

Container shipping: The next 50 years

Travel, Transport & Logistics October 2017



Steve Saxon
Matt Stone



Contents

Container shipping: The next 50 years	2
In 1967, containers were disrupting the shipping business, so the players had to rethink everything. Now it's digital, big data, and the Internet of Things. Is it time to rethink everything again?	
The view from 1967	2
Four themes	
1 Market growth: 'Peak container' is nowhere in sight	5
2 Scale: The 50,000-TEU ship? But probably no bigger	13
3 Industry structure: Four big players by 2067?	17
4 Productivity: A completely digitized, autonomous industry	23
The view from 2067: A smart, customer-focused container industry	27

Container shipping: The next 50 years

In 1967, containers were disrupting the shipping business, so the players had to rethink everything. Now it's digital, big data, and the Internet of Things. Is it time to rethink everything again?

In 1967, the British Transport Docks Board (BTDB) commissioned McKinsey & Company to assess the impact of a recent development from the United States: container boxes.^a The first purpose-built ships for them were being launched, and a few US lines were carrying these novelties on their regular service.

Fifty years on, how does the reality of today's industry compare with the future envisioned in this report to the BTDB? As with any set of predictions, there are hits and misses (Exhibit 1). In this article, we reflect on the past half-century of developments

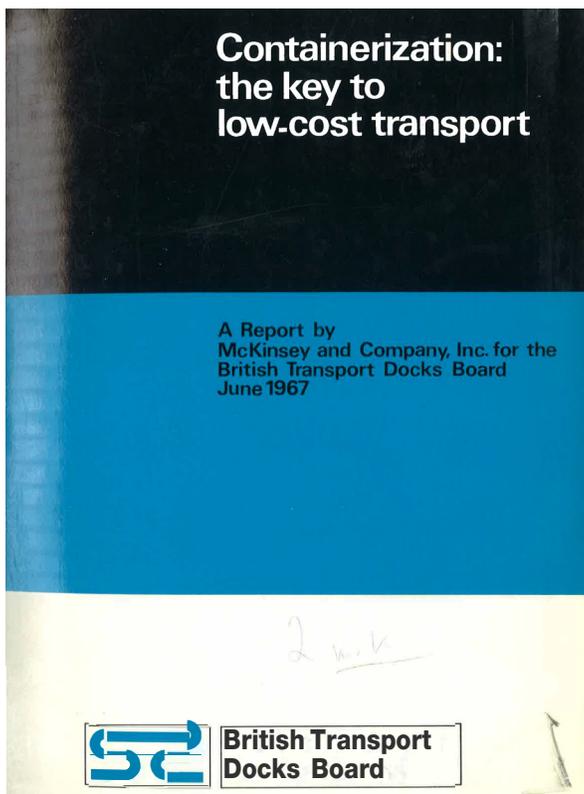
in container shipping, discuss major themes underpinning the industry then and now, and look ahead to what the next 50 years may bring.¹

The view from 1967

Over the two decades after the end of World War II, the world economy was in vigorous health. Global real GDP growth had averaged 4.8 percent a year since 1950, and world trade had recovered from its postwar low (10 percent of GDP), to reach 22 percent of GDP. The stagnation of the 1970s hadn't set in, and the explosive globalization that began in the 1990s wasn't even on the horizon.

Yet not all was well with the shipping industry. Sir Arthur Kirby, the BTDB's chairman, was forthright in his discontent, telling an audience at the Institute of Transport in 1965, "Had we set out to devise the most difficult way to work our ports, we could not have succeeded better than the existing state of affairs." In particular, he criticized irregular conditions of employment, uncoordinated and fragmented approaches to handling cargo, the ad hoc nature of transport to and from ports, and "the inertia of long-established custom."²

Sir Arthur asked McKinsey to examine long-term trends likely to affect the ports sector, and in response the firm produced two reports, in 1966 and 1967. The 1966 report's cover letter sounded the alarm from its opening lines:



^a This article has been published by permission of the BTDB's successor organizations: Associated British Ports (ABP) and the UK Department for Transportation.

Exhibit 1 Here's what we said in 1966–67 about the container-shipping industry.

Hits ✓

"Containerized cargo is effectively becoming homogenous, like other bulk cargoes, and is subject to the same economies of scale.... Economics [sic] of scale will result in this concentrated cargo being handled by a small number of large organizations.... Efficient use of expensive containers will require extensive route networks under unified control to allow load balancing."

"Now that standardized containers have been introduced in the shipping industry, the rush to 'get on the bandwagon' will probably lead to substantial overexpansion."

"If container ships follow the tanker trend, ships of more than 10,000-container capacity could be available."

"Feeder services will tend to replace direct calls when the large container ships come into service."

"Rotterdam is an example of a European port which is in a good position to fill a major transoceanic role."

"The role of British ports may tend to become that of feeders to the Continent.... Proximity of British East Coast ports to Europe will dictate their use."

Source: *Containerization—its trends, significance, and implications*, report for the British Transport Docks Board, McKinsey & Company, July 1966

Misses ✗

"Ship operators on most trade routes may have virtual monopolies to gain benefits of scale and therefore should be treated as international utilities."

"Trade with the Far East and Australia from both Europe and North America may be concentrated at a single distribution point in the Pacific."

"It therefore appears that only five ships ... would be required to handle the entire UK general cargo trade with North America ... and approximately 25 could handle all European/North American general cargo trade."

Containerization is emerging as the most important and far-reaching single factor in the movement of exports and imports through UK ports.... It is already well advanced and proceeding at a pace that has so far been seriously underestimated by virtually all those sectors of the national economy that will be most affected by it.... Our recommendations to your board at this stage are mainly that containerization be recognized as an urgent "fact of life," and that all major Docks Board plans and decisions be reviewed—and if necessary modified—within the new context created by it.

Where the 1966 report forewarned, the 1967 report elaborated. Many of its conclusions have stood the test of time; others proved wide of the mark. We do not claim to have a crystal ball, but some of the trends evident at that time are still shaping today's industry. Questions about market growth, the importance of scale, the evolving industry structure, and how to drive productivity continue to loom as large as they did in the late 1960s.



1

Market growth: 'Peak container' is nowhere in sight

Global trade took off in the 1800s as the innovations of the Industrial Revolution reduced transport costs and enabled countries to specialize in specific areas of production (Exhibit 2). After a hiatus during World War I, the Great Depression, and World War II, trade growth picked up again—this time with the help of container boxes, introduced in 1956.

The authors of the 1967 report observed that “low-cost transportation [would] affect the economic trade-off between small-scale local manufacture and centralized high-volume operations”—favoring the latter—resulting in “greatly increased volumes of trade.” Decades of growth in container trade, far exceeding global GDP growth, quickly followed. Even as recently as 2001–07, container-trade volumes were growing by about 11 percent a year—triple the rate of global GDP growth (Exhibit 3).

