Into the Fold

Solving the Empty Containers Problem

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Image Source: Theberge, Albert E. *Shipping Containers at the Terminal at Port Elizabeth, New Jersey*. June 2004. NOAA, Port Elizabeth, NJ. Web.

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Executive Summary

The intermodal shipping container is one of the most ubiquitous and underappreciated pieces of technology in the world today. Its introduction revolutionized the global shipping industry and laid the foundation for a modern interconnected economy predicated on frictionless movement of goods and capital. Yet, the success of the container has come with a downside: the logistical challenge of moving and storing "empties" – containers with no goods inside.

Empties add cost at several levels of the global supply chain, both in port and at sea, which make an already volatile shipping industry more difficult to navigate and pass extra costs both onto companies who count on efficient movement of goods to succeed, and on again to their consumers.

Development of a viable folding container, which would allow multiple empties to fold and nest together interchangeably with regular containers, would be a breakthrough technology. It would modernize an indispensable item that nonetheless has had myriad unintended consequences, from port congestion to pollution. Folding containers would be a key cost saver for an industry often beset with unpredictability, and allow for a more efficient, safer, and cleaner global supply chain.

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Introduction

Perhaps no piece of writing better exemplifies the diffuse nature of the modern economy than Leonard Reed's "I, Pencil." The titular object's creation across multiple continents, involving dozens of industries and thousands of workers, is a miracle of economic ingenuity. All the more remarkably, the pencil's construction happens without any individual person knowing how to assemble such a seemingly simple object from start to finish.[1] Reed's work may now be more than half a century old, but its lessons have never been more applicable. Almost every object in use in the industrialized world "sits at the capstone on the very tip of a vast pyramid of enabling technologies."[2]

Supporting the dizzying amount of specialized materials and labor available in our increasingly interconnected world is the transportation infrastructure that allows everything from raw materials to finished products to move cheaply over vast distances. The development of the intermodal transportation system beginning in the 1960s, allowing goods to shift seamlessly between trucks, rail, and ocean vessels, has revolutionized the global economy. Fifty years ago, it would have been unthinkable for Scottish cod to be shipped to China, filleted, and shipped back to Scotland more cheaply than simply doing it in one place.[3] Today, it's just another footnote in a globalized economy with its foundation in affordable transportation of goods.

The cornerstone of this system is the intermodal shipping container. The sight of millions of these objects, piled on massive ships and stacked in ports around the world, is the visual signifier of the modern global economy. As Marc Levinson describes in *The Box*, his seminal history of the

[1] Read, Leonard. *I, Pencil*. Irvington-on-Hudson: Foundation for Economic Education, 1958.
[2] Dartnell, Lewis. *The Knowledge*. New York: Penguin, 2014, p. 3.
[3] George, Rose. *Ninety Percent of Everything*. New York: Picador, 2013.

shipping container, "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."[4] Efficient use of these simple objects ramifies throughout global trade flows. Optimizing their implementation throughout the intermodal transportation system must be a critical priority for logistics operations around the world. Indeed, although the container industry "is fast reaching a maturity phase characterized by a wide diffusion of the technology around the world and technical improvements that are more and more becoming marginal," there are still areas of inefficiency the improvement of which can make a dramatic difference in the streamlining of global trade.[5]

> "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."

The logistical externalities that empty containers cause are a key part of improving global supply chains. Trade imbalances between both intercontinental and local ports lead to large numbers of empty containers taking up valuable time and resources in the course of moving goods. For example, at the Port of Long Beach, the second largest port in the United States as measured by container traffic, approximately 27 percent of the 2015 twenty equivalent unit (TEU) tonnage was empty, an increase of more than 20 percent over the prior year.[6] [7] At the nation's biggest container port, the Port of Los Angeles, over 57 percent of departing TEU volume in 2015 was empty.[8]

