European Technology Platform of the Waterborne Industries

Maritime Europe Strategy Action

SEVENTH FRAMEWORK PROGRAMME
THEME 7: Transport (including Aeronautics)

Market trends towards 2030

Maritime Europe Strategy Action

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Description of the Task:
<u>Task 5.3 Market Trends towards 2030</u>
Under the responsibility of CESA the studies will start from the analysis of the actual maritime market situation, illustrating the principal market segments and their characteristics; the main market drivers, and new market opportunities, will be examined. The activity will focus on the perceivable market trends, both inside the existing maritime market segments and for the new developing ones, such as arctic operations, retrofitting and repair, and the different sectors of the “blue economy”; in particular the Blue Growth potential for the maritime technologies industry will be analysed on the basis of the study work undertaken by the European Commission (study on “Scenarios and drivers for sustainable growth from the oceans, seas and coasts", as far as relevant for the maritime technologies industry). Task leader CESA will deliver a report outlining the trends towards 2030 (D.5.3).

Executive Summary

The MESA foresight activity provides market, societal and regulatory trends, with the aim to compare these with present and expected technology developments and, thus, to able to derive R&D needs to address identified gaps. This document provides the market trends foreseen until 2030, and in some cases, beyond, based on an analysis of the previously identified and assigned trends on energy supply and consumption, the economy, waterborne industries, waterborne trade, and ICT.

The OECD has predicted that:

1. The global economic balance will continue to shift towards the current non-OECD area, whose economic structure and exports will increasingly resemble those of the OECD.
2. Global growth will slow from 3.6% in 2010-2020 to 2.4% in 2050-2060 and will be increasingly driven by innovation and investment in skills.
3. Due to the rising economic importance of knowledge that will tend to raise returns to skills, by 2060 pre-tax earnings inequality in the OECD area may reach the level of today's most unequal OECD countries.
4. Climate change will curb global GDP by 1.5% on average and almost 6% in South and South-East Asia before 2060, unless increases in CO2 emissions are curbed.

World energy consumption is forecast to growth at than 1.5% per year between 2014 and 2035, i.e. a rise from over 13.000 million tons [oil equivalent] in 2013 to over 18.000 million tons [oil equivalent] in 2035. Renewable energy and nuclear power are predicted to be the world's fastest-growing energy sources, each increasing over 5% per year, however, liquid fuels will continue to supply almost 80% of world energy use to 2035.

Of total trade, 90% is carried by sea. The growth of seaborne trade is driven by growth in demand. Since 2010, when world trade recovered from the downturn, after the economic and financial crisis exploded in 2009, existing overcapacity of the merchant fleet, historically high oil prices and the use of low steaming has moderated growth of seaborne trade. Dry bulks and containerised cargoes constitute 70% of the global seaborne trade, while oil and gas tankers account for the remaining 30%.

The European Shipbuilding & Marine Equipment Association SEA Europe 2014 Market Forecast Report provides forecasts on newbuilding requirements for the period to 2035, as follows:

- The dry bulk cargo trade is forecast to continue growing in the long term, driven by demand in developing economies; mainly Asian countries, which will need iron ore, coal and other minerals for their industry and power generation.
- Containerised trade is expected to grow at higher levels due to the stabilisation of the financial and economic situation in the US and the expected increase of western consumers' demand for goods manufactured in Asia and other developing countries.
- The demand for seaborne trade of oil and petroleum products is expected to continue growing. The unexpected drop in oil prices is benefiting shipping, as lower bunker costs are providing

higher margins for shipowners. The decrease in oil price should lead to an increase in oil to countries such as China, who might seek to increase their oil reserves.

- There is increasing demand for LPG, especially in the Asia Pacific region, bolstering the demand for very large gas carriers [VLGC], however, the market for LPG is still unpredictable and though the demand for LPG will certainly increase in the short term, the long-term trend is still uncertain.
- The world cruise Industry has faced some challenging times in recent years, linked to both supply (mainly from changing ship size and safety/environmental issues) and demand (economic turmoil, security concerns etc.) By its very nature, the sector is inherently dynamic in that cruise lines are continuously seeking new ways to attract first-time and repeat passengers. Analysis of the development profile of the world cruise fleet over the past decades reveals that there exists a distinct trend of vessels becoming larger. This has led to rapid growth, not only in vessel numbers but also in vessel capacity, for the large categories.
- The current trends in term of policy and energy demand will lead to an increased in marine renewable energy demand urging the need for a proactive regulation and R&D policy.
- The saturation of onshore agricultural land, the decrease in fish stock and the increase of world population tend to push for a massive development of offshore aquaculture linked to mutualisation of offshore infrastructure with other activities.
- Beyond renewable energy fixed infrastructure, other new building requirements will come from the new offshore industrial activities like aquaculture, desalination, sand & gravel extraction, tourism, container hub, logistical hub, floating hotel to escape saturated coastlines.
  This trend will require the maritime industry to adapt to new materials and methods to cope with. This point will be addressed through 'multi-use offshore platform' developments.

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1. Introduction

Background

The MESA foresight activity will provide market, societal and regulatory trends, with the aim to compare these with present and expected technology developments and, thus, being able to derive R&D needs to close identified gaps. In this sense, this foresight activity contributes to the refinement of the European maritime transport RDI policies/strategies (Vision 2030, the Strategic Research and Innovation Agenda and the Implementation Plan of the Waterborne Technology Platform).

Objectives

Within work package 5 of MESA, three reports (5.2, 5.3 and 5.4) will elaborate on market, societal and regulatory trends, respectively. This document provides

Scope

To meet the outlined objectives, this document will present

2. Relevant assigned studies

Trend/topic	Task 5.2 – market	Task 5.3 – society	Task 5.4 – regulatory
Population		X	
Food & water		X	
Energy supply and consumption	X	X	X
Economy	X		
Waterborne trade	X		
Waterborne industries	X		X
ICT (Information & Communication Technology)	X		X
Climate change /Environment		X	X
Health and Safety		X	X
Security			X
IMO strategy plan			X

Table 4: recommended focus assignment of trends/topics to subsequent tasks in work package 5

3. Method of work

The work followed the path described in deliverable 5.1. To facilitate work, the following research questions have been formulated:

- Which impact and when is seen related to ships, incl. inland waterway vessels, leisure craft and fishing vessel?
- Which impact and when is seen related to blue growth?
- Which impact and when is seen related to vessel owners and operators?
- Which impact and when is seen related to yards and systems suppliers?
- Which impact and when is seen related to service suppliers (e.g. class)?
- Which impact and when is seen related to infrastructure?

4. Identified trends

General

A number of foresight studies to be reviewed were recommended in MESA Report D5.1. However, a number of these studies were very general in nature and not specifically focused on the market trends for the waterborne sectors. Therefore, it was decided to review an additional number documents that seek to identify trends over the next twenty years. In many cases, these were documents that were produced by specific maritime industry sectors. The results of these reviews are as follows:

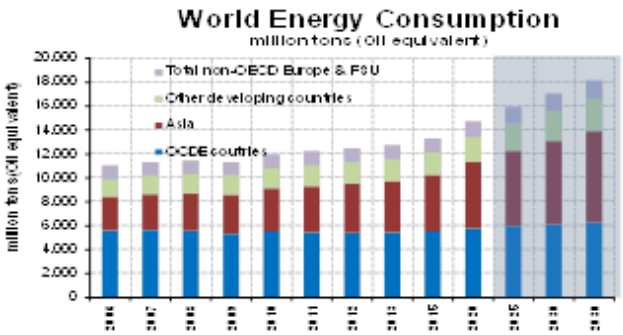
Energy supply and consumption

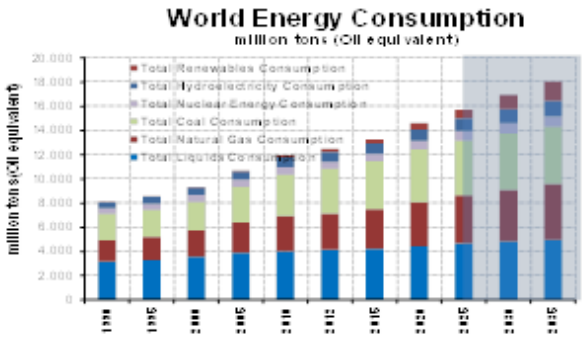
The market trends were derived from the following studies:

- Review of Maritime Transport, 2013, UNCTAD
- Statoil (2014): Energy intensity of world economy
- SEA Europe in house report: 2014 Market Forecast Brochure
- ….

Energy consumption:
Multilateral and International Energy Organizations forecast that world energy consumption will grow more than 1.5% per year between 2014 and 2035. This means a rise from over 13.000 million tons [oil equivalent] in 2013 to over 18.000 million tons [oil equivalent] in 2035. Most of the growth in energy consumption occurs in non-OECD countries, where demand is driven by strong and sharp long-term growth. Energy use in non-OECD countries is forecast to increase at about 2.5% per year between 2013 and 2035, whilst in OECD countries, it is forecast to be nearly 0.5%.

Energy demand:
Reference scenario: The Statoil Report [Energy Perspectives 2014] predicts that energy demand is expected to grow by 1.3% on average, reflecting an expected and continued improvement in energy efficiencies. It foresees a gradual greening of the energy mix, with new renewables, gas and nuclear energy developing faster and gaining market share relative to coal and oil, but with demand for all fossil fuels continuing to grow. Consequently, global CO2 emissions continue to grow until oil (and coal) demand is expected to peak somewhere around 2030. In the Reference scenario, coal, oil, and gas demand on average grow by 1.1, 0.6, and 1.4% per year, respectively, until 2040. In other words, gas is expected to grow its market share moderately, while coal and oil are losing market share to other fuels. New renewables (wind, solar, geothermal energy) are growing by 8% per year, entailing that energy from these sources are almost 6 times higher than today and constituting 6.5% of total energy demand in 2040.





In order to visualize that the world might go in different ways than that portrayed in their Reference Scenario, they also developed two alternative scenarios, or development paths. These represent possible futures that could materialize, even if they think such developments are less likely than the one displayed in the Reference scenario.

Low carbon future scenario: One of the alternative scenarios represents a Low Carbon future, expanding on possibilities for policy changes and technological developments resulting in significantly lower energy demand and greener energy mix than in the Reference Scenario, but with roughly the same level of income (GDP) in 2040. In this scenario, total primary energy demand in 2040 is roughly the same as today (and 38% lower than in the Reference Scenario), and energy related CO2 emissions are 24% lower than today. Oil and gas demand are lower than in the Reference scenario, but still much higher than what can possibly be produced from existing oil and gas reserves. Even in a Low Carbon scenario, therefore, there is a substantial need for continued investments in new oil and gas production.

Policy Paralysis scenario: Characterized by geopolitical conflict, less international economic integration, “beggar-thy-neighbour” economic policies, lack of progress on climate policies and focus on security of supply. This results in a future with significantly lower economic growth and energy demand more dominated by local sources of supply in key regions, including a larger coal share in the fuel mix. In this scenario, total primary energy demand in 2040 is 26% higher than today (and 12% lower than in the Reference Scenario), with CO2 emissions 5% lower than in the Reference Scenario, pulled down by the lower GDP growth.

Future energy mix:

Over the next two decades, renewable energy and nuclear power will be the world's fastest-growing energy sources, each increasing over 5% per year, although liquid fuels will continue to supply almost 80% of world energy use through 2035. Saturation onshore and the need for increased predictability of renewable energies will tend to substantially increase the demand for marine renewable energies and their related offshore infrastructure..

World petroleum and other liquid fuels have entered a period of great structural change. The main reason is that potential new suppliers of oil from tight and shale resources, for example, the US, have simultaneously entered both oil and natural gas market. The potential for growth for the demand of liquid fuels is focused on emerging economies, whilst improvements in energetic efficiency have slowed the growth of liquid fuel consumption among OECD economies. Projected world natural gas consumption grows at nearly 2% per year versus oil crude increase above 1% per year until 2035. Increasing supplies of tight gas and shale gas support this growth in projected worldwide natural gas use.

On the other hand, coal use grows faster than petroleum and other liquid fuels use after 2030, mostly because of increases in China's consumption of coal and rapid growth in liquids demand attributed to slow growth in the OECD regions.

The effect of the shale boom:
In the past decade the oil industry has moved towards deeper fields and the marginal barrel has to a large extent become ultra-deepwater barrels. However, as a result of the shale revolution in the US, the marginal barrel may change towards shale oil. One main advantage of shale oil versus offshore is a far shorter lead-time from development to production start, reducing the time until a project turns cash positive. Conversely, shale oil wells have higher decline rates, with production declining 80% within the first three years. However, this becomes less of a concern when taking into account the lead times and costs. Given the current focus on cash flow, this is a factor in favour of shale oil developments, which can be quickly halted and restarted depending on the oil price relative to the cash cost and economic return of specific projects. Thus, due to shale development there is a risk of slowdown or postponement of the most expensive offshore oil projects, incl. Arctic.

Uncertainty of Oil prices:
Since the middle of 2014, the sector has experienced challenging conditions in that oil prices have dropped from over $110/barrel [Brent Crude] to a present price of around $50/barrel. A consequence of this is that bunker fuel prices have also dropped, albeit by a less significant rate, but still around 40%. Although over the medium to longer term it is likely that the oil price will start to rise once more, the oil price may remain volatile in the short to medium term, due to a number of factors, including the supply of US shale gas, lower economic growth in developing countries in Europe and South East Asia, as well as the strategies of leading OPEC members.

Maritime transport

1. The U.S. shale gas revolution is increasing LPG Exports from the U.S., resulting in increasing demand for very large gas carriers (VLGC), with a capacity of approximately 82,000 cubic metres. Demand of LPG is growing mainly from developing countries, given that LPG is cheaper and cleaner than oil. The enlarged Panama Canal is projected to open in late 2016 allowing VLGC to cross. This will decrease the transit route between North America and Asia Pacific region and reduce transportation costs. The trade between the U.S. and Asia Pacific region is anticipated to increase at a rapid pace owing to the decrease in transportation costs. High LPG prices in the Middle East are leading to increased demand from the U.S. market.
2. With an increased trend to use alternative fuels as a bunker fuel [e.g. LNG, methanol, ethanol, DME, biodiesel and biogas], not only will there be a greater demand for these fuels, increasing market price, but also a greater requirement for their transportation to ports around the world.
3. Another future trend is likely to be renewable energy propulsion (wind, sea and solar power), which is likely to utilise technologies being developed on land. Furthermore, there will be fuel cells running on hydrogen as auxiliary propulsion power; and in the longer term, a diverse fuel mix adoption, with LNG, biogas, batteries and hydrogen produced from renewable sources.

4. The volatility of the oil price, and as a consequence, bunker prices will lead to need to "future-proof" vessels, for example dual-fuel engines, and flexibility in prime-movers.

Blue growth

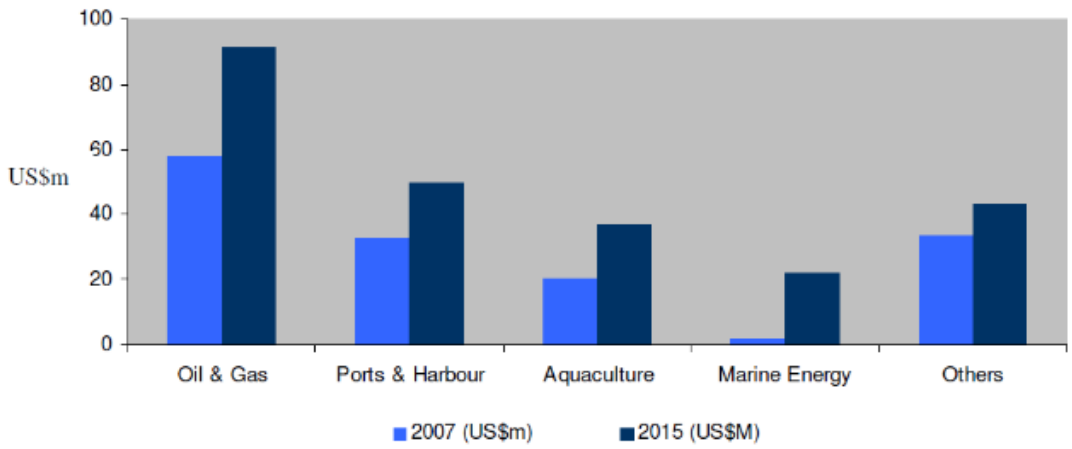
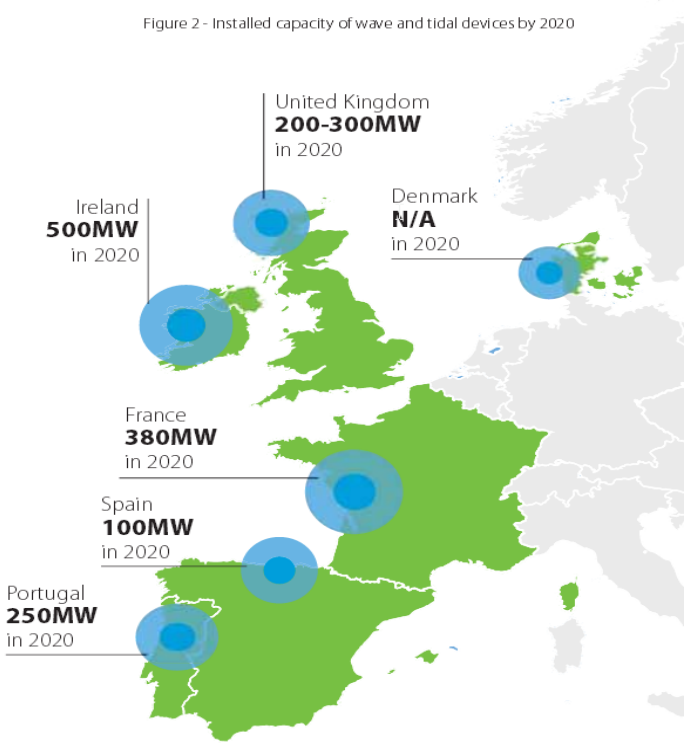


Figure 3.2 RTIMS Market: Total Revenues by Sector (World) 2007 & 2015 (fonte: Frost&Sullivan 2009)

1. EU energy and environmental policies binding States to rely more on renewable energy sources given the expected population growth in coastal areas, saturation of shore and climate change. In particular, by 2030, renewable energies should represent 27% of the European energy mix.



in addition to the contribution to the long-term objectives of the EU with respect to the reduction of greenhouse gas emissions, the target of self sufficiency and reduced dependency towards volatile and unsecured energy sources is a strong identified trend that will lead to an acceleration of renewable energy deployment.

In the next two decades, renewable energy will be one of the world's fastest-growing energy sources, increasing at over 5% per year. Marine renewables (MRE) is a major constituent of this and there will be an increasing market for floating energy devices for wave, wind, tidal current and OTEC along with vessels to support maintenance and

monitoring of these devices; many of which are predicted to be unmanned, if not totally autonomous.

2. The development of MRE will help limit the EU's dependency on fossil fuels for the production of electricity and reinforce its energy security.This aspect could prove to be particularly important for island states and regions where ocean energy can contribute towards energy self-sufficiency and replace high-cost electricity produced by diesel power stations.

All the available technologies will have to contribute toward achieving this ambition which shall allow Europe to keep its leadership in this field. At this date, marine renewable energies will have started their commercial deployment phase with a forecast 30MW plus installed for wave power and tidal current power alone[1].

3. Among the other marine resources, offshore biomass production and desalination will become other key drivers. These two industrial offshore developments will support human shore based activities concentration, with less and less areas dedicated to agriculture and more and more water requirement.

4. The development of new offshore activities is looking towards the mutualisation of costs through the utilization of multi-use offshore platforms. In order to deploy this trend certain challenges will have to be met to enable MRE development :

- Reaching competitive energy cost with respect to fossil fuels in the longer term. The LCOE should be profitable by means of public authority support (e.g. buy-back rate) by 2020 and reach fixed offshore wind turbine costs by 2030.
- Pushing for research and innovation developments in critical technology blocks (quoted below) leading to
    - an increased predictability;

      simplified maintenance;

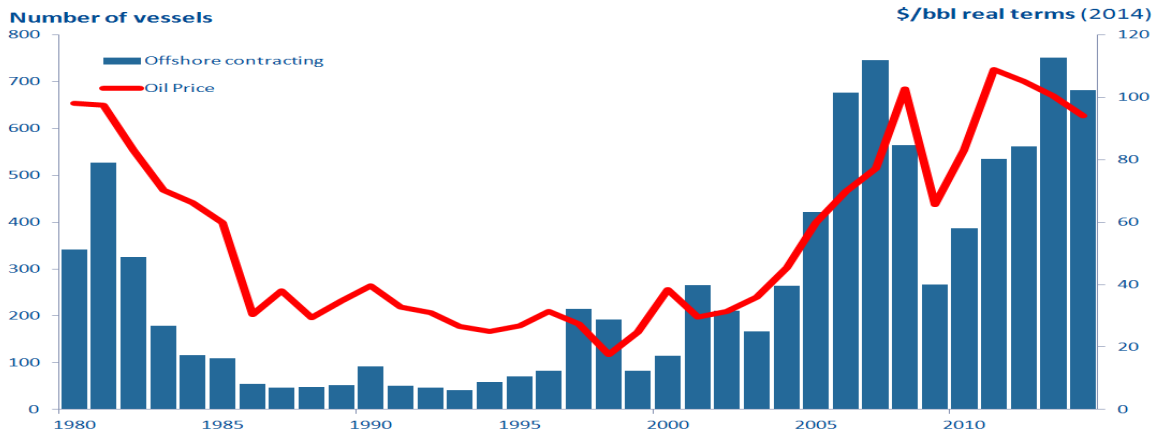
      an increased adaptability and polyvalence (rapid transport and installation phases);

      reduced engineering work.

Technological building blocks
Subsea connectors
Offshore substations
Foundations and anchors
Materials, structures and seaworthiness of installations
Control and monitoring
Modeling, development of resource simulation and assessment tools
Marine operations
Industrialization

5. Oil price and the perception of future oil price development vs. actual and expected cost development is one of the key drivers for offshore hydrocarbons new-building demand is the prevailing. With higher oil price there is higher number of profitable offshore fields, more exploration activity and thus higher

spending and a higher demand for rigs and ships. However, it is a challenge to predict future oil price development and, therefore, the future level of vessels demand.



New significant discoveries in one region will usually affect the sentiment of oil companies. New discoveries and high hit rates in areas previously regarded as not promising will be a key driver for increased interest and further exploration activity.

- In emerging regions, the infrastructure is often limited, distances may be longer and the rig density is low. Thus, a higher number of support vessels per rig will be needed. Assuming oil prices return to historic levels, there is likely to be continuing exploration and oil production in ever-deeper waters or in more difficult regions, e.g. the Arctic, and this will drive this number even further.

- Mature regions with predicted lower future production are often interpreted as a declining offshore market. However, lower production is also an important driver for higher exploration activity when there is a sufficient focus on replacing reserves. In addition there will be higher focus on increasing the production rate per field or well. Development of marginal fields and tie-backs will also require subsea vessels. A mature installed base of subsea wells and pipelines will require vessels for inspection, maintenance and repair. Then at some point there will be a need for decommissioning and specialist vessels accordingly. Activity in mature areas is often key for driving innovation.

6. Countries' aiming to get less dependent on oil or gas import is also a driver for offshore activity. For national oil companies (NOC) there will often be less attention on short-term profitability and more attention on long term growth of reserves and production. This will depend on government policy. Still, as NOCs usually share production licences with international companies the challenge will be to make licences and projects as attractive as possible.

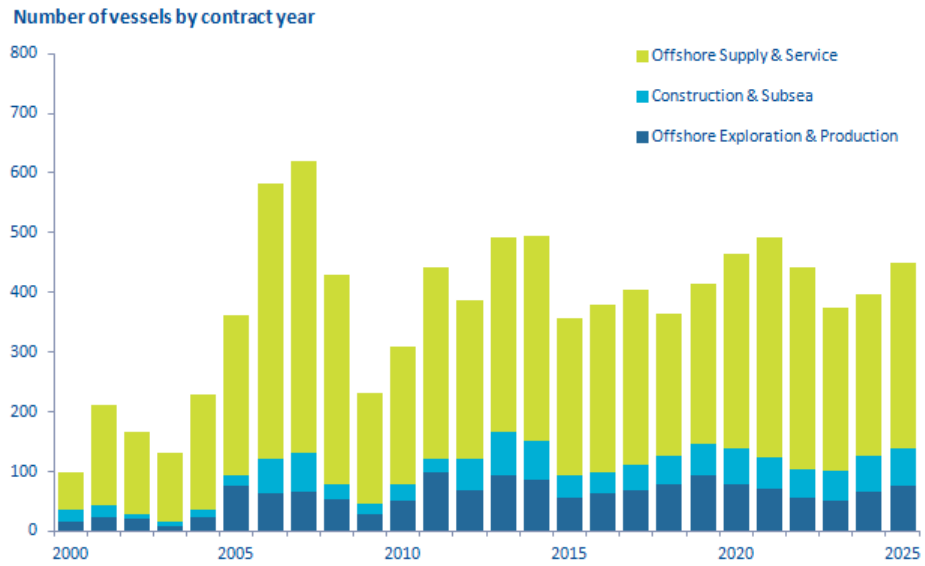
7. Within oil and gas production there is a trend towards offshore growing faster than onshore and within offshore deep-water is growing faster than shallow water. This trend is expected to continue. Since 2008 60% of oil and gas offshore discoveries have been in deep water (boe). In addition distances

from shore are increasing leading to higher demand for more efficient vessels. With this, there are new requirements and a need for more rigs and ships capable of operating in these areas in the most efficient and safe way. More cost efficient vessel designs and systems are also important drivers, as vessels then will have a competitive advantage, obtain higher utilisation and thus be preferred in the market.

8. Oil price development has always influenced the volatility of the offshore shipping market. Among other reasons are low market visibility, speculative orders, lack of discipline, the fight for market shares and overreaction from too many of the market players. There is often a trigger point: when fleet utilisation exceeds a certain level the day rates are skyrocketing. If the market believes this will continue there will be a boom in new orders for the relevant vessel type. However, what is often the case is an order book containing too many vessels at the time when day rates start to drop again. The consequence may be several years with a low number of offshore orders.

9. In the past decade the oil industry has moved towards deeper fields and the marginal barrel has to a large extent become ultra-deep-water barrels. However, as a result of the shale revolution in the US, the marginal barrel may change towards shale oil. One main advantage of shale oil versus offshore is a far shorter lead-time from development to production start, reducing the time until a project turns cash positive. A disadvantage of shale oil wells is the higher decline rates compared to offshore, where the typical shale oil well declines 80% in production within the first three years. However, this becomes less of a concern when taking into account the lead times and costs. Given the current focus on cash flow, this is a factor in favour of shale oil developments, which can be quickly halted and restarted depending on the oil price relative to the cash cost and economic return of specific projects. Thus, due to shale development, there is a risk of slowdown or postponement of the most expensive offshore projects, incl. Arctic

10. Forecast: It is very difficult to predict the future oil price development, it being dependent on future global economic growth, energy demand and international politics. The outlook will depend on hurdle rates for investment, profitability, financing possibilities and state-controlled oil companies often with higher focus on self-sufficiency than short-term profitability. The mix of onshore, shallow-water, deep-water, ultra deep-water activity and effects of increased activity in remote areas is also key. Longer distances will drive demand for offshore vessels. Innovation and technology development, costs and efficiency improvements are also important. In the short-term most offshore markets will be affected, however, increased activity is expected towards 2020.



Infrastructure

- The shale gas revolution in the US is likely to require new infrastructure for the storage and loading of LPG, particularly in the relevant US ports
- Ports will continue the trend to reduce energy consumption and emissions. The use of cleaner and cheaper alternative fuels replacing the traditional HFO have already been proved as successful and it is expected that their use will increase. I.e. LPG and bio-fuels will increasingly be used for feeding and other port operations towards 2030.
- Renewable energy sources will also increase their use as power generators for cheaper and cleaner port operations, buildings, etc.
-

Economy

The market trends were derived from the following studies:

- "OECD: Looking to 2060" report
- NIC Report…
- SEA Europe in house report: 2014 Market Forecast Brochure
- ….

The "OECD: Looking to 2060" report makes the following predictions:

1. The global economic balance will continue to shift towards the current non-OECD area, whose economic structure and exports will increasingly resemble those of the OECD.

2. Global growth will slow from 3.6% in 2010-2020 to 2.4% in 2050-2060 and will be increasingly driven by innovation and investment in skills.
3. Due to the rising economic importance of knowledge that will tend to raise returns to skills, by 2060 pre-tax earnings inequality in the OECD area may reach the level of today's most unequal OECD countries.
4. Climate change will curb global GDP by 1.5% on average and almost 6% in South and South-East Asia before 2060, unless increases in CO2 emissions are curbed.

In addition, the NIC Report identified a number of trends, to 2030, that will have an effect on the waterborne sector, as follows:

1. Middle classes most everywhere in the developing world are poised to expand substantially in terms of both absolute numbers and the percentage of the population that can claim middle-class status during the next 15-20 years. This trend will lead to an increased consumption of technologic product raising the need of finding new minerals sources.

2. The US, European, and Japanese share of global income is projected to fall from 56 percent today to well under half by 2030. In 2008, China overtook the US as the world's largest saver; by 2020, emerging markets' share of financial assets is projected to almost double.

3. Whereas in 2012 only Japan and Germany have matured beyond a median age of 45 years, most European countries, South Korea, and Taiwan will have entered the post-mature age category by 2030. Migration will become more globalized as both rich and developing countries suffer from workforce shortages.

4. Today's roughly 50-percent urban population will climb to nearly 60 percent, or 4.9 billion people, in 2030. Africa will gradually replace Asia as the region with the highest urbanization growth rate. Urban centers are estimated to generate 80 percent of economic growth; the potential exists to apply modern technologies and infrastructure, promoting better use of scarce resources.
5. The rush to coastal areas and the constant urbanisation which is affecting all countries will reduce the available agricultural parcels while demand for food is expected to rise at least 35 percent by 2030 while demand for water is expected to rise by 40 percent. Nearly half of the world's population will live in areas experiencing severe water stress. Fragile states in Africa and the Middle East are most at risk of experiencing food and water shortages, but China and India are also vulnerable.

Many of these trends are already reflected in the Waterborne Trade section, however, other potential are as follows:

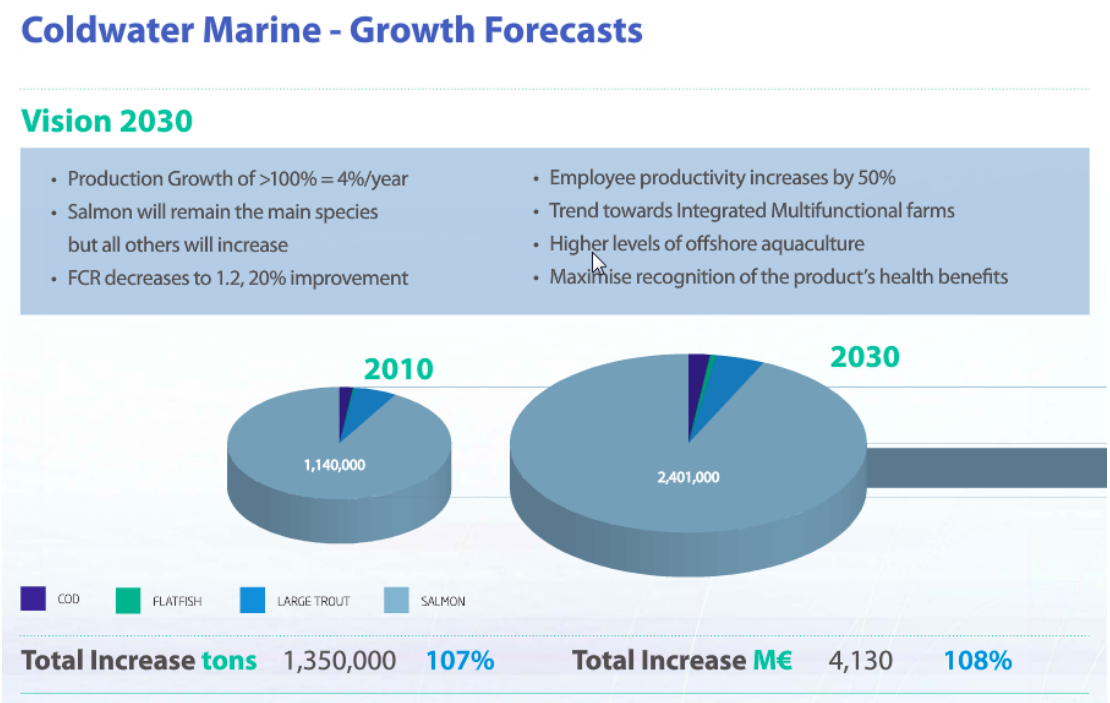
Maritime transport

1. Increasing trade of manufactured goods to Africa
2. Transportation of fresh water to Africa and the Middle East
3. The stabilisation of the financial and economic situation in the US and Europe in the mid-term is expected to benefit the demand from western consumers' for goods manufactured in Asia and Africa, increasing the seaborne trade of manufactured goods
4. The progressive economic development of countries in Asia and Africa in the period until 2035 will drive the grow in the demand of bulks, oil and gas for their industrial development, usually coming from the US and Australia, increasing the need of maritime transport in those trade lanes;

Blue growth

1. The increased access to "high tech" product and the scarcity of onshore mineral resources will lead to to an increased demand for raw materials only accessible through the development of seabed mining technologies enabling the exploitation of oceans floor;
2. The need to identify new sources of food, thus an increased demand for offshore or marine aquaculture;
3. The need for fresh water and the potential increased demand for offshore desalination plants;
4. The development of those activities will require the use of offshore multi-activities platform in order to allow cost competitiveness through synergies.

In relation to aquaculture some market projections are available from FEAP (Federation of European Aquaculture Producers), as shown:



In relation to deep seabed mining, there will be a demand for a number of systems, including:

- Support vessels
- Floating mineral processing platforms/plants
- Remotely Operated Vehicles (ROVs)
- Autonomous Underwater Vehicles (AUVs)
- Tracked seabed vehicles
- In situ sea bed observatories

Infrastructure

- Increasing trade to and from Africa, will require significant investment in existing and new ports
- Mass dissemination of goods through ever bigger TMC, will encourage Harbour industry to develop offshore hub and short sea shipping, where shore based harbour infrastructure can't adapt to the container ship size continuous increase

Waterborne Trade

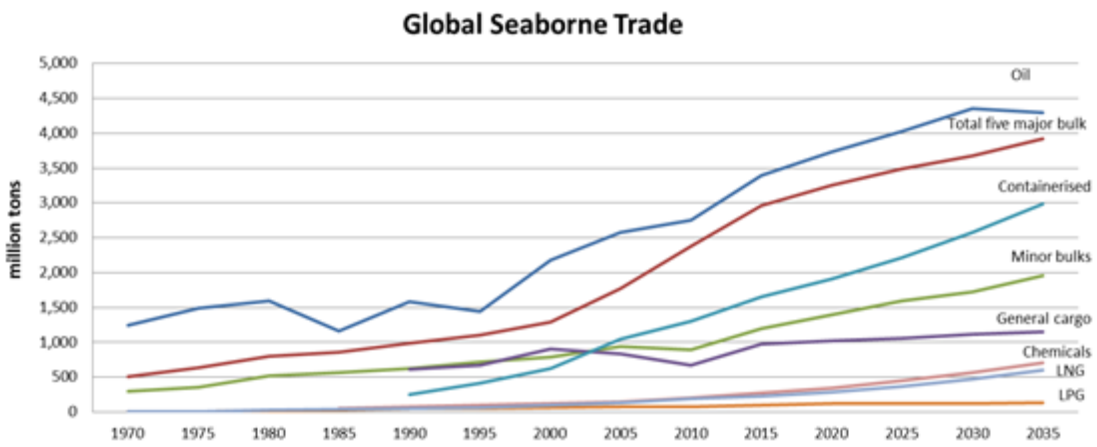
The market trends were derived from the following studies:

- Review of Maritime Transport, 2013, UNCTAD
- SEA Europe in house report: 2014 Market Forecast Brochure
- ….

Maritime transport

Of total trade, 90% is carried by sea. The low cost of shipping compared to other means of transport, improvements in port infrastructures and logistic chains, and the new generation of energy efficient vessels benefit seaborne trade and its leadership in international freight transport.

The growth of seaborne trade is driven by growth in demand. Since 2010, when world trade recovered from the downturn, after the economic and financial crisis exploded in 2009, existing overcapacity of the merchant fleet, historically high oil prices and the use of slow steaming has moderated growth of seaborne trade. Dry bulks and containerised cargoes constitute 70% of the global seaborne trade, while oil and gas tankers account for the remaining 30%.



1. The dry bulk cargