

Quitzeau, Jörn et al.

**Research Report**

## Shipping in an era of digital transformation

Strategy 2030 - Capital and Life in the Next Generation, No. 25e

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# SHIPPING IN AN ERA OF DIGITAL TRANSFORMATION



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**BERENBERG**

PARTNERSHIP SINCE 1590

**STRATEGY 2030** CAPITAL AND LIFE IN THE NEXT GENERATION. AN INITIATIVE  
OF BERENBERG AND THE HAMBURG INSTITUTE OF INTERNATIONAL ECONOMICS.

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We have endeavoured to meticulously research and process the information contained in this study. In part, we have drawn upon information collected by others. Certain data may no longer be correct, especially due to the passage of time or as a result of changes in legislation. We can therefore accept no responsibility for guaranteeing that all information is accurate, complete and up to date.

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## Executive Summary

/// The intensity of global trade has dipped slightly over several consecutive years. In the long term, we expect global trade to return to a stable path for growth. Nevertheless, changing framework conditions mean that we expect a smaller rise in demand than that to which the shipping industry has been accustomed since the time before the crisis.

/// The trend of globalisation of value chains appears to be coming to an end. This is linked to changed growth strategies in the major emerging markets, with strong economic growth leading to higher wages in those countries. In addition, there has also been a change of direction in the political strategy, with emerging markets moving away from export-intensive industry and toward domestic services. More and more, this calls into question the existing distribution of roles in foreign trade, where emerging markets act chiefly as an extended workbench for labour-intensive processes.

/// In many industrial countries the population is ageing and decreasing. This will lead to a gradual erosion of consumption figures there in the years to come. At first glance, these developments offer a pessimistic outlook for the trade of goods and thus for shipping. Yet the global demographic trend is very different. The UN forecasts that the global population of almost 7.6 billion people at present will grow by roughly one billion to almost 8.6 billion by the year 2030. The future population boom will take place in regions in which the population is young and where the propensity to consume will increase in line with rising incomes. Therefore, demographic change will bring with it a shift in trading patterns.

/// A huge opportunity for shipping lies in the connectivity of ships and ports. The basis and the prerequisite for such connectivity is to collect data and connect it in an intelligent way. This will require ports and ships to be retrofitted with a high-performance digital infrastructure and involves fitting fibre optic cables, 5G mobile networks and across-the-board use of sensors and satellites.

It is possible that unmanned shipping may become a reality in the longer term. However, the economic benefits of unmanned shipping are likely to be limited compared to the optimised logistics chains, shorter waiting times, faster routes and more transparent information or even energy-efficient fuels.

The container era will be replaced by an era of platforms and data. 3D printing technology is likely to affect the overall transport volume and at the same time create a shift between container ship, bulker and tanker transport capacities. 3D printing will change the way goods flow, both in container shipping and in the transport of raw materials. Container ship transport is likely to decline in relation to bulker transport on account of the decentralised nature of 3D printing. In addition, digital goods are likely to play a greater role in consumer spending in the future. Unlike physical goods, they do not have to be shipped. It is possible that people in developing countries will even skip a »consumption level« in which they will forego many material goods and consume digitally instead.

All of this will take place in an environment already characterised by excess capacities. The situation in the container industry in recent years seemed paradoxical at first glance, with order books for new ships full to the brim despite excess capacities and falling freight rates. The reason for this situation is a changed strategic status quo, where technological innovations and economies of scale with larger ships known as »megacarriers« has led to a redistribution of market share and thus to cut-throat competition. This in turn has created a situation in which the rational strategic decision can be to invest in new types of ships and thus create additional capacities even if this means incurring losses. Economists refer to this type of situation as »the prisoner's dilemma«.





## Introduction

The world is currently experiencing an economic boom. All of the major economic areas – the USA, Europe, Japan and China – are seeing strong economic growth. But beyond current favourable conditions there are signs that the world is currently undergoing a fundamental transition and that it will continue to change significantly in the coming years. Consequently, the macroeconomic environment is subject to a great deal of uncertainty in the medium and longer term. Is this the start of a new era of economic isolation? What effects will the changing demographic patterns have? What will be the extent of the impact of climate change and the resulting environmental policy measures? What are the consequences of the digital transformation for the economy in general and for the trade of goods in particular?

These questions affect large sections of our economy and our society. The shipping industry is impacted directly or at least indirectly by many of these questions surrounding the future. The unusually high level of uncertainty for the shipping sector poses a special challenge in this context, particularly as shipping has been undergoing a process of consolidation since the global financial and economic crisis and the existing excess capacities have not yet been reduced.

This publication does not constitute a forecast on our part regarding the specific development of the shipping market. Instead, we aim to outline the economic framework upon which the industry must base its future decisions. We focus here on the process of digital transformation, and our analysis shows that the environment for shipping will remain very challenging in the years ahead.


## Current market situation in shipping

**The global economic crisis put an end to trends that had impacted on the shipping industry for many years. Overall, excess capacities have accumulated in all shipping segments. The process of consolidation will endure for a while longer.**

Thanks to globalisation, there was a sharp rise in global trade between 1990 and 2008, with international trade growing more than twice as fast as global economic output over a period of several years. The shipping industry benefited especially from this development. A key driver of the boom in shipping was the integration of many populous, high-growth developing and emerging countries, not least China. These countries were increasingly used as production locations for goods that were needed in the industrial countries. This meant a spatial decoupling of production on the one hand

and consumption on the other. The task of shipping in this context was to transport the raw materials to the production sites and later to transport the goods produced back to the consumers. Shipping capacities were increased accordingly. Before the global economic and financial crisis happened, trading volume and transport capacities –

also by sea – had risen to a whole new level. The crisis led to a rupture in trends that had prevailed for many years, with far-reaching consequences for the shipping industry.



**Excess capacities in shipping take a very long time to reduce.**

### **Over-optimistic expectations created a bubble in the shipping sector.**

The shipping market is characterised by particular structural economic features, marrying a side of the market that responds quickly to change with a side that reacts slowly. While demand for maritime transport adapts very rapidly to changes in the economic landscape, the transport capacity of the ships on the supply side remains more or less constant in the short term. Because it takes time to build new ships, shipping companies must gauge at an early stage how transport volumes will develop going forward. Also, once the ships have been built and commissioned, the transport capacities created remain in place for at least 20 years. This explains why initially there was no apparent break in the trend for the development of transport capacities during the crisis years (see Figure 1).