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[4] Levinson, Mark. *The Box*. Princeton: Princeton University Press. 2006, p. 2.
[5] Notteboom, Theo, and Jean-Paul Rodrigue. "Containerisation, Box Logistics and Global Supply Chains: The Integration of Ports and Liner Shipping Networks." *Maritime Economics & Logistics* 10.2008 (2008): 152-74. Web. 10 Aug. 2016, p. 155.
[6] "Top 50 World Container Ports." *World Shipping Council*. World Shipping Council, n.d. Web. 10 Aug. 2016.
[7] Slangerup, John, and Steven B. Rubin. Comprehensive Annual Financial Report for the Fiscal Year Ended September 30, 2015. Rep. Harbor Department, Long Beach, California, p.78
[8] "The Port of Los Angeles Container Statistics - 2015." *Port of Los Angeles*. Web. 11 Aug. 2016.

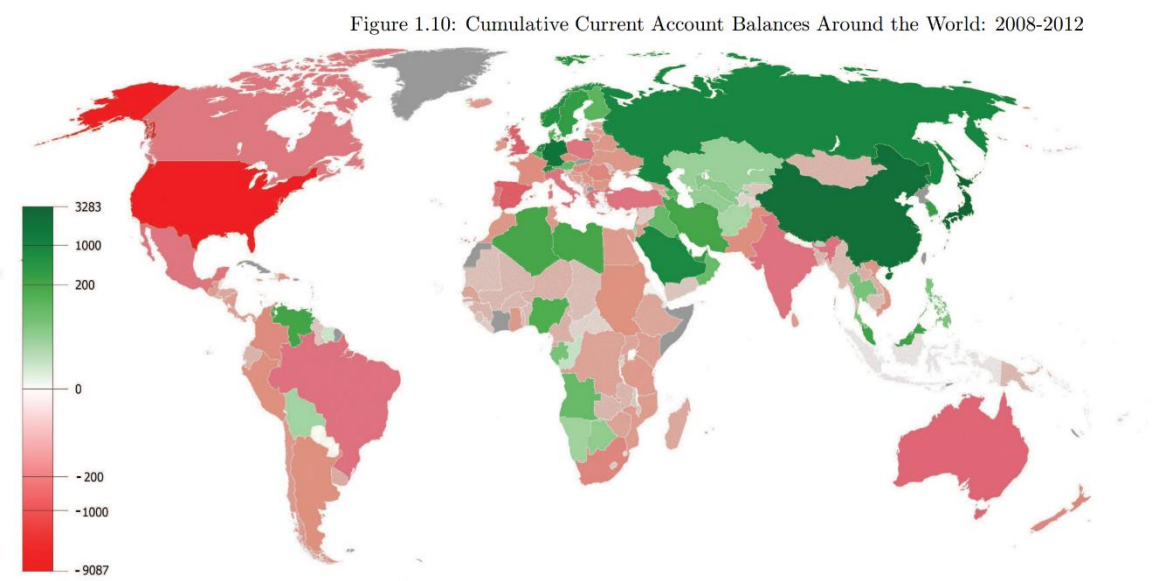
These empties impose monetary and temporal costs on shipping carriers, large companies such as Maersk or Hapag-Lloyd, which are then passed through to the shippers themselves and then again to consumers. Any solution that significantly alleviates the empties problem will be a vital step in pushing the efficiency frontier of global logistics.

The containers themselves are owned primarily by two groups. First, shipping carriers such as the examples mentioned above. Second, container leasing companies, which lease containers to carriers when capacity is below demand. Thus, benefits from solutions that ease inefficiencies related to empties will accrue most directly to these actors, although improvements will impact the entire supply chain.

Despite past failures of new container designs to alleviate the empties problem, there is no question that shipping carriers would derive enormous benefits from any solution that reduced the loss associated with empty containers. The costs of transporting, loading, and storing empty containers in ports worldwide provide no benefit to carriers or their clients, in addition to worsening port congestion and contributing to the persistent irritant of pollution associated with the shipping industry. In short, the time is ripe for a container design that can save shippers, their clients, and ultimately consumers the cost of dealing with empties.