Today, the industry may be at an inflection point. The underlying growth of trade faltered after the global financial crisis: since 2012, the volume of traded goods (including noncontainerized goods) has increased approximately in line with GDP. The World Trade Organization (WTO) reports that the volume of merchandise trade rose by 1.3 percent in 2016—the first time since 2001 that trade growth has lagged behind global GDP growth.

What's more, much of the low-hanging fruit from the early years of containerization has already been harvested. When containers were gaining share from breakbulk (noncontainerized) cargo,

container trade could grow much faster than overall trade. However, the containerization ratio—a measure of seaborne cargo transported in containers—has stabilized at 13 percent since the financial crisis.³ Some sectors (such as electronics, medicines, and apparel) are entirely containerized; others seem stuck somewhere in the midrange; for instance, the containerization ratios for automobiles and for nonrefrigerated agricultural goods—25 percent and 12 percent, respectively—have remained more or less static for the past decade. In the absence of tailwinds, achieving container-trade growth that's higher than the growth of GDP and overall trade is harder than ever.

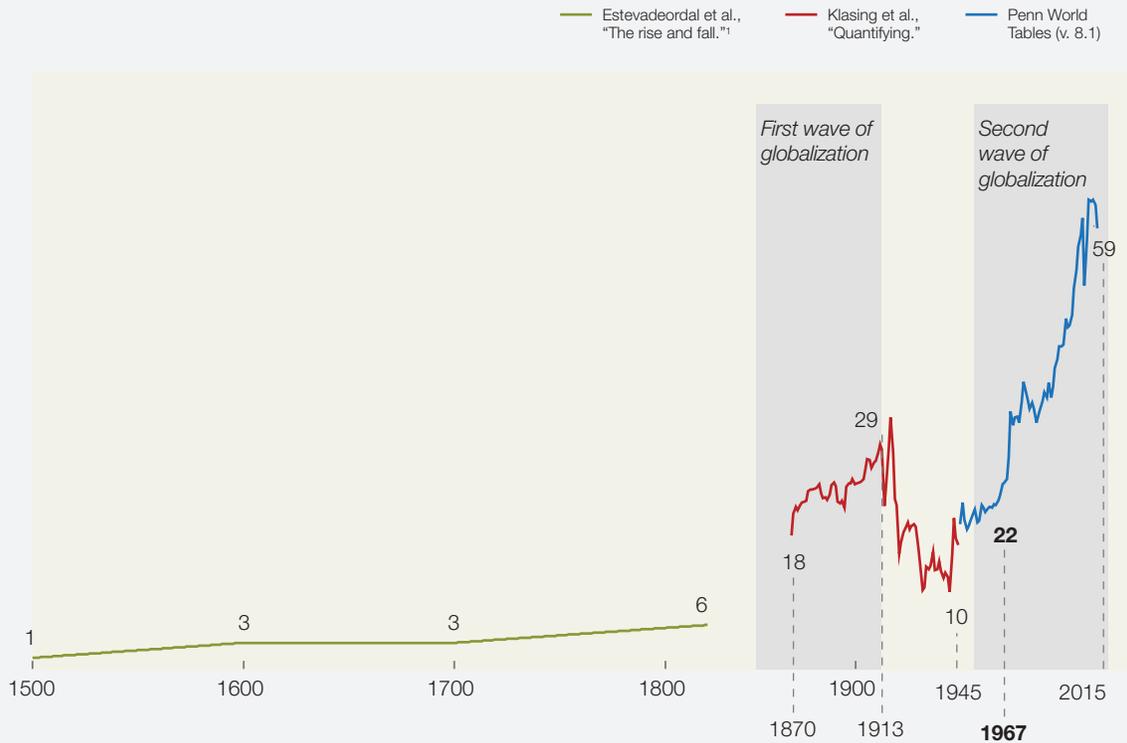
A number of interlocking trends are driving the slowdown in the multiplier—the multiple of container-trade growth over GDP growth:

- **Growth in emerging markets.** China's integration into the global economy, during the 1990s and 2000s, contributed very significantly to the growth of trade as manufacturing value chains adapted to utilize the country's abundant labor and to serve new customers. China became the world's factory, producing ever-larger shares of global manufacturing output and absorbing enormous amounts of natural resources and intermediate goods. The container-shipping industry supported much of this trade: in 2015, China imported and exported 52 million 20-foot equivalent units,⁴ a fourfold increase on the 13 million twenty-foot equivalent units (TEUs) of 2000.⁵

Exhibit 2 Global trade took off in the 1800s and picked up again—this time with the help of container boxes—after a hiatus from 1914 to 1945.

World exports and imports of goods and services

Share of world GDP, %



¹Simple average of lower- and upper-bound estimates.

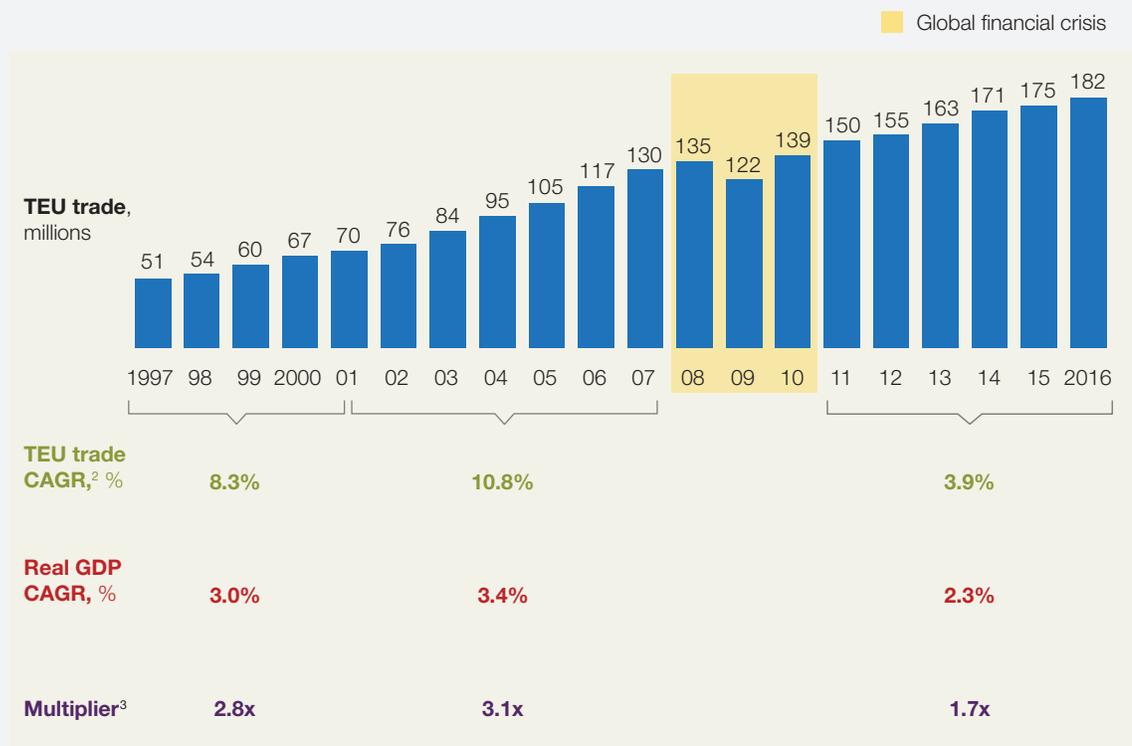
Source: Antoni Esteveordal, Brian Frantz, and Alan Taylor, “The rise and fall of world trade, 1870–1939,” *Quarterly Journal of Economics*, May 2003; Esteban Ortiz-Ospina and Max Roser, “International trade,” OurWorldInData.org; Mariko Klasing and Petros Milionis, “Quantifying the evolution of world trade, 1870–1949,” *Journal of International Economics*, January 2014; Penn World Tables Version 8.1; McKinsey analysis

