frontier economics

THE DEVELOPMENT OF SHIPPING CONTAINERS

An Interoperability Case Study

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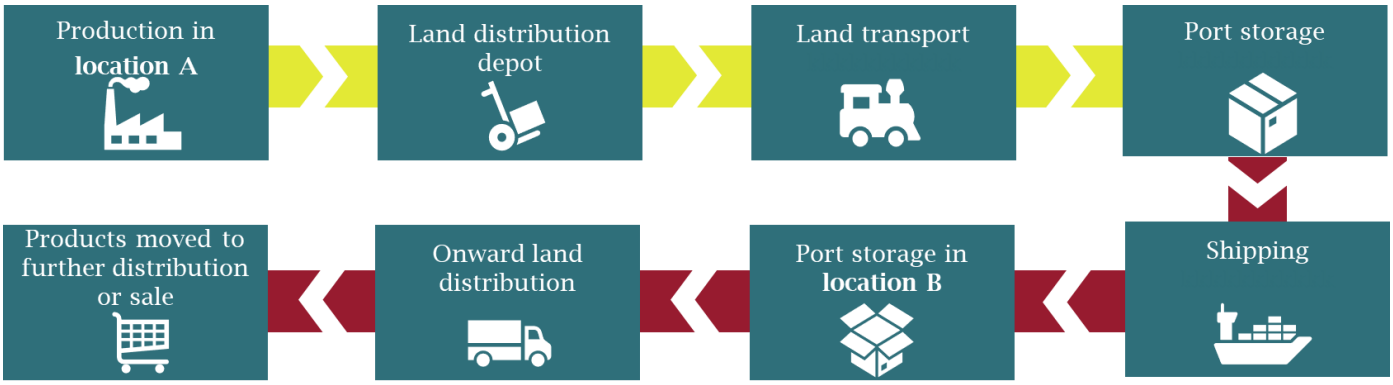
In the logistics industry, year zero is 1956. That was when American trucking entrepreneur Malcom McLean came up with the idea of using the same container for both land transport and shipping. The resulting interoperability revolutionised land and sea distribution networks.

BEFORE THE STANDARD

Before containers were widely adopted, homogeneous cargoes, such as oil or cereals, could be loaded and unloaded relatively efficiently at ports with specialised facilities. But most goods were shipped as break-bulk, the term used to describe the tedious process of transferring diverse types of cargo from lorries into sacks, barrels and wooden crates directly onto ships (Song & Panayidas, 2012).

It could take up to three weeks to load each ship as dockworkers squeezed as many items as possible onboard. They had to distribute the weight carefully to make sure the cargo couldn't move during the voyage, for fear of damaging the goods or even causing the ship to capsize (Levinson, 2006). There was no coordination with road and rail networks, so the costly break-bulk process had to be repeated at each distinct, non-interoperable distribution node.

FIGURE 1 STAGES REQUIRED TO TRANSPORT GOODS FROM PRODUCTION TO CONSUMPTION



Source: Frontier Economics

This lengthy process led to ships spending two-thirds of their productive time in port (Bernhofen, et al., 2016). The scope for economies of scale that could be realised from larger vessels was reduced. High levels of theft, loss and accidents increased insurance costs, while disputes with strong labour unions were common.

WHAT LED TO THE STANDARD

McLean did not invent the shipping container. The idea of moving goods in a box already existed. His insight was to make the same standardised container usable on ships, in ports and on land rather than being suitable for one network but not for others (Thompson, 2018).

In 1956 McLean remodelled his ships so containers could be stacked to increase capacity. Decks were widened and hatches expanded to give cranes access. The first converted ship sailed from Port Newark to Houston in 1956 carrying just 58 containers (Bernhofen, et al., 2016). The cost of transport came out at just $0.16 per tonne compared with the normal break-bulk rate at the time of $5.83 (Levinson, 2006).

The idea of containerisation started to gain popularity, but there was initially little change in the type of ship used because firms would design containers for their goods and for the vessels they already had (Tomlinson, 2009).

FORMAL STANDARDS

Shipping firms could not reach a consensus on a standard since they used different dimensions and materials for their containers, depending on their business model and customer base. Each company needed its own port infrastructure. What's more, ships designed to one standard could not be sold to a firm using a different standard, thus limiting their resale value.

Efforts to agree on a common standard began in the US in 1958. But the going was tough. Implementing new norms could have a big cost or commercial impact on a multitude of stakeholders. After various US government agencies became involved, agreement was eventually reached in 1961, and by 1968 the International Standards Organisation (ISO) had settled on a global standard for the size of containers.

Other norms were agreed to ensure the system's interoperability between distribution nodes, including a common fixing system so that different containers could be stacked or lifted. Again, the negotiations were difficult. The breakthrough came when McLean released his patent on his container fixings, free of charge and without conditions, paving the way for it to become the basis for the US standard (Ham, et al., 2012).

The international standard subsequently adopted by the ISO in 1970, after much haggling and compromise, was widely viewed as sub-optimal (Levinson, 2006). Nevertheless, it would go on to revolutionise world trade.

THE STANDARD UNLEASHED INVESTMENT

The standard may not have been the most efficient, but it permitted interoperability. Businesses could have confidence that almost every train, truck, port and ship could transport a standard container. The design of ships duly changed to accommodate the containers' specifications. Companies could invest in larger and faster vessels. The average ship length increased from 180m in the 1960s to 275m in 1973 (Levinson, 2006). The largest modern container vessels can be 400m long.[1] The ships grew in size due to the economies of scale that could be achieved from the rapid loading times made possible by the standardised container (Tomlinson, 2009).