International Trade Flows

Imbalances in global trade caused by wide-ranging macroeconomic conditions are the underlying root of the empty containers problem. The explosion of international trade and growth, as well as economic development paths unique to each country, has created a fundamentally unbalanced international trade economy. These are longstanding trends, and are unlikely to change in the near term absent an unexpected, widespread economic disruption.[9]



Moreover, the container shipping industry reflects the same developments. East Asia (especially China) is driving huge volumes of exports, particularly to North America and the United States, while receiving a much smaller volume of goods in return.[10] In short, far more good-laden containers are leaving some countries than are returning, driving a global logistics handicap related to containers that are unavoidably empty during large portions of the shipping routes.

[9] Schmitt-Grohe, Stephanie, and Martin Uribe. *International Macroeconomics*. Chicago, 2014, p.31.

[10] Haji, Solmaz, Eoin O'Keeffe, and Tristan Smith. "Estimating the Global Container Shipping Network Using Data and Models." *Low Carbon Shipping Conference* (2013), p.9.

Empty containers are the inevitable consequence of a simple imbalance of container movements both between continents and between countries. Therefore, any solution to the empties problem must come from within the broader trade networks within which the issue exists. Given the extreme unlikelihood that empties cease being a logistical problem due to macroeconomic shifts, carriers and ports must seek to address the problem under the current status quo of international trade.

Empties in the Supply Chain

Shipping carriers and the ports through which they move goods are the cornerstone of global logistics. Supply chains increasingly span multiple continents, and therefore enable products to pass through multiple ports en route to completion and delivery to customers. Take, for instance, a straightforward toy – the Barbie Doll. Produced partially in China, Japan, Europe, Taiwan, and the United States, each stop along the way involves movement from one port to another, often on opposite sides of the world.[11] In so doing, they traverse an intricate system of ships, ports, trucks, and trains, as goods move from one part of the globe to another, and back again.

Much of global shipping networks are laid out in a hub and spoke system. That is, a larger ship will make berth at a hub port, such as Kingston, Jamaica. Once there, it will offload its containers into the port facility. At a hub port, a much smaller percentage of overall TEU traffic will actually leave the port for delivery to a consignee, and will instead be stored on site at the port to

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[11] Levinson, Mark. *The Box*, p. 264.

await smaller vessels to transport the containers to so-called "feeder" ports. When these smaller ships arrive, the relevant containers are re-loaded for shipping to their next destination.

Once picked up and taken to a feeder port, such as Cartagena, Colombia, the port will once again unload the containerized contents of the ship. Subsequently, there are three main options that govern the next movement of a particular container. First, and least common, containers with goods too dangerous to sit in storage for any amount of time will immediately be picked up and leave the port.

Second, after storage of anywhere from 24 hours to several days, a container will be removed from a stack, its contents unloaded into a truck, and then returned to storage empty without ever having left the port.

Image Source: Alf van Beem, Wikimedia Commons

Third, and most common, the container will be lifted from the stack and loaded onto a truck chassis, where it will be driven to its final destination. Once there and unloaded, the empty container will either be returned to the port if the delivery is close to the coast and cheap to transport, or else sit in an inland depot until called upon to return to the port or assigned to pick up goods locally. Regardless, the container will sit empty either in port or in a depot until the shipping carrier again requires its use.

The costs associated with empty containers in the above operations are multiform. First, ports charge for every "lift" they perform on any container. While the fee for lifting a full container is obviously offset by the value of the goods within it, the cost of lifting an empty container provides no commensurate benefit. Shipping carriers lose money on every lift of an empty container, and with containers often undergoing multiple lifts during a single stay in port, the cost is recurring.

THE COSTS ASSOCIATED WITH EMPTY CONTAINERS IN THE ABOVE OPERATIONS ARE MULTIFORM. FIRST, PORTS CHARGE FOR EVERY "LIFT" THEY PERFORM ON ANY CONTAINER... SECOND, THERE IS THE COST OF STORING EMPTY CONTAINERS EITHER IN PORT OR WITHIN INLAND DEPOTS... FINALLY, THERE IS THE OPPORTUNITY COST OF MOVING EMPTY CONTAINERS.

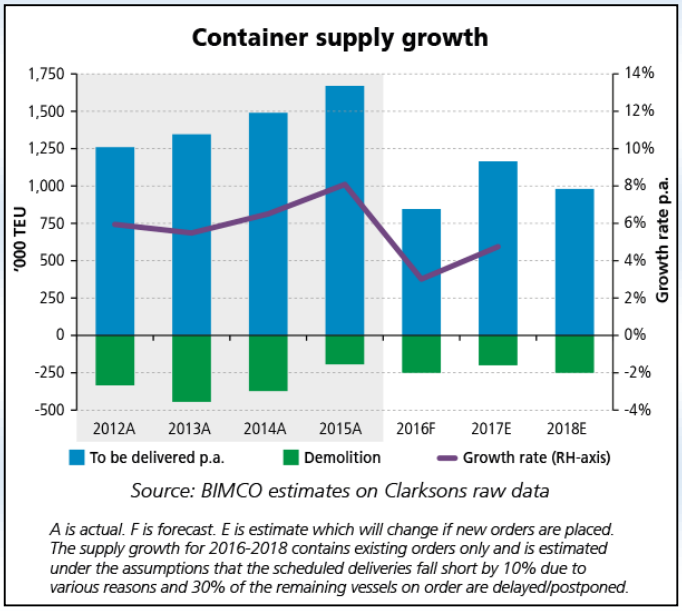
Second, there is the cost of storing empty containers either in port or within inland depots. While this is difficult to quantify due to the difference between shipping carriers' individual arrangements with port or storage entities, the financial and logistical problem caused by the storage of empty containers exists across firms.

Finally, there is the opportunity cost of moving empty containers. If a shipping carrier does not receive an order with which to fill an empty container before moving it to a new destination, then it must ship the empty container to the place where it can be of the most use. By taking up ship space that could be used for paid freight, empty containers eat away at carrier revenues.

Consequences of Empties

In each of these subcomponents of the supply chain, reducing the number of empty containers could result in significant cost savings for shipping carriers. This becomes even more important, however, when considering current trends within the shipping industry. First, the shipping industry itself is caught in a downturn.[12] As supply outpaces demand, carriers will face increasing pressure to cut costs and find savings to relieve the burden of suppressed freight rates.

Second, the number of containers worldwide continues to grow in concert with rising international trade, following a trend that has continued unabated for decades.[13] [14] As this happens, ports and carriers will face mounting problems with storage costs and availability, especially if continued growth necessitates port expansion, which requires costly investments.[15] A solution that



[12] Moody's. Investors Service. Moody's: Outlook on Global Shipping Sector Turns Negative as Supply-demand Gap Widens and EBITDA Declines. *Moody's*. N.p., 17 Mar. 2016. Web. 10 Aug. 2016.
[13] Rodrigue, Jean-Paul. "World Container Traffic and Throughput, 1980-2013 (millions of TEU)." The Geography of Transport Systems. Hofstra University, n.d. Web. 28 July 2016.
[14] Bimco. "Container Shipping: A Difficult Market Is Helped Along By Low Supply Growth In 2016." Bimco, 25 Jan. 2016. Web. 28 July 2016.
[15] "US Ports Investing Billions to Expand Operations to Improve Efficiency." *JOC*. Web. 10 Aug. 2016.

helped reduce capacity problems associated with empties could prevent expenditures that are vastly more expensive.

Port congestion is an especially pertinent issue. In 2015, the Federal Maritime Commission in the United States identified congestion in American ports as a "serious risk factor to the relatively robust growth of the American economy and to its competitive position in the world economy."[16] As the report states, "In light of the recent congestion problems at several key U.S. port gateways, it is a daunting prospect that at five to seven percent annual rates of growth twice as much port capacity may be needed in just 10 to 15 years to accommodate anticipated growth."[17] Given that so many containers at the United States' biggest ports are empty, a great deal of storage capacity is allocated to these assets. A solution that cuts down the number of empties sitting in port would be a far more cost effective solution to congestion than financially exhaustive port expansions or other high intensity infrastructure projects.

