Quarterly.*