As a result, the supply side did not react to the collapse in demand. Periods of high growth rates in the global economy gave rise to over-optimistic expectations, with the result that options for the construction of new ships were traded for several millions of dollars and external financing was used for new capacities in many cases. This created a systemic risk that was leveraged many times over. One of the biggest problems for the shipping markets is that excess capacities take a very long time to reduce, so the consequences of a bubble bursting are felt for a very long time.

**World merchant fleet in tonnage, 1990–2017**

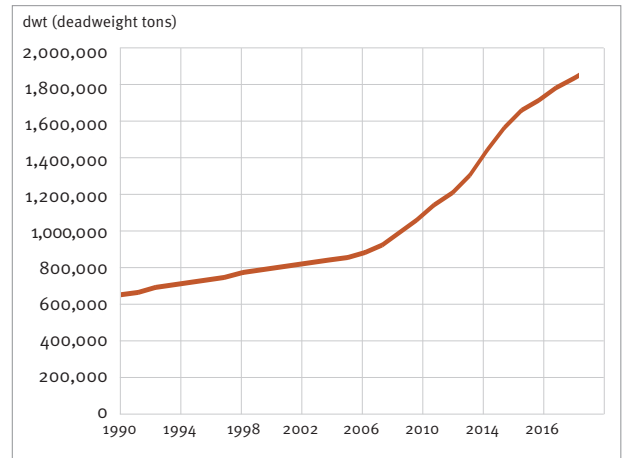


Fig. 1

Source: UNCTAD (2017).

### The process of consolidation in the industry will endure for a while longer.

Overall, the environment described above led to the accumulation of excess capacities in all shipping segments. This is putting pressure on freight rates and thus burdening shipping companies' earnings possibilities. Nevertheless it is by no means certain that the existing excess capacities will not continue to be increased even further. For example, the situation in the container industry in recent years seemed paradoxical at first glance, with order books for new ships full to the brim despite excess capacities and falling freight rates. The reason for this situation is a changed strategic status quo, where technological innovations and economies of scale with larger ships known as »megacarriers« has led to a redistribution of market share and thus to cut-throat competition. This in turn has created a situation in which the rational strategic decision can be to invest in new types of ships and thus create additional capacities even if this means incurring losses. Economists refer to this type of situation as »the prisoner's dilemma«.<sup>1</sup>

Despite excess capacities and falling freight rates, the order books for new ships were full to the brim in recent years. This is the outcome of what is known as »the prisoner's dilemma«.



<sup>1</sup> The term »prisoner's dilemma« comes from game theory and describes a situation in which individual stakeholders acting rationally pursue a course of action that does not result in the ideal outcome for all stakeholders. This happens when the individual stakeholders cannot agree on and commit to a joint strategy. Applied to the shipping market, this means that if the shipping companies were to agree and commit mutually not to make investments in

megacarriers, they could record the highest joint profit. However, each shipping company has an incentive to increase its own profit further by investing in megacarriers – provided that the other shipping companies do not invest. Because this incentive exists for each individual shipping company, ultimately all of the shipping companies will invest and thus create inefficient overinvestment.

On the whole, the adjustment reactions that are still reflected in a rise in M&A transactions in the industry today can be broken down into three observable phenomena:

1. Large ships are replacing small ships in order to realise economies of scale.
2. Large shipping companies are taking over small shipping companies in order to remove competing excess capacities from the market.
3. New strategic alliances are changing the logistics chains in order to develop market power.

Against the backdrop of the general existence of excess capacities, a cursory glance at the most recent past shows interesting developments in the individual ship segments:

#### **Container ships:**

The container industry witnessed the beginnings of a process of consolidation throughout 2017. In 2015 and 2016, the growth in supply outstripped the rise in demand, but this trend was reversed in the past year. The higher demand stems principally from an increased trading volume on the main traffic routes. Although the shipping companies had full order books, high scrapage numbers and postponed orders kept supply in check, so the amount of laid-up (unused) ships is currently at a low level. The majority of fleet growth relates to the large container ships, with signs of excess supply emerging in this segment. By contrast, the percentage of smaller container ships is decreasing sharply. Improved market conditions have given rise to a noticeable increase in time charter rates and freight rates, though they are still at a comparatively low level. Liner shipping companies responded to the difficult competitive conditions of recent years through cooperations. This has given birth to an oligopolistic market structure, dominated by the »The Alliance«, »2 M« and »Ocean Alliance« mergers.

#### **Bulkers\*:**

Somewhat surprisingly, the bulk cargo sector developed very positively in 2017. The upswing is chiefly attributable to increased demand from Asia, buoyed by an extensive Chinese lending programme and stricter environmental regulations. Especially China imported more iron and coal products in the past year. Another positive factor was the strong dynamic in the steel

\* Bulkers (also called »bulk carriers«) transport unpackaged bulk cargo such as coal, ore or grains. By contrast, tankers transport liquid bulk cargo such as crude oil or liquid chemicals and fuels.  
See this in detail: Berenberg Capital Markets (2018)

industry and the manufacturing sector. Charter and freight rates blossomed in this environment, particularly in the second half of 2017.

**Tankers:**

The tanker sector suffered from serious excess capacities in 2017. The fundamentals indicate that the market has not yet bottomed out. Fleet growth for the two main ship types, crude tankers and product tankers, will continue to outpace the growth in demand on account of high numbers new tankers delivered. Demand in 2017 was slowed by uncertainty on the global oil market, high stock levels that had built up due to low oil prices and the OPEC decision to extend the restriction on production. In addition, the USA replaced imports with its own production in some cases by expanding fracking technology. The number of idle tankers is correspondingly high. Freight and charter rates as well as ship values are stuck at a low level.

## Overall economic environment

**The global economy is in good shape, and the outlook is positive. At the same time, there are many uncertainties. For example, the pace of global trade is slowing, and the trend of globalisation of value chains appears to be drawing to a close. Demographic change will also lead to a shift in global patterns in the long term.**

The economic prospects for all major economic regions are currently positive. Even the eurozone has now emerged from the systemic euro crisis. With 2.5% GDP growth, it presented a surprisingly strong growth performance in 2017. So the shipping industry is currently operating in a positive overall economic environment with prospects that continue to be upbeat. At the same time, the generally positive outlook is accompanied by considerable uncertainty. The pace of global trade has been weakening since 2010. In real terms, global exports climbed by just 2.7% and 2.2% respectively in 2015 and 2016. Nominally, these figures are even contracting again for the first time since 2009. Unlike during the financial crisis, however, this deterioration does not appear to be due primarily to a general collapse in production: the global economy continued to grow in recent years at annual rates of 3.2 to 3.6% in real terms.<sup>2</sup> The intensity of global trade has thus dipped slightly over several consecutive years. In the long term, we expect global trade to return to a stable path for growth. Nevertheless, changing framework conditions mean that we expect a smaller rise in demand than that to which the shipping industry has been accustomed since the time before the crisis.