A SOLUTION THAT CUTS DOWN THE NUMBER OF EMPTIES SITTING IN PORT WOULD BE A FAR MORE COST EFFECTIVE SOLUTION TO CONGESTION THAN FINANCIALLY EXHAUSTIVE PORT EXPANSIONS OR OTHER HIGH INTENSITY INFRASTRUCTURE PROJECTS.

Finally, there is the issue of pollution. The shipping industry produces a variety of emissions, both greenhouse and particulate. While many of these emissions occur at sea, they present serious health and quality of life problems when ships dock in port. According to the OECD, they are responsible for "almost EUR 12 billion per year in the 50 largest ports in the OECD for

[16] United States. Federal Maritime Commission. Bureau of Trade Analysis. Federal Maritime Commission, July 2015. Web. 10 Aug. 2016, p. 2.
[17] Ibid, p.3.

NOx, SOx and PM emissions."[18] These, in turn lead to an astonishing 60,000 worldwide deaths per year.[19] Any operational improvements that increase throughput and decrease energy expenditure within the port would have a measurable impact on environmental and human health. More efficient processing of empties would be a key step in this process.

[18] Merk, Olaf. "Shipping Emissions in Ports." International Transport Forum. OECD, Dec. 2014. Web. 28 July 2016, p.4.
[19] Ibid, p.6.

What is to be Done?

As stated above, businesses have attempted in the past to construct a viable collapsible shipping container that allows several empties to fit into the space of a single standard container. A variety of designs with this goal in mind have been proffered as a palliative to the empties problem. These containers would allow shipping carriers to save space on their vessels and streamline port operations that are currently spent on the storage and handling of empty containers.

Despite multiple attempts, however, no collapsible container has succeeded. The designs have not held up mechanically in the variety of climates and conditions to which shipping containers regularly face exposure. From the freezing arctic to the hot and humid tropics, as well as the generally corrosive sea air, the stressful environments that containers endure have raised the costs of maintaining and using collapsible containers above the savings they generate.

Among the key failings of past designs is the fact that they collapse downward, which puts too much stress on the load bearing joints of the structure. In addition, they often require expensive specialized equipment and training, which have raised adoption and usage costs by carriers and ports.

Development of a new design that folds inward, allowing for greater structural and mechanical integrity due to the stability of the vertical support, could be the key to creating a structure that can withstand the stressful conditions to which every container is subjected. Assuming it can be nested interchangeably with standard containers, and requires no specialized equipment or training, such a design could be a breakthrough for ameliorating the empties problem.

Staxxon, a six-year old US technology and Intellectual Property licensing company, has designed and prototyped such a product, which has already been certified under test conditions. By creating a solution for an unavoidable problem at a key junction of the global economy, Staxxon's foldable shipping container has the potential to disrupt and streamline the global shipping industry in an enduring way. Its two unique innovations in container design will offer owners a competitive advantage at a time when vessel operators are reeling from overcapacity and rock-bottom freight rates.

The global shipping industry has been a foundation of prosperity, growth, and innovation for the past half-century. It has underpinned vast amounts of trade in people, goods, and ideas, disrupting the world for the better in ways that would have been thought impossible just decades ago. The intermodal container was a key step in this transfor mative process. In some ways a victim of its own success, proliferating beyond anyone's expectations, the ubiquity of the container has caused problems in its own right. To that end, adding a cutting-edge foldable design to the backbone of global trade is a step well in line with the transformative change the intermodal container has brought to the world.

ADDING A CUTTING-EDGE FOLDABLE DESIGN TO THE BACKBONE OF GLOBAL TRADE IS A STEP WELL IN LINE WITH THE TRANSFORMATIVE CHANGE THE INTERMODAL CONTAINER HAS BROUGHT TO THE WORLD.

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