China is now moving away from a development model based on investment and the export of goods and toward a consumption- and services-based model. Its annual real GDP growth has fallen from more than 10 percent to 6–7 percent, and its trade in goods with the rest of the world has slackened, as well.⁶ Emerging markets elsewhere are not compensating for this slow-

down. Only India is large enough to have a comparably dramatic impact on global trade, and whether the country actually does so will depend on how quickly it develops and integrates into global value chains. China found a winning recipe in policy reforms (such as openness to foreign direct investment) and massive infrastructure development;

Exhibit 3 Container-trade growth has slowed since the financial crisis.

Global TEU¹ trade and real GDP growth



¹Twenty-foot equivalent unit.

²Compound annual growth rate.

³Ratio of TEU growth to GDP growth.

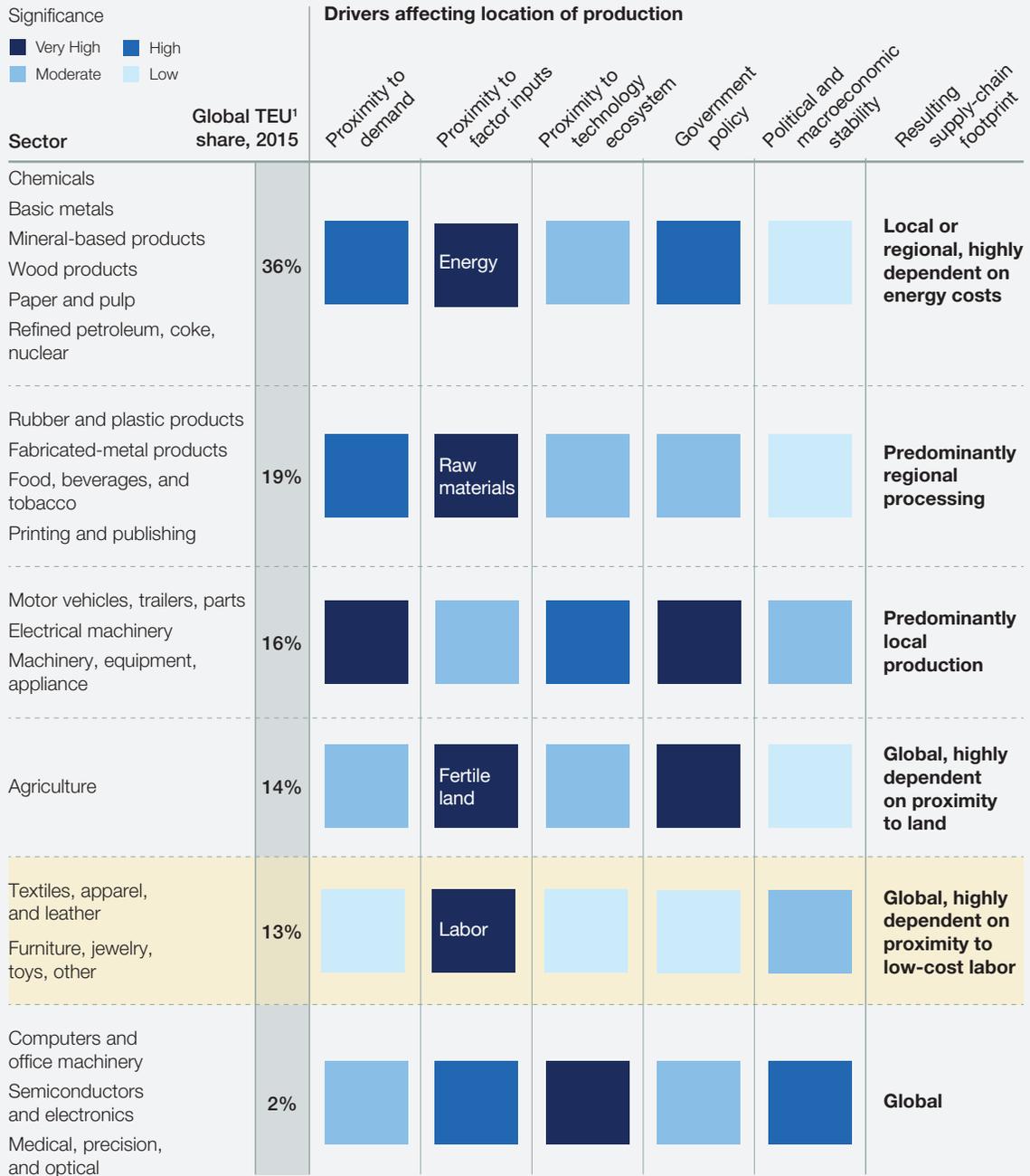
Source: Alphaliner; McKinsey analysis

India has begun taking steps to capture the slack.

- **Changing manufacturing footprints.** Today’s manufacturing sector is in a state of flux as the growing use of digitally enabled technologies (such as advanced robotics and 3-D printing) starts to change the regions where production takes place. According to some analysts, a wave of “reshoring” is imminent as new manufacturing technologies displace labor.

However, labor costs are not the sole determinant of manufacturing locations; Alabama still makes automobiles though labor is less expensive in Anhui. In fact, sectors in which labor costs are the main driver of location decisions produced only 13 percent of TEUs in 2015 (Exhibit 4). Over half—55 percent—came from sectors (such as chemicals, food processing, pulp and paper, plastics, and rubber) that treat access to affordable raw materials as a more pressing consideration.

Exhibit 4 Labor costs drive only a small portion of trade flows.



¹Twenty-foot equivalent unit.

Source: Expert interviews; McKinsey Global Institute

One technology in particular—3-D printing—could have a novel impact on trade volumes, but not by precipitating a mass localization of production. With this technology, objects are made by adding layers, thus minimizing waste, instead of by milling down materials. The Airbus subsidiary AP Works, for example, recently used 3-D printing to manufacture an electric motorcycle 30 percent lighter than a traditionally made one, mostly by using less material. As 3-D printing gets cheaper, faster, and more compatible with metals, ceramics, and other materials, its increasing use may affect trade in raw materials for manufacturing. At the moment, though, the impact is expected to be marginal: one analysis estimates that TEU volumes will fall less than 1 percent by 2035.⁷

- *Dematerialization of demand.* As societies get wealthier, they gradually saturate their demand for goods, and demand for services tends to take over. The global rise in incomes thus has two countervailing effects: on the one hand, expanding the consuming class and, on the other, dematerializing its consumption.