**The shipping industry is currently operating in a positive overall economic environment. Nevertheless, this positive outlook is accompanied by uncertainty.**

### **Cyclical and lasting factors are leading to a decline in trade intensity.**

The drop in the intensity of trade stems from two aspects in particular. Firstly, heavily traded goods groups are accounting for a lower share of global economic output in the current economic cycle. Such a composition effect can be observed for example with regard to the generally trade-intensive capital goods and consumer goods.<sup>3</sup> Secondly, a range of structural factors that propelled the growth in trade in recent decades have lost

<sup>2</sup> See IMF (2017).

<sup>3</sup> See ECB (2016).

impetus. The trend toward globalisation of value chains, a key factor in promoting the trade integration of the emerging markets, appears to be drawing to a close. The Federal Reserve has calculated that the share of the value chain created by production abroad as a percentage of global exports is no longer growing steadily, but has in fact been waning slightly since 2011.<sup>4</sup> This development must be seen in the context of the changed growth strategies in the main emerging markets, where steady economic growth has led to an intensifying scarcity of labour and an aspiring middle class, something that is reflected in wage increases. In addition, there is also political support for a change in strategy.

**Emerging markets are moving away from export-intensive industry and toward domestic services.**



Emerging markets are moving away from export-intensive industry and toward domestic services. More and more, this calls into question the existing distribution of roles in foreign trade, where emerging markets act chiefly as an extended workbench for labour-intensive processes.

#### **A dangerous tendency to favour isolation over free trade.**

A further obstacle is the shift that can be observed in the trade policy gearing of the industrial countries. The global financial crisis has played its part in undermining trust in a liberal global economic order that safeguards welfare. Two developments are at play here. Firstly, there is increasing opposition to plans to liberalise trade, with large, extensive free trade agreements in particular appearing to be more difficult to enforce. Most recent examples include the halted TTIP negotiations and the USA's departure from the TPP. One possible explanation for these setbacks is that in view of the progress made in trade policy in recent decades the economic benefits from further liberalisation are not enough to outweigh the political cost (domestically).<sup>5</sup>

Secondly, there is an increasing inclination toward hidden forms of protectionism. For the period from 2011 to 2016, the Global Trade Alert institution counted a total number of 8,512 trade policy interventions globally, of which 6,054 (i.e. almost a quarter) constituted obstacles to trade but only 2,458 liberalised trade. Classic tariff-based instruments accounted for a share of just roughly one third.<sup>6</sup> These kinds of indirect protectionism are likely to continue to be seen as an effective means of protecting domestic industries in the future without having to contend with major trade policy conflicts.

<sup>4</sup> Federal Reserve (2016).

<sup>5</sup> See Rodrik (2012).

<sup>6</sup> See GTA (2017).

The influence of advancing demographic change on the international trade of goods is a hotly debated issue. In Germany and many other established industrial nations, societies are ageing and diminishing.<sup>7</sup> Germany's baby boomers, born between 1955 and 1969, are often at their best working age at present, with high incomes and a corresponding high appetite for consumption. But these baby boomers are gradually approaching retirement age, and their drive to consume will thus gradually decline over the coming years. The generations following on behind are diligent consumers, but there simply aren't enough of them, so demographics alone would suggest that there are hard times ahead for consumer spending.

**Demographic change will bring with it a shift in trading patterns.**

At first glance, these developments offer a pessimistic outlook for the trade of goods and thus for shipping. However, a fall in consumers' willingness to spend based on demographic change is mainly to be expected in the saturated industrial countries. The global demographic trend shows a very different picture. Based on the most recent UN projection, the global population of almost 7.6 billion people at present will grow by roughly one billion to almost



**African countries are expected to yield the fastest pace of population increase.**

8.6 billion by the year 2030.<sup>8</sup> The world's population is currently increasing by 83 million people per annum, meaning that the number of the world's inhabitants is growing by the size of the entire population of Germany virtually every year.<sup>9</sup>

African countries are expected to yield the fastest pace of population increase, with a projected increase of almost half a billion people to 1.7 billion inhabitants on the African continent by 2030. The population explosion is forecast to be similarly dramatic in Asia in absolute figures. Already the most populous continent, it is set to be home to nearly five billion inhabitants by 2030. This means that the future population boom will take place in regions in which the population is very young and – with rising incomes – very happy to spend money: 60% of Africa's inhabitants are under 25; in Asia, the figure is 40%. The corresponding percentage for Europe stands at just 27%. Furthermore, the countries experiencing the largest growth in terms of population are generally those countries that the United Nations classifies as the least developed.<sup>10</sup>

7 For a detailed study, see Berenberg/HWWI (2014), Demographics, Strategy 2030.

8 See United Nations (2017), World population prospects – Key findings & advanced tables, 2017 revision.

9 While growth of the world's population will slow down somewhat over time, according to UN projections the total population will increase to roughly 9.8 billion by 2050 and to more than 11 billion people by 2100.

10 This includes a total of 47 countries, 33 of which are in Africa and 9 in Asia.



So future population growth will take place particularly in those regions that have a lot of catching up to do – as a production and a consumption location.<sup>11</sup>

Unlike the industrial nations, these countries are likely to grow in significance as procurement, production and sales markets if they succeed in integrating the growing population in the labour market. If young people from the southern hemisphere continue to immigrate northward, however, trade patterns will not develop as described.

It is possible, however, that people in the developing countries will skip a »consumption level« by using digital instead of physical goods. The growing importance of digital goods is likely to affect the overall transport volume.

**The climate is changing.**

Climate change is also having an effect on shipping. Wind is the industry’s most important climate and weather parameter. Depending on the size of the ships, storms need to be anticipated and circumnavigated. The high water temperatures in the Atlantic in 2017 as well as the resulting rise in hurricane activity may be an indication that more and more powerful storms can be expected in the future. This reduces profit prospects in maritime trade. One positive aspect – at least for shipping – involves the changing shipping routes. We can assume with a high degree of probability that both the Northeast Passage and the Northwest Passage will be navigable all summer long by the middle of this century. This will cut costs for transports to and from Asia, a market that is already very important. Apart from adjusting to climatic changes, above all else it will be regulatory rules to prevent climate change that will preoccupy shipping more in the future. It is true that ships are considered a comparatively environmentally friendly form of transport on account of their large capacity (tonnage).

**Projected population by continent**

Figures in millions

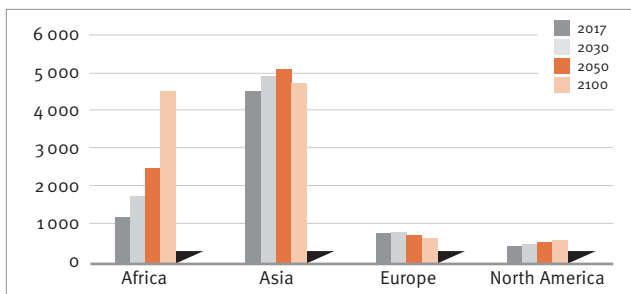


Fig. 2

Source: UN (2017).

**Projected world population**

Figures in millions

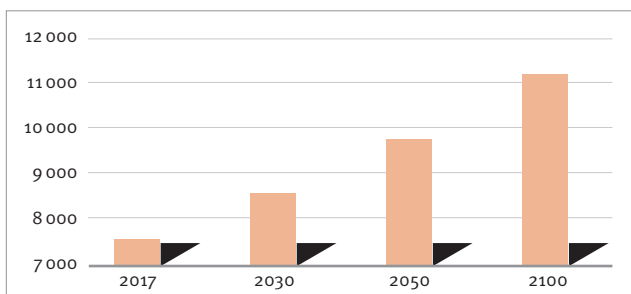


Fig. 3

Source: UN (2017).

11 See Berenberg/HWWI (2010), Africa, Strategy 2030.

However, air pollutants and pollution from oil, waste and ship sewage are a heavy burden on marine eco-systems. Other burdens include the effect of shipping noise and of foreign organisms transported in the ballast water. According to statistics from Germany's Federal Environmental Agency, maritime transport is responsible for over 2% of harmful global CO<sub>2</sub> emissions. The International Maritime Organization IMO is addressing these problems by defining bans, threshold values and other legal constraints. Measures already introduced are beginning to bear fruit, and further interventions are planned.<sup>12</sup>

This will force market players to look at the issue of suitable propulsion technology and to make adjustment investments in spite of the fact that difficult prevailing financing conditions are prompting them to reduce environmental protection efforts to a minimum. For container ships, gas- and oil-based fuels will be the most economically efficient for the foreseeable future, also because electric propulsion systems cannot provide the requisite amount of energy efficiently. Liquefied natural gas (LNG) is anticipated to play a key role, being considerably more environmentally friendly than traditional marine diesel in terms of nitrous oxide and sulphur oxide emissions. On the other hand, potential savings in CO<sub>2</sub> emissions are as low as roughly 30%, because it is also a fossil fuel.<sup>13</sup> This means that, in the long term, even LNG is seen as more of a transition technology. Because the regulation of greenhouse gases affects all transport modes based on fossil fuels to a similar extent, ships as a means of transport are not expected to be at a structural disadvantage compared to other alternatives. Nevertheless the need for additional investment may be especially painful for the struggling shipping industry. Any general large (or excessive) increase in transport costs linked to regulation could additionally give rise to a regionalisation of value chains and thus to negative knock-on effects on the freight market.

### **The low interest rate environment continues to shore up economic activity and maritime trade.**

Interest rates have been extremely low in recent years. For example, the yield on ten-year government bonds has been less than one percent for over three years now. Interest on government bonds with a shorter maturity – currently with terms of up to four years – are even negative. This low interest environment is spurring demand on the financing side, with economic data consistently positive in recent years. The flourishing economic situation is supporting global trade and with it the shipping market. As


<sup>12</sup> See CE Delft (2016).

<sup>13</sup> Heidt, C. et al.; Federal Ministry of Transport and Digital Infrastructure (2014).

<sup>14</sup> See Mayer, Martin, Wolfgang Pflüger and Jörn Quitzau (2017), Zinswende: Ein Stück Normalität, Berenberg Makro Trends from 27 January 2017.

the central banks gradually emerge from crisis mode, interest rates will rise in the coming years. However, we expect the rise to be moderate. Monetary policy is just one factor that impacts on market interest rates.<sup>14</sup>

When monetary policy loses its influence as a means to throttle interest rates, there are still several other factors that have a dampening effect. Because interest also represents compensation for a loss of purchasing power due to inflation, the interest environment will remain lax for as long as inflation rates are low. And even if interest rates rise due to rebounding inflation rates, this would only apply to nominal interest rates, whereas real interest rates would stay at a stubbornly low level. An analysis of real interest rates for ten-year government bonds shows that the downward trend has already been ongoing for more than 20 years and was therefore not triggered by the financial crisis. So there must be other reasons apart from just the unusual monetary policy in the wake of the crisis that are responsible for this long-term downward movement of interest rates. In addition to the aforementioned price stability, one reason is the global glut of savings. While the supply of capital is high, the demand side is low. The growth trend in the industrial countries is on the decline, and there is no exuberance in the global economy.



**The low interest rate environment is spurring demand on the financing side, with economic data consistently positive in recent years. The flourishing economic situation is supporting global trade and with it the shipping market.**

On top of that, demand for credit is slow, probably also because economic growth is no longer as capital-intensive in the era of digital transformation. These are structural factors that will have a longer-term or even a permanent effect. This makes a significant rise in interest rates in the coming years improbable. However, the turn-around in monetary policy will herald a moderate rise in interest rates in the months and years to come. Nevertheless, because of the moderate scope involved, we do not expect any significant negative effects on global trade.

Alongside the developments described, it is first and foremost digital transformation that has been impacting on the economy and on society in a variety of ways for a long time now. For example, internet firms have a fixed place in the business world, and entire industries – such as the music industry and the media industry – have undergone fundamental change. Digitalisation will also pose a greater challenge for shipping in the future. Big Data, digital platforms and 3D printing: these are just some of the topics we will discuss in the following section.

# Influence of digitalisation on shipping

**Digitalisation is advancing apace in all areas, and will also shape the future of shipping. The use of digital data and communication systems will change the functions of the industry.**

## **Digital technologies in shipping.**

Not since the event of industrialisation more than 150 years ago has there been a technological structural change quite as far-reaching as digitalisation already is today and will go on to be. The point of departure for this change is a quantum leap in technological development: For the first time, Big Data can be collected on the go, processed in real time and connected intelligently. This leap allows for a whole new quality in communication, connectivity and ultimately also in production and in transport. The digital possibilities of connectivity mean that time and space are being completely recalibrated. Economically, this is tied to a reallocation of resources which will entail a massive shift in production, trade and logistics. These developments and changes will also affect shipping in a multitude of ways.

## **Digitalisation is recalibrating the world.**

Digitalisation means a system transformation. It is taking over from the industrial age and thus disrupting established structures and business models. The industrial logic of value chains provides for breaking down production by means of division of labour, producing efficiently by way of specialisation and then putting it back together through trade. All three stages require transport and logistics. By contrast, the digital logic of production implies that production will become more integrated again, with more localised production taking place. This will suppress demand for transport and logistics.

Periods of systemic transition are characterised by the simultaneous and exponential nature of the changes. Changes take place simultaneously in many industries and accelerate over time. Agility and speed thus become decisive competitive factors in the recalibration of the world. The new technological possibilities to process Big Data and connect them intelligently using algorithms is resulting in various digital innovations. The most important of these from an economic perspective are:

- Digital platforms,
- Virtual and Augmented Reality,
- Artificial Intelligence,
- Internet of Things,
- Blockchain,
- 3D printing methods.

Many of these digital innovations will play a major role for shipping in the future, both directly and indirectly. Because trade, transport and logistics are derived variables, developments and changes outside of shipping will play at least as important a role as the direct changes in processes and business models within the shipping industry. The many different innovations will interact and trigger a complex change process, the depth, breadth and speed of which is scarcely imaginable today. Digitalisation will have just as much of an influence on the demand for transport as on the supply of transport capacities. Figure 4. presents just a few examples of the most relevant topics for shipping.

**Digitalisation will fundamentally change the function of shipping.**



Although the power of digitalisation to change shipping is already evident, its importance is rated rather modestly by stakeholders in the industry. Only a small number of industry players in the maritime sector consider that digitalisation has already changed their business significantly, whereas companies in high-tech and in public transport have already seen greater change from the pressure of digitalisation (see Figure 5).

Even for the future, shipping companies rate the importance of digitalisation rather modestly for their own industry. A comparatively low 15% consider radical industry change to be unavoidable, while 69% feel that there will be significant changes but no revolution in the industry and a sizeable 16% consider the topic to be overrated.<sup>15</sup>

**Digital technologies in shipping – direct and indirect trends**

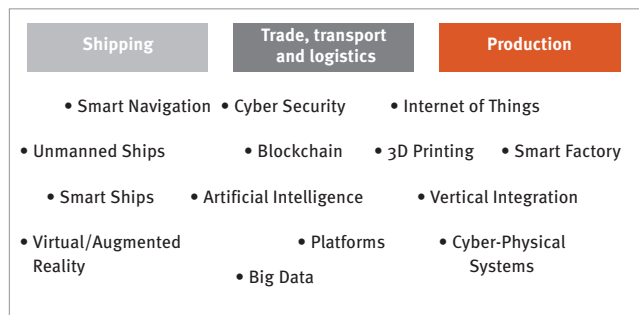


Fig. 4

Source: HWWI based on porttechnology 2018.

<sup>15</sup> PwC, 2017.

### Importance of digitalisation

How much has digitalisation changed your business in the last five years?

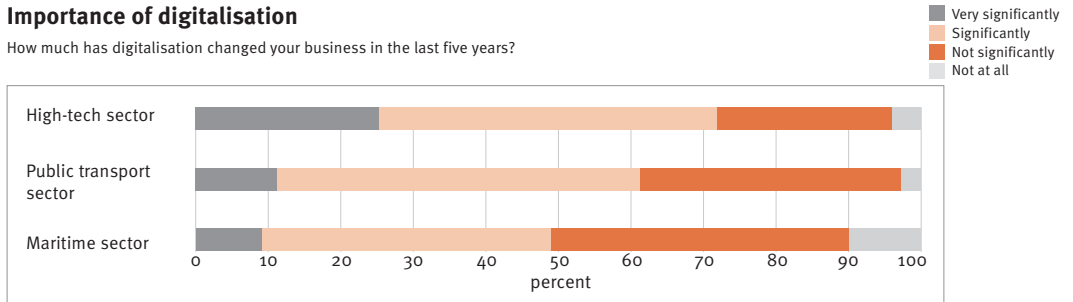


Fig. 5

Source: PwC (2017).

### Change in importance in the maritime sector

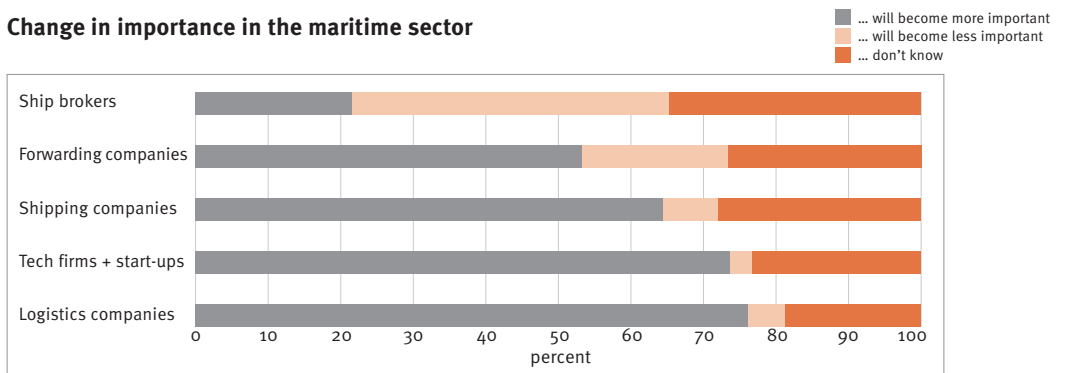


Fig. 6

Source: PwC (2017).

The impact of digitalisation on sub-sectors of the shipping industry are viewed in an uneven light. For example, it is believed that logistics companies and tech firms as well as start-ups will become more important in the future but that pure ship brokers and forwarding companies will be less important (Figure 6). As a general finding, it can be concluded that systemic players that offer more complex, connected and technological solutions will become more important, while margins for pure trading or intermediation services are likely to decline rapidly.

**Main areas of innovation and digital trends in shipping.**

A huge opportunity for shipping lies in the connectivity of ships and ports. The basis and at the same time prerequisite for such connectivity is to collect data and connect it in an intelligent way. Particularly for ports and ships, this requires retrofitting with high-performance digital infrastructure. It involves fitting fibre optic cables, 5G mobile networks and across-the-board use of sensors and satellites. Based on this, ships, cargoes and ports will form their own cyber-physical system in which they are connected to and communicate via the internet, so that logistics chains can be controlled optimally in real time and organised efficiently. For example, weather, traffic and ship arrival times can be predicted with more reliability. Using *predictive analytics and predictive maintenance*, routes can be planned better, necessary repairs can be detected in good time and carried out reliably.

Shipping is becoming a connected, complex technological system through the exchange of data.



**Connectivity: Big Data, Artificial Intelligence and Cyber Security.**

On the whole, increased connectivity offers the possibility of unmanned («crewless») shipping in the future. However, the economic benefits of unmanned shipping are likely to be limited compared to the optimised logistics chains, shorter waiting times, faster routes and more transparent information or even energy-efficient fuels. The buzzwords here are Smart Navigation, Smart Containers and Smart Shipping. Also innovations like Virtual and Augmented Reality and Gamification already have an important role to play in shipping today. These and other developments create a high volume of data and require the technical possibilities to process these data. This means that data network capacity in international shipping will grow exponentially. The VSAT (Very Small Aperture Terminal) system offers fast broadband satellite communication via the internet on the high seas, allowing all relevant stakeholders from the ships to the terminals to be interconnected. The data capacity is expected to increase enormously in the coming years (see Figure 7).

**Projected VSAT network capacity**

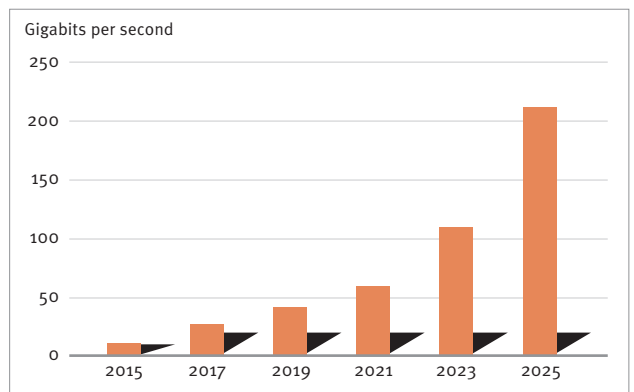


Fig. 7

Source: DNV GL (2018).

IT-based logistics network

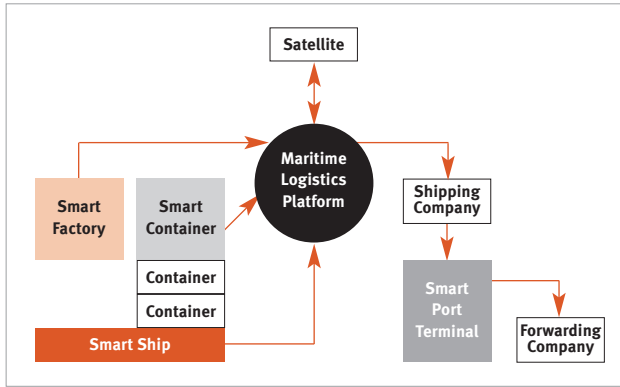


Fig. 8 Source: HWWI (2017).

Many ports such as Rotterdam or Hamburg are already investing heavily in the digital infrastructure, as this is identified as a key competitive factor going forward. This infrastructure is the prerequisite for implementing all relevant digital innovations in shipping. However, data-based connectivity brings with it the inherent systemic risk of cyber-attacks. For example, shipping company Maersk suffered a complete outage of its IT systems in 2017 that lasted for several days and caused a significant loss of business.

Establishing a global IT-based logistics network must also go hand in hand with developing security-based redundancies. But the efficiency potential of stronger and more integrated connectivity is obvious. At present, shipping just one container for one product involves more than 30 people with over 200 interactions. Monitoring and securing these transactions also costs a lot of money.<sup>16</sup>

**Platforms offer efficiency and concentration.**

The first concrete economic disruption to digitalisation was triggered by the emergence of platforms. The possibility to centralise on one platform information spread decentrally yields considerable potential for organising markets efficiently. The large digital platforms are interposed between providers and customers and coordinate their plans. The economic logic behind platforms implies that their efficiency increases in proportion to their size. But this does mean that large platforms acquire considerable market power, putting a major squeeze on smaller providers, intermediaries and intermediary suppliers.

Industrialisation has organised the physical production of goods in the form of highly specialised value chains with division of labour. Digitalisation will organise the data-based services in the form of central platforms. The digital economy will in future be characterised by an architecture of platforms that

1. result in centralisation of data and information,
2. cause a shift in market power.

<sup>16</sup> See btc-echo, 2018.



The transition from the industrial world of value chains to the digital world of platforms can be seen by looking at the changes in the list of the world's most valuable companies (in billions of US dollars) over the past ten years.

The platforms' specific asset is not the physical capital but the data as an intangible asset. Standardised products are thus being replaced by individualised services. For example, mobility provider Uber does not own a single car, and accommodation provider Airbnb does not have any rooms of its own. Against this backdrop, trading and logistics companies must endeavour to have relevance on platforms and to develop technological innovations. A key feature of platforms is their customer gearing rather than the product-focused and process-centred approach of traditional companies.

**Large platforms are organising the entire logistics chain and winning more market power.**



**Smart Factory: Internet of Things und Blockchain.**

The architecture of the platforms will be shaped by an interplay of global and local players. Consequently, we can expect that there will be only a small number of providers for logistics services worldwide. For example, Amazon is currently building airports and seaports as prototypes for future logistics models. Platforms like Amazon will likely be able to handle the entire logistics chain end to end. Yet there will still be a place for local providers of last mile logistics to coexist alongside these end-to-end providers.

**The world's most valuable companies**

2008		2018	
ExxonMobil	453	Apple	919
Petro China	424	Alphabet	782
General Electric	370	Microsoft	691
Gazprom	300	Amazon	629
China Mobile	298	Tencent	541
Microsoft	264	Facebook	521
AT&T	231	Alibaba	481

Linear business model
  Platform business model

Fig. 9 Source: Schmidt (2018).

Another area of digitalisation is the evolution of the Smart Factory. The basis of a Smart Factory is that machines communicate autonomously with each other via the internet. This development is occasionally described as Industry 4.0 to highlight the fact that digitalisation will herald the fourth industrial revolution. The key economic consequences will be

1. interface-free production that is time and space-efficient as a result,
2. vertical integration of production stages,
3. shortening and decentralisation of value chains.

The above consequences of digitalisation for production mean that production will not only be decentralised but also need considerably less space. This makes the prospect of production taking place on a ship using a Smart Factory feasible. However, it remains to be seen whether this technical possibility will in fact give rise to an economic business model. For a model



**The fourth industrial revolution is fundamentally changing how production works. Shortened value chains will reduce global transport volumes.**

like this to work would probably require a type of universal ship to be developed that can transport and produce raw materials and energy at the same time. This then brings us back to issues such as the logistical problem of empty containers. In any case, it can be expected that new business models and logistics solutions will ensue from the new technology possibilities and their connectivity. Furthermore, combining Industry 4.0 with Blockchain technology promises even more efficiency gains, as supply contracts can be integrated peer to peer and processed flexibly.

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**3D printing: decentralisation and individualisation of production.**

3D printing technology (additive layer manufacturing) is one of the digital innovations that will have the greatest impact on production in the future. The key features are that

1. several stages of production are combined in one printing process,
2. consumption of raw materials decreases thanks to optimised design,
3. production can be decentralised more,
4. more flexible and individualised production (down to a batch size of one) becomes cost efficient.

**Industry shares in world trade and shares in investments in 3D printing, 2016**

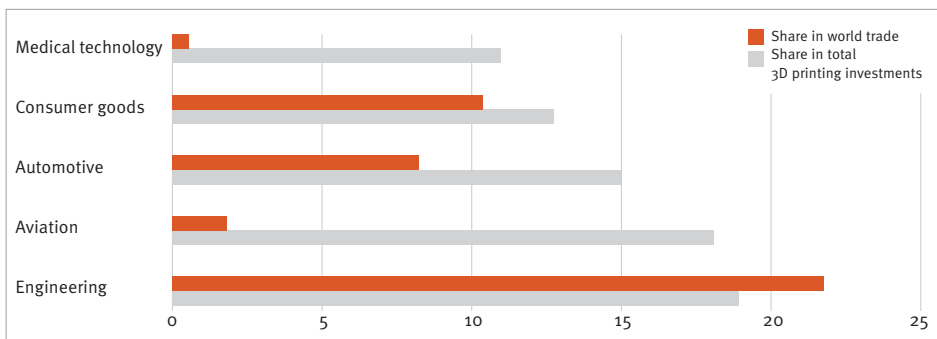


Fig. 10

Source: PwC (2017).

All of these effects will combine to cut transport volumes and at the same time shift transport capacities between container ships, bulkers and tankers. 3D printing will change the way goods flow, both in container shipping and in the transport of raw materials. Container ship transport is likely to decline in relation to bulker transport on account of the decentralised nature of 3D printing.

The extent of the potential effect of 3D printing on production and trade is reflected in investments in 3D printing technology made by various industries. The engineering, automotive and consumer goods industries are three industries investing particularly heavily in 3D printing while also having a large share of global trade (see Figure 10).

**Raw materials transport will gain in significance over the transport of semi-finished and finished goods.**



### Impact of digitalisation on the shipping fleet.

There is a plethora of ways in which digitalisation is impacting on shipping. The different innovations and the related structural changes outlined above can be grouped into three overarching economic effects:

1. Digital innovations are changing the degree of technological economies of scale. The event of 3D printing in particular means that smaller firms can produce just as efficiently as large companies. 3D printing also allows for production to be much more individualised. In extreme cases, even a batch size of one can be produced just as cost efficiently as a larger number of pieces. This leads to the emergence of more decentralised production locations, and transport volumes between what were once the larger central production locations decline.
2. Digital innovations are changing the degree of functional specialisation. In particular the autonomisation of production via data-based connectivity of machines is leading to more pronounced vertical integration of value chains. This shortens the value chain, and fewer intermediate products need to be transported.
3. The more that production costs deviate internationally, the more worthwhile an international division of labour and trade of goods becomes. Transport costs are not such a major factor in this scenario. Digital innovations are changing the degree of these comparative cost benefits. Transport costs become a more significant factor, and international division of labour, trade and transport volumes decline.

Cargo in millions of ton-miles by ship type

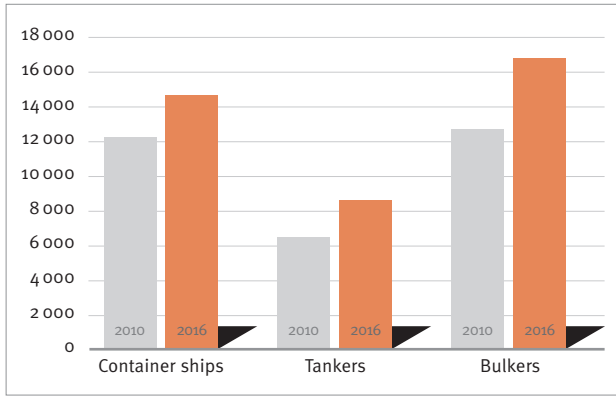


Fig. 11

Source: Clarksons (2018).

So the decisive question is how the entirety of digital innovations will impact by means of the three effects described on the ratio of transport volume to value added and/or the transport intensity of value added. In addition to the development of the overall transport volume, the distribution of that volume among container ships, bulkers and tankers is decisive. The

transport of raw materials, first and foremost of industrial and energy commodities such as ore and oil, can be expected to gain in relative significance. The possibility for producing in Smart Factories on ships directly during transportation using solar and wind energy is difficult to gauge.

Over the medium to long term, the structural changes must be reflected in an altered supply structure for transport capacities. It is difficult to isolate these effects because shipping has been subject to a long and drawn-out process of consolidation in recent years in the wake of a severe crisis,

which has led to different overlapping developments. The recovery of the global economy has brought about a steady rise in transport capacities for container ships, tankers and bulkers over the past six years (see Figure 11).



**Digitalisation is leading to sizeable and radical structural changes in shipping. The container era will be replaced by the era of data flows.**

Over the decades, the different developments in the global economy and phases of globalisation can be seen in the distribution of shipping capacities. Around the 1980s, global production was characterised by a high level of energy consumption. Accordingly, it was tankers that contributed most to global transport (measured in tons) (see Figure 12).

## Share in cargo in tons by ship type

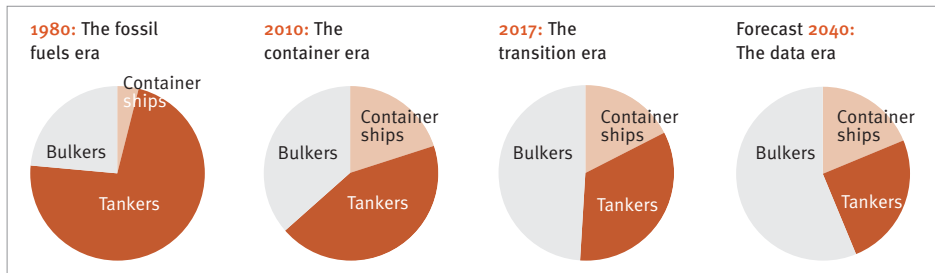


Fig. 12

Source: Clarksons (2018), HWWI (2018), own calculations.

By contrast, the past 20 years of globalisation were virtually symbolised by the container, which supported the increasing connectivity of the global economy by means of standardised and thus cost-efficient transport. The features of this phase of globalisation were the integration of large emerging markets, primarily China, and a massive deepening of the international division of labour as well as increasing complexity of the global value chains. This explains the rise in container transport volumes especially, but also the rise in bulker transport relative to tanker transport (see Figure 12).

However, the global financial and economic crisis of 2008/2009 marked a sudden break with globalisation. In recent years, the view has increasingly taken hold that a new chapter of globalisation is beginning

which will not necessarily be determined by further connectivity and more vertical integration. In this regard, findings on the distribution of cargo by ship type for 2017 must already be seen as a transition to a new phase of globalisation. These figures already show signs of the rising share of bulker transport, which is attributable to stronger intraindustry trade as well as a diversification strategy that is driven more by geopolitical factors (see Figure 12).

**Bulker capacities will grow at an above-average rate. Container ships will remain important, but global production growth will become more raw materials intensive in transport. Paradoxically, this is attributable to data-based autonomous production.**

Future global economic growth, which will be shaped more by technical advancement and less by further economic integration, will favour bulk carriers disproportionately. While container ships will remain important, demand will shift more to the transport of raw materials. The decentralisation

of production through 3D printing and vertical integration of value chains will contribute to a spatial-geographical widening of production locations worldwide, with deliveries of raw materials increasing at an above-average rate as a result. While any estimate is subject to great uncertainty, it is possible to determine in qualitative terms that the transport of energy and raw materials will increase. Shortened value chains and a reduction in benefits of scale will make more decentralised production economically feasible, and transport of standardised intermediate products will be substituted by the transport of additional energy and raw materials. New routes will be created as a result, and central hubs will decrease in significance, leading to a relative increase in the transport of energy and raw materials. An approximate estimate of the rate at which container ships will be substituted by additional raw material transports as a consequence of these developments leads to a further increase in the significance of bulkers (see Figure 12).

The increasing significance of raw materials in the global economy is nowadays expressed through geostrategic conflicts about access to important industrial commodities or rare earths, for example cobalt or lithium, which are essential for battery technology. Digitalisation can be expected to lead to increasing energy requirements overall. However, more and more of the energy required is likely to be obtained decentrally from renewable sources, as digital systems will raise the efficiency of the energy market considerably (Smart Grids and Smart Metering\* etc.). This means that the share of tanker cargo will fall compared to bulker cargo, as the former will not grow as strongly as the latter.

\* Smart Grids and Smart Metering describe a system of efficient energy networks and efficient energy consumption.

## Conclusions



The global financial and economic crisis of 2008/09 triggered a great need for consolidation in the shipping industry that is still ongoing today. The chief consequences of this consolidation are that small ships are being ousted by large ships, shipping companies are merging to form a small number of large providers, and new strategic alliances are being formed. For a while, there was a paradoxical situation in which more new ships continued to be built despite existing excess capacities on the market. Against the backdrop of a global economy that has been improving since 2017, freight rates are also gradually recovering.

Beyond the scope of the favourable framework conditions currently prevailing for the global economy, however, there are some far-reaching structural changes and shifts on the horizon. For example, the global economy is undergoing a period of geopolitical transition to becoming a multipolar global order in which China especially will play an authoritative role. The next phase of globalisation could be characterised by a stronger emphasis on national interests and a return of strategic trade policy with some protectionist tendencies. In this sense, we have reached a phase of »peak globalisation« in our history.

Alongside the geopolitical shift, the most pronounced impact on the shipping industry comes from the technological revolution that is digitalisation. The changes affect the structures and the business models of the industry itself as well as production as a whole. Shipping itself will be characterised by much stronger integration of the individual business models in an overarching logistics platform. This will lead to the disappearance of many intermediaries from the market and to the shifting of market power toward the major platforms as a result of a process of market concentration (winner-takes-it-all markets). In production, above all else it will be 3D printing technology and the automation of processes by means of algorithms and robots that have the most disruptive effects and cause significant structural changes. The result will be increased decentralisation of production as well as shorter value chains. All other things being equal, the global transport volume will then decline.

The status quo described and the imminent structural shifts pose a challenge for the shipping industry to transition out of the crisis and into a new structural equilibrium. This means that the process of consolidation triggered by the crisis will be displaced by a structural adjustment process. Transport capacities as a whole will develop in a new relationship to global growth as a consequence of this development. The established rule of thumb that »International trade grows twice as fast as GNP« no longer applies. From now on, the two can be expected to match each other, or international trade may even develop at a slightly slower pace than GNP. So demand for transport will respond rather inflexibly to global growth.

Ultimately the dominant significance of container shipping as a symbol of globalisation over the past 20 years is likely to be replaced by a higher significance of bulkers, relatively speaking. Bulk carriers are expected to benefit disproportionately from the structural changes, thus increasing their share of global transport capacities. The decentralisation and integration of production in particular are expected to reduce the transport of preliminary and intermediate goods, while the spatial diversification of production will raise transport volumes of raw materials worldwide. The increasing significance of raw materials, also including rare earths such as cobalt or lithium, is also reflected in a new geopolitical race for access to raw materials.

On the whole, the years ahead will be important ones for shipping, and some of them will be shaped by disruptive developments. Sensitivity to geopolitical and technological shocks is likely to increase. The process of consolidation and adjustment to the new long-term market equilibrium is certain to continue for another five to ten years.





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