Ports were initially resistant to change. But once containerisation proved to be effective and profitable, ports raced to build new terminals with the modern infrastructure needed to be competitive. Between 1973 and 1989, American ports spent $2.3 billion on container handling facilities (Levinson, 2006).

HOW THE STANDARD IMPROVED OUTCOMES

Efficiency. Economies of scale allowed for larger ships and more specialised port equipment, cutting delivery times and costs. In 1965, dock labour could move only 1.7 tonnes of cargo per hour; by 1970, that had jumped to 30 tonnes. Losses and damage due to repeated loading and unloading fell, slashing insurance premiums to one-sixth of pre-containerisation levels (Bernhofen, et al., 2016).

[1] Marine Insight, *10 Smart Ship Technologies For The Maritime Industry*, September 2021 - https://www.marineinsight.com/know-more/10-smart-ship-technologies-that-maritime-industry/

Further efficiency gains are still possible today to speed up global cargo flows. Many countries have their own systems to check goods, often using paper forms. Freight forwarders are campaigning for standard digital trade documents and improvements are starting to be made.[2] It has also been suggested that this further interoperability could increase exports, decrease costs and have environmental benefits (Duval & Hardy, 2021).[3]

Globalisation. There were wider externalities from containerisation. The world became more interconnected. Once containerisation reduced the cost of shipping, it became economic for manufacturers to move factories to countries with lower labour costs or readily available raw materials (Song & Panayidas, 2012).

Containerisation also gave manufacturers greater confidence to ship components and finished goods around the globe. One academic study found that in a subset of countries trade soared by 320% over five years after the container was introduced (Bernhofen, et al., 2016).[4] Firms could calculate the speed of unloading and loading more accurately (Tomlinson, 2009). As shipping became more consistent and reliable, just-in-time production flourished. As well as saving money on goods storage and reducing waste, this allowed manufacturers to respond more quickly to changes in the market.

The upshot was exploitation of comparative advantages through greater specialisation. Companies no longer needed to be vertically integrated. Rather than making a product from start to finish, containerisation allowed them to outsource production of parts to specialised manufacturers and transport them somewhere else to be assembled. International supply chains duly lengthened (El-Sahli, 2013).

Globalisation has lowered the cost and increased the range of goods available to consumers. Developing countries that were able to plug into global supply chains have prospered, notably China. But globalisation has also capped the wages of certain groups, particularly unskilled workers in advanced economies (Morris, 2015).

CONCLUSION

Containerisation has dramatically reduced transport costs, boosted world trade and transformed global supply chains. It demonstrates many important features of interoperability.

First, standardisation cut costs and saved time when shipping goods. This in turn led to a wave of investment in distribution infrastructure. Each of the new inventions was interoperable through the

[2] Port Technology, *Shift in political thought needed to prepare supply chain for future crises*, July 2021 - https://www.porttechnology.org/news/shift-in-political-thought-needed-to-prepare-supply-chain-for-future-crises/

[3] In addition to Duval and Hardy's work on estimating the emissions savings from paperless trade, work commissioned by the ICC (International Chamber of Commerce) suggests that the facilitation of paperless trade (exchange of trade-related data and documents in electronic form across borders) could reduce costs as a share of total trade across the G7 by 76% through improvements such as reduced compliance times and could create $267 billion of additional exports by 2026 compared to base forecast. Further digitalising of the trade ecosystem could create as much as $6 trillion in extra exports by 2026. ICC, *G7 | Creating a Modern Digital Trade Ecosystem - Cutting the Cost And Complexity of Trade*, 2021 - https://www.iccgermany.de/wp-content/uploads/2021/10/Creating-a-Modern-Digital-Trade-Ecosystem-G7.pdf

[4] In comparison, the paper found that bilateral free-trade agreements only increased trade by 45% over 20 years.

shipping container, allowing different stakeholders to make their own investments – in ports, ships, trucks and railways - without explicitly coordinating.

Second, achieving interoperability is complex. Even with something as simple as a stackable box, the process for agreeing on standards was exhausting because of conflicting incentives and vested interests. In the case of containers, the involvement of independent coordinating standards bodies and the US government was necessary to forge consensus.

Third, Malcolm McLean hastened standardisation by opening up the patent on his container. If he had not, it might have been harder to agree on an interoperable standard. Of course, McLean was not acting out of altruism. He recognised that opening up the patent would increase the size of the market for transporting goods.

Fourth, interoperability creates winners and losers. Groups unwilling to adapt will inevitably resist. In this case, dockworkers stood to lose and initially put obstacles in the way of the adoption of the standard.

Fifth, interoperability is not simply a binary choice. The development of the container has made the global transportation of goods vastly more efficient. But further improvements are possible, notably by switching to standard digital trade documents. Encouragingly, progress is being made on this front (Thompson, 2018).

Sixth, perhaps most importantly, containerisation shows that interoperability can unlock much wider economic benefits. These can dwarf the efficiency gains that interoperability makes possible in a particular market – in this case, the transportation of goods. The profound changes to world trade and the structure of the global economy witnessed in the last half century can in part be put down to the interoperability characteristics of a standardised steel box.

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