Of these two effects, we have reason to believe that dematerialization is gradually winning out. First, China is already evolving toward services-led consumption. Second, incomes are growing

in Africa, India, and Latin America more slowly than they did in China over the past three decades, muting the goods-intensive phase of development in these other regions. Third, technology is both miniaturizing products (a smartphone replaces, among other things, a camera, a map, a flashlight, a calculator, a newspaper, and a telephone) and promoting services (say, taking an Uber) at the expense of goods (buying a car).

- *Uncertainties in geopolitics and policy.* The geopolitical and policy environment is now somewhat precarious: a quarter-century of globalization, carried along by a steady stream of trade deals, has stalled. Many such deals remain on the agendas of political leaders, but the future is uncertain.

Taken together, these trends will probably slow down the growth of container trade. So what can we expect in the next five decades? An optimist might envision a world where India reaches an “escape velocity” growth rate by improving infrastructure, reforming markets, and liberalizing trade barriers—integrating more than one billion people into the global economy and its supply chains.

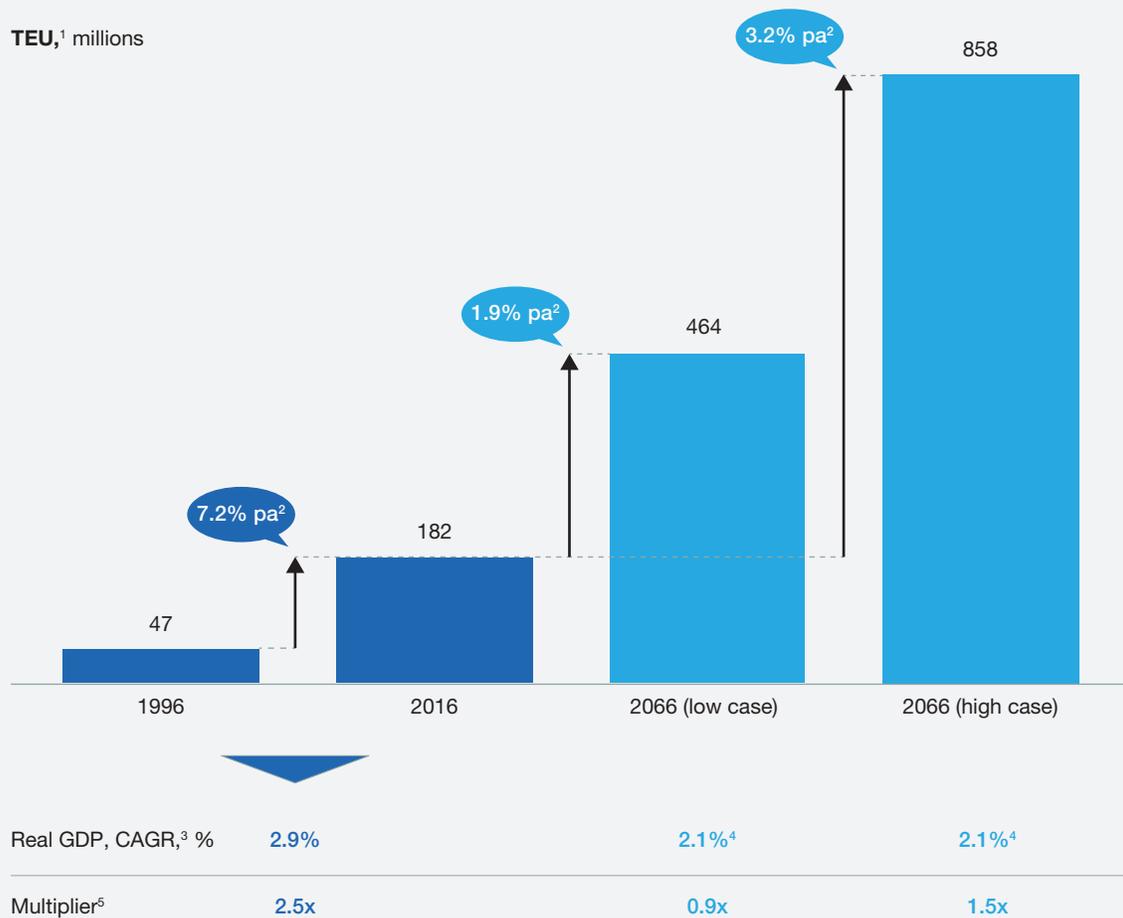
In that scenario, manufacturers would enjoy a new round of labor-cost savings and start a second wave of offshoring, this time from East Asia to India. Robotics and 3-D printing wouldn’t localize most production but rather supplement existing supply chains and create new ones, as Align Technology, for example, does by 3-D printing dental products in Mexico and shipping them to the United States, Europe, and other markets. Consumers would purchase more and more services—digital ones or holidays, for example. But since the growing companies that provide them would require goods (such as airplanes and servers in the cloud), the overall demand for goods would continue to grow. And the geopolitical and policy context would

The effects of ... container technology will be felt internationally in all sectors.... The implications for the movement of general cargo through U.K. ports must therefore be considered within a global context.

Cover letter, McKinsey report to BTDB, 1967

Exhibit 5 'Peak container' is not on the horizon.

TEU,¹ millions



¹Twenty-foot equivalent unit.

²Per annum.

³Compound annual growth rate.

⁴Based on same growth in output per worker as 1966–2016 (1.8% a year) and slowing employment growth (0.3% a year).

⁵Forecast multipliers are assumptions and not the result of modelling.

Source: Alphaliner; McKinsey Global Institute

be benign as great powers continued to understand that their shared prosperity depends on a stable international system governed by agreed-upon rules.

For the pessimist, on the other hand, China's achievements over the past three decades probably won't be repeated elsewhere. Supply chains wouldn't

fragment further, because opportunities to slice up and offshore various stages of production wouldn't be worth the hassle. Many supply chains would retrench—nearshoring—as new technologies made labor costs less relevant. Geopolitics might also intervene: tensions between great powers could create incentives to keep suppliers close. A highly

circular economy, with more recycling and reuse of materials, would encourage the efficient use of resources. Meanwhile, consumers would emerge into a brave new world of augmented reality and asset-light lifestyles as the dematerialization of consumption accelerated.

Some argue that these trends, in combination, could force global trade into a structural decline. We see this as unlikely. Economic growth goes hand in hand with specialization, which in turn promotes further trade. So long as underlying economic growth is positive, trade too is likely to grow—even if the multiplier is less than one. The real impact may be to shorten the distance between trading partners, thereby limiting the growth of long-distance international trade.

The optimistic and pessimistic views concur that container trade will continue to grow; “peak container” isn’t on the horizon (Exhibit 5).⁸ Indeed, the flexibility of the container trade makes it resilient: one product may go out of fashion but another will come along to fill the box. This contrasts with the likely fate of the crude-oil tanker industry, for example, since reliance on a single commodity with challenging prospects makes “peak tanker” a very real possibility.⁹ The trade environment in 2017 may be difficult, but if our 1967 report is any guide, it is easy to underestimate the growth coming decades may bring.



2

Scale:

The 50,000-TEU ship? But probably no bigger

Containers transformed the economics of shipping: the ability to pack different goods into uniform boxes simplified loading and unloading, as well as transfers to rail, truck, and other modes of transport. McKinsey's 1967 report noted that this newfound uniformity would lend itself to lower unit costs at larger scale.

This logic has manifested itself most obviously in the race for scale in vessel sizes. In 1956, the first ship to transport containers—the *Ideal X*—carried only 58 of them.¹⁰ Since then, container-ship capacity has grown 370-fold: today's largest vessels can hold more than 20,000 TEUs (Exhibit 6).

The search for scale certainly isn't over. Larger vessels provide greater cost efficiencies in fuel and crews, reduce greenhouse-gas emissions per container, and enable hub-and-spoke network strategies. Moreover, as operators collaborate in alliances, putting a single large vessel instead of two small ones on a given route has its advantages. But when most or all competitors strive to keep up in the race for efficiency, it can quickly erode these benefits and create overcapacity. The “lumpiness” of the industry's supply is the primary reason for its boom–bust dynamic.

How much longer will this trend toward growth in capacity continue? In the long term, three factors could limit it. The first is that returns to scale

decline with increasing size, so a move from 20,000 to 40,000 TEUs wouldn't reduce unit costs as much as a move from 10,000 to 20,000 TEUs. Second, the narrowness and shallowness of some of the world's waterways impose physical constraints: for example, the Strait of Malacca (between the Malay Peninsula and the Indonesian island of Sumatra) has a minimum depth of 25 meters, the most modern channels of the Suez Canal a depth of 24 meters. The latest designs for vessels that carry 24,000 TEUs have a depth of 16 meters, which leaves scope for further growth in capacity.¹¹

Third, over the past decade, the blitz for bigger vessels has strained terminal and port operators, forcing them to invest in new cranes, dredging equipment, reinforced quay walls, and extended berths. Unloading containers from bigger ships takes longer because cranes must reach farther across vessels, thus extending berth occupancy and reducing productivity. Nonetheless, this problem can be seen not as a limiting factor but as an opportunity for further innovation. New ways could be found to unload boxes: the 1966 report pointed to the “unitization” of containers (moving multiple ones simultaneously) to improve loading, unloading, and transshipment times. Meanwhile, terminals could mitigate the cost of new investments not by raising rates across the board but rather by exploring tailored pricing to align the interests of the carriers with their

Exhibit 6 Container-ship capacity has grown massively since the *SS Ideal X*, a converted World War II oil tanker, first sailed, in 1956.

Maximum container-vessel capacity, TEU¹



¹Twenty-foot equivalent unit.

Source: McKinsey analysis

Containerized cargo is effectively becoming homogenous like other bulk cargoes and is subject to the same economies of scale. . . . If container ships follow the tanker trend, ships of more than 10,000 container capacity could be available.

McKinsey report to BTDB, 1966

own and to give carriers an incentive to work more productively.¹²

On balance, we do not view 20,000 TEUs as the natural end point for container ships—50,000-TEU ones are not unthinkable in the next half-century. However, progress will probably be much slower than it was in the past decade: overcapacity means that new ordering will be slower over the next five to ten years. Lower slot costs materialize only when demand fills up larger ships, which hasn't happened recently. But if demand catches up with supply, as it may well do in the early 2020s, the logic of scale will once again drive orders for bigger and bigger ships. Nonetheless, since 40 percent of all shipyard capacity is unutilized, and it's not conceivable that governments will allow shipyard bankruptcies on a large scale, they could find a way to prompt some level of new ordering.

The price of fuel also plays a key role in the speed of adoption. The biggest savings from larger ships come from reducing bunker costs per container shipped, but falling oil prices have cut such cost advantages by a third since 2013–14.¹³ If fuel prices remained at today's levels, a rush toward 30,000-TEU and larger ships would probably

be delayed, perhaps for 20 years. On the other hand, if prices returned to higher levels, we might see even bigger ships within ten.

The size of boxes could also increase. From the original six-foot-long Conex box the US military used in the 1950s, they have grown to 20 and now 40 feet and above. The limitation on box size is compatibility with road, rail, and other modes of transport. On US and Chinese roads, the maximum box length is 53 feet, so containers of this size are common for US domestic trade. As road networks improve and trucking becomes autonomous on major routes, we may well see containers 60 or more feet long, as well as wider and taller containers. Some trailblazing carrier—perhaps one that can coordinate investments across the value chain—will have a chance to improve efficiency by redefining container sizes.¹⁴

If the physical characteristics—and thus economics—of container transport don't change, the logic of scale probably won't be abandoned in the next 50 years. But we can't make this assumption safely. New and emerging technologies could change the game by rendering ships themselves redundant: for example, autonomous dronelike containers that float across oceans would make the entire industry more modular, though the economics of small-scale propulsion represent a major hurdle. Hyperloop technology, to create "pipelines" of containers, is already being investigated, but mostly on land so far. It's hard to imagine a future in which such technologies entirely displace ships, but as the pace of innovation accelerates, all bets are off.



3

Industry structure: Four big players by 2067?

The advent of containers introduced assembly-line efficiency into the formerly chaotic practices of shipping breakbulk cargo. The economics of the business therefore shifted toward industrial-scale organizations that could afford the upfront investment both in infrastructure for containers and, over time, in a network of routes to ensure that they were highly utilized. The numerous small companies that made up the container-shipping industry of the 1960s have therefore consolidated into a handful of behemoths. One of the largest, Maersk Line, recently generated revenues on par with those of McDonald's or SAP in 2015. The top five container-shipping companies now account for 64 percent of market capacity—an increase of nearly 30 percentage points since 2000 (Exhibit 7).

The fragmented nature of the transportation industry is the primary reason for the existence of independent forwarding agents. Their main role is to deal with the many segments of the industry on behalf of importers and exporters. Thus, the complexity of the industry has led to the need for middlemen.

McKinsey report to BTDB, 1966

Scale has conferred some advantages on container-shipping companies: market leaders like Maersk and CMA CGM outperform their peers, on average (Exhibit 8). Nonetheless, a handful of smaller operators, such as Wan Hai, have found profitable niches in particular geographies. All the same, consolidation is a driving force in the industry as alliances among shipping businesses give way to outright M&A.¹⁵

In the past five years, the carriers' quest for scale has transformed a fragmented market into one shaped by three major alliances.¹⁶ These alliances enable carriers to capture some of the benefits of scale without committing large amounts of capital or adding further capacity in an already over-supplied market. They have in some cases improved the utilization of vessels and enhanced services for shippers by increasing frequencies and making more capacity available. But alliances still have ample scope to strengthen their collaboration: for example, they could extend it to the global level and enter into commercial relationships that (like alliances in air cargo) collaborate on procurement and on the delivery of inland services. For a mid-size carrier, the latter alone could reduce costs by some \$100 million.¹⁷

On the other hand, alliances could also undermine the competitive advantages of individual carriers. One drawback is the fact that these pacts reduce the scope for differentiation by turning the product into a commodity: from a shipper's perspective, carriage on one alliance partner's vessel is much the

Exhibit 7 The container-shipping industry continues to concentrate.



¹Twenty-foot equivalent unit.

²Figures may not sum to 100%, because of rounding.

³As of July 2017 and includes Hapag-Lloyd + UASC, Maersk + Hamburg Süd, CMA CGM + APL, merged capacity of 3 Japanese liners, and COSCO + CSCL + OOCL.

Source: Alphaliner; McKinsey analysis

same as carriage on another's. In addition, the carrier finds it harder to give customers end-to-end transparency on their shipments: a given box can sail on one of many vessels arriving at one of many terminals. Alliances also help keep smaller carriers in the market and thus prolong overcapacity.

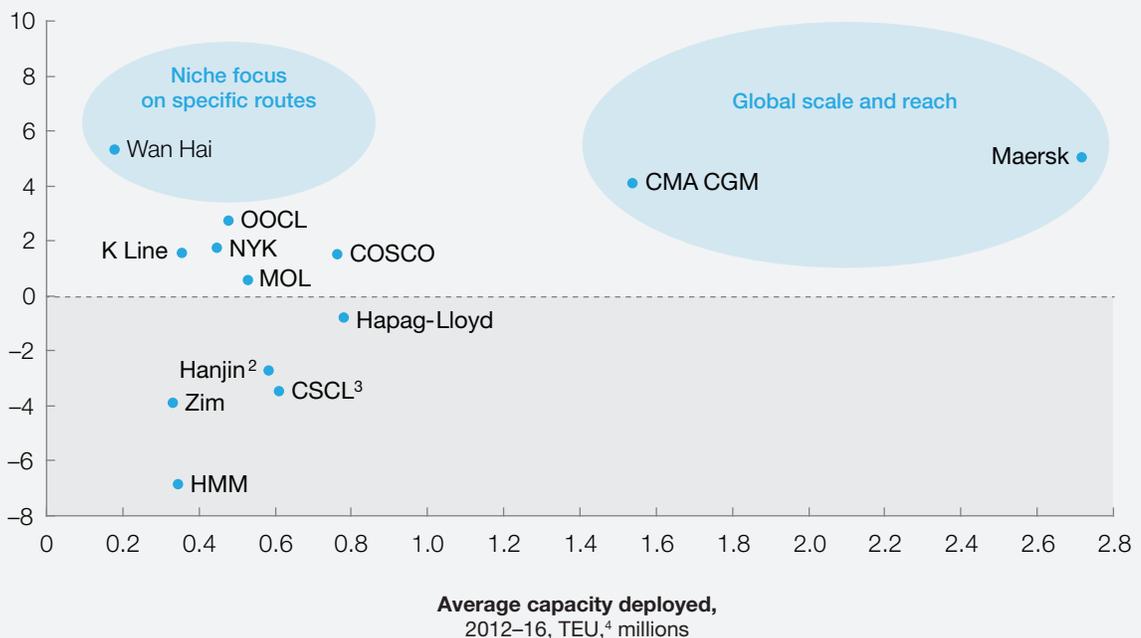
Container-shipping companies would be well advised to think not only about building better alliances but also about consolidation. Cost synergies are valuable: those announced in container-shipping mergers tend to be on the order of 2 to 6 percent of the combined cost base. Scale

also gives carriers the financial wherewithal to invest in innovative operating models and differentiated (and perhaps higher-priced) offerings, such as additional inland services, digital operations with superior interfaces, and different speeds of service on the same routes. Some commentators suggest that greater use of collaboration and concentration could reduce imbalances between supply and demand.

We can expect the regulators of competition to watch closely for any hint of oligopolistic behavior. In fact, for a long time, container shipping received exemptions to allow coordinated industry pricing, or “conferences.” However, these have come to an end. Regulators have occasionally blocked alliances, but nothing like a monopoly has come to pass in container shipping.

Exhibit 8 The largest container-shipping companies enjoy higher operating margins.

Average operating-profit margin, 2012–16,¹ %



¹ Latest 2016 figures where available.

² Declared bankrupt in August 2016.

³ Merged with COSCO in March 2016.

⁴ Twenty-foot equivalent unit.

Source: Alphaliner; annual reports; McKinsey analysis

Exhibit 9 Digital start-ups are proliferating.

New players' offerings by value sources

		Superior market transparency	Stronger purchasing power	Supplier management	Leverage of information/data	Value-added specialist services	E2E ¹ offering	Physical consolidation	Solution tailoring	Transportation
New market players	Digital freight forwarders	Flexport	Freight Filter	Shippabo	Kontainers	iContainers				
	Customer-facing specialists	Rate analytics <ul style="list-style-type: none"> Freightos Logistitrade Transporteca Xeneta 	Collaboration platforms <ul style="list-style-type: none"> GT Nexus 					E-commerce fulfillment platforms <ul style="list-style-type: none"> Amazon Fulfillment 		
		Booking platform <ul style="list-style-type: none"> Intra 						Tracking platforms <ul style="list-style-type: none"> ATTI Detrack Fleetmatics HiLocate KeepTruckin Traxens 		
Exchange platforms <ul style="list-style-type: none"> Cargoclix Load-Me Cargomatic Truckstop China Spark 										
Enabler	Digital back-end/IT solutions		Procurement platforms <ul style="list-style-type: none"> MM4 	Supply-chain control <ul style="list-style-type: none"> Berlinger 				SaaS² or cloud-based optimization and information <ul style="list-style-type: none"> CargoSmart LeanLogistics Routific Transmetrics Transporeon 		

¹Exchange to exchange.

²Software as a service.

But the creation of value in shipping no longer hinges on scale alone. Over the next 50 years, the industry is ripe for digital disruption to tackle a multitude of structural inefficiencies—a lack of

market transparency, handovers between providers (up to 16 for one shipment), cumbersome document flows, costly manual processes, lengthy and painful customer interactions, and

other operational issues. Venture-capital flows into transport and logistics are growing rapidly, to the tune of \$12 billion in 2015, up from \$2 billion in 2013.

Meanwhile, digital start-ups are striving to give customers better value at the incumbents' expense (Exhibit 9). Xeneta, for example, provides a platform where users submit price quotes from container-shipping lines—a first step toward more transparent rates. Flexport and Kontainers aim to be “digital native” freight forwarders, providing hassle-free online user interfaces for customers shipping goods.

Although such start-ups have not yet gained traction in handled volumes, they are making incumbents digitize to avoid being disrupted. Both carriers and freight forwarders are investing heavily to digitize internal processes, develop integrated IT infrastructures, introduce state-of-the-art customer interfaces, and offer real-time transparency on shipments. Looking ahead, the industry can expect increased efforts to establish data ecosystems that enable real-time data sharing between multiple participants, perhaps even culminating in one industry-wide ecosystem that opens up new opportunities to coordinate and optimize activities.

Intermediaries such as freight forwarders and nonvessel-operating cargo carriers (NVOCCs), which together process more than half of today's global freight, could face additional challenges in a digitally disrupted world. These companies add value by combining inland logistics functions, negotiating with container lines, dealing with complex customs paperwork, and making prices and availability more transparent. In light of digital disruption and other recent developments—for example, the Port of Shanghai's initiative to digitize

Now that standardized containers have been introduced in the shipping industry, the rush to “get on the bandwagon” will probably lead to substantial overexpansion.

McKinsey report to BTDB, 1967

paperwork—we find it hard to imagine that customs will still require stamps on paper forms by 2067. The online exchange of information under globally agreed-upon standards will speed the flow of goods but reduce the value intermediaries can add.

Moves by tech giants also loom large in the shipping industry. Amazon is blazing a trail in logistics with its Prime Air cargo service and its recent acquisition of an ocean-freight-forwarder license in China; it has even reported interest in buying physical infrastructure assets such as Frankfurt's Hahn airport.¹⁸ Alibaba, having recently entered a partnership with COSCO Shipping to develop an integrated logistics platform for small and midsize enterprises, seems to be moving in the same direction. In time, Uber and Tencent (owner of WeChat) may also expand into logistics and shipping.

The risk for container-shipping and terminals companies—those that own and operate the assets—is becoming “dumb pipes” for players that take over and extract value from customer relationships. Parallels with the telecom industry in the mid-2000s are imperfect but apposite.



4

Productivity: A completely digitized, autonomous industry

Operational productivity—especially the interface among ships, ports, and hinterlands—is central to the creation of value in the container-shipping industry. Terminal operations have evolved dramatically since the 1960s, when Sir Arthur observed (in his Institute of Transport speech) that “cargoes move largely by untidy methods and by the employment of men and machines humping goods in essentially no different manner than in the days of sailing ships.”¹⁹

Today’s container terminals are tidy, complex, and highly professional. Their productivity can be measured down to the level of individual cranes, and improvement levers stretch from optimizing crane split to changing stowage strategies. Fully automated processes—like those at TraPac’s terminal at Los Angeles and the ship-to-shore crane operations of APM Terminals at Rotterdam—are already in place at some terminals.

Opportunities to further improve productivity remain. One frequently proposed idea is unitization: developing a “box of boxes” would allow 20 or more containers to be unloaded together, lifted not by today’s quay cranes but by giant gantry cranes spanning redesigned berths. This kind of innovation in loading and unloading will be essential for handling the 50,000-TEU ships of 2067.

Wholly automated terminal and inland operations, with self-driving trucks (and perhaps even self-driving containers or “hyperloops”) transporting containers to inland distribution centers, will probably become the norm in the next couple of decades. Self-loading trucks, arriving just in time to pick up the next container without waiting or moving around unproductively at terminals, would improve the interface between ports and inland transport. Imagine a terminal with no stacks in the yard; instead, customs would pre-clear boxes digitally, and autonomous trucks would take them straight from ships and out to customers.



Palletization and unitization have been long recognized as major factors in increasing the efficiency and productivity of the transportation function. . . . As volume increases warrant it, containerization will be followed by multi-container units. For example, large numbers of containers may eventually be unitized for transshipment by sea.

McKinsey report to BTDB, 1966

Extending autonomous operations to ships would not only reduce labor costs but also make possible new ship designs, with additional space for containers. Filling it would increase revenues per ship and reduce fuel costs per container. Imagine a container vessel with no superstructure, just boxes—a concept that’s already on the drawing board but involves challenges such as ensuring safety and amending regulations. Improvements in other vessel technologies, such as liquefied natural gas (LNG) for propulsion and advanced materials to reduce hull weight, are also making headway.

Advances in the use of data and analytics will bring further step changes in productivity. Shipping companies could heed the example of today’s state-of-the-art aircraft, which generate up to a terabyte of data per flight.²⁰ Coupled with the introduction of more sensors, the better usage of the data that ships and containers generate would allow enhancements such as optimizing voyages in real time (by taking into account weather, currents, traffic, and other external factors), smarter stowage and terminal operations, and predictive maintenance. Data could also improve the coordination

of arrivals at port—a major benefit, since 48 percent of container ships arrive more than 12 hours behind schedule, thus wasting the carriers’ fuel and underutilizing the terminal operators’ labor and quay space.

Data can create additional value for customers too. Full transparency on shipments, from one end of the value chain to the other, would be an enormous boon to carriers, forwarders, and shippers alike, giving them access to real-time information and enabling them to predict a container’s availability, arrival times, and so forth. Some ports (such as Antwerp, Hamburg, and Singapore) are already starting to share information in real time across data ecosystems, which could eventually extend throughout the whole industry. That would create a truly integrated end-to-end flow of containers and therefore make the industry more productive by reducing handovers, waiting times, and unnecessary handling.

A data-enabled shipping industry could also support its customers’ supply chains in important ways—but that will require a truly new order of performance and efficiency. The real-time visibility of all container movements, reliable forecasts, and integrated flow management will pave the way for flexible, dynamic supply chains that all but eliminate waiting times and inefficiencies. This achievement will be especially beneficial for industries (such as automotive) that have increasingly complex supply chains or for those with special needs (such as cold chains). It will also allow smart logistics providers to differentiate themselves and earn premiums. But these opportunities won’t appeal to all customers; other sectors will demand only basic logistics services at the lowest possible cost.





The view from 2067:

A smart, customer-focused container industry

In 1967, McKinsey was right to recognize containers as a disruptive force in the shipping business and to advise the British Transport Docks Board to rethink everything in light of the emerging transformation of the industry. Today it's in the throes of another one: the penetration of digital technologies, big data, the Internet of Things, and the like into all walks of life, including container shipping.

Let's imagine what the industry will look like 50 years from now. By 2067, we believe it will have some or all of these characteristics:

- Autonomous 50,000-TEU ships will plow the seas—perhaps alongside modular, dronelike floating containers—in a world where the volume of container trade is anything from two to five times greater than it is today.
- Short-haul intraregional traffic will increase as manufacturing footprints disperse more widely because of converging global incomes and the increasing use of automation and robotics. Container flows within the Far East will continue to be huge, and the second most significant trade lane may link that region to Africa, with a stopover in South Asia.
- After multiple value-destroying cycles of overcapacity and consolidation, three or four major container-shipping companies might emerge. These businesses could be either digitally enabled independents with a strong customer orientation and innovative commercial practices or small subsidiaries of tech giants seamlessly blending the digital and physical realms. Freight forwarding as a stand-alone business will be virtually extinct, since digital interactions will have reduced the need for intermediaries to manage logistics services for multiple participants in the value chain. Across the industry, all winners will have fully digitized their customer interactions and operating systems and will be closely connected via data ecosystems.
- A fully autonomous transport chain will extend from initial loading, stowage, and sailing all the way to unloading directly into autonomous trains and trucks and drone-enabled last-mile deliveries.
- The needs of customers will diverge: some will expect their shippers to be fully integrated into their supply chains—and be willing to pay a premium for that—while others continue to demand sea freight at the lowest possible cost. Both sets of customers will expect transparency and reliability to be the norm, not the exception.

No doubt this will seem a daunting agenda for an industry enduring a steep downturn. What can decision makers do to bring about such a world?

First, invest in digital, which is the main way to differentiate products, disintermediate value chains, improve customer service, raise productivity, and cut costs. The risk is that tech giants and would-be digital disruptors will move faster than incumbents and capture most of the value from customer relationships.

Second, think about consolidation: the industry's natural end game may involve fewer, larger operators. The past few decades of explosive trade growth created an environment that could sustain many players. Now that growth has slowed, the industry must rationalize overcapacity. Although some companies and investors could be candidates to lead the next wave of consolidation, becoming a target may sometimes be better for shareholders than struggling to be the winner at any cost. McKinsey research shows that from 2000 to 2015, in a range of industries, the value from deals was nine percentage points higher for average target companies than for average acquirers.²¹

Third, integrate. Some next-generation innovations now on the drawing board require careful orchestration across the value chain. Carriers and terminal operators share a particularly rich agenda: bigger vessels paired with investments in infrastructure for terminals, complete transparency on ship arrivals and berthing (thanks to geospatial analytics), and larger containers. Integrated logistics providers could make today's freight forwarders largely irrelevant by mastering the complexity and the customer interface.

Fourth, be bold. The shipping industry has been built on the vision of audacious leaders with the perseverance to sail through the storms. It now faces a wave of digital disruption. The ability to convey a sense of purpose for employees, to create optimism about the journey ahead, and to maintain a steady course will be the hallmarks of the leaders shaping the industry for the next 50 years. ■

- ¹ Our analysis in this article is in no way meant to imply that companies should take steps contrary to any applicable laws, including antitrust or competition laws. McKinsey does not render legal advice; companies should seek it before taking action if they have any legal questions relating to these options or recommendations.
- ² “Primitive cargo handling at British ports’ charge,” *The Commercial Motor*, March 12, 1965.
- ³ This ratio covers all seaborne trade, including agricultural commodities and natural resources such as iron ore, crude oil, and liquefied natural gas.
- ⁴ Twenty-foot equivalent units (TEUs) are the measure of a container ship’s capacity and one of the most common standard sizes for containers.
- ⁵ These figures do not include flows within China.
- ⁶ A palliative may come in the form of increasing specialization as Chinese incomes converge with those in the developed world. One scholar notes that countries “trade more as they get larger and more similar in size. This suggests that the rapid growth of emerging markets will create more trade than it displaces. US–China intra-industry trade would have to increase sixfold to match the intensity of French–German trade.” (Richard Baldwin, “Global supply chains: Why they emerged, why they matter, and where they are going,” Centre for Economic Policy Research, August 2012.)
- ⁷ Mao Ye, “The impact of 3-D printing on the world container transport,” master’s thesis, Delft University of Technology, 2015.
- ⁸ Ian Tomb and Kamakshya Trivedi, “Pushing back against ‘peak trade,’” Goldman Sachs Economic Research, September 28, 2016.
- ⁹ David Sheppard and Anjali Raval, “Oil demand might peak in just over a decade, says OPEC,” *Financial Times*, November 8, 2016.
- ¹⁰ Marc Levinson, *The Box: How the shipping container made the world smaller and the world economy bigger*, Princeton, NJ: Princeton University Press, 2006.
- ¹¹ *The Impact of Mega-Ships*, OECD/International Transport Forum, May 1, 2015.
- ¹² Timo Glave and Steve Saxon, “How to rethink pricing at container terminals,” December 2015, McKinsey.com.
- ¹³ Calculation for an 18,000-TEU vessel compared with a 9,000-TEU one.
- ¹⁴ APL introduced 53-foot containers on its trans-Pacific trade in 2007 but abandoned them in 2013.
- ¹⁵ China Shipping and COSCO merged in February 2016; CMA CGM acquired Neptune Orient Lines (APL’s parent company) in June 2016; Hapag-Lloyd acquired CSAV in December 2014 and is in the process of merging with United Arab Shipping Company; K Line, Mitsui OSK Lines, and NYK announced a joint-venture combination of their container-shipping arms in October 2016; Maersk Line and Hamburg Süd announced a tie-up in December 2016; and COSCO announced the acquisition of OOCL in July 2017.
- ¹⁶ Namely 2M, which includes Maersk and MSC; Ocean Alliance, which includes China COSCO, CMA CGM, Evergreen, and OOCL; and THE Alliance, which includes Hapag-Lloyd, K Line, Mitsui OSK Lines, NYK Line, and Yang Ming.
- ¹⁷ Martin Joerss, John Murnane, Steve Saxon, and Ronald Widdows, “Landside operations: The next frontier for container-shipping alliances,” April 2015, McKinsey.com.
- ¹⁸ Will Waters, “Amazon ‘in talks over Hahn Airport base,’” *Lloyd’s Loading List*, April 14, 2016.
- ¹⁹ “Primitive cargo handling at British ports’ charge,” *Commercial Motor*, March 12, 1965.
- ²⁰ Peggy Hollinger, “Smarter aircraft create a wealth of data but it remains underexploited,” *Financial Times*, 12 June 2015.
- ²¹ Werner Rehm and Andy West, “M&A 2015: New highs, and a new tone,” December 2015, McKinsey.com.

Steve Saxon is a partner in McKinsey’s Shanghai office, and **Matt Stone** is a consultant in the London office.

The authors would like to thank Katharina Poehlmann for her contributions to this article.

Copyright © 2017 McKinsey & Company.
All rights reserved.

McKinsey practice experts on container shipping



Fox Chu
Partner
Hong Kong
Fox_Chu@McKinsey.com



Timo Glave
Partner
Copenhagen
Timo_Glave@McKinsey.com



Martin Joerss
Senior Partner
Hamburg
Martin_Joerss@McKinsey.com



John Murnane
Partner
Atlanta
John_Murnane@McKinsey.com



Maximilian Rothkopf
Partner
Munich
Maximilian_Rothkopf@McKinsey.com



Steve Saxon
Partner
Shanghai
Steve_Saxon@McKinsey.com

Contact for distribution: Justyna Wlodarczyk
Phone: +48 61 842 1288
Email: Justyna_Wlodarczyk@McKinsey.com

October 2017
Designed by Global Editorial Services
Copyright © McKinsey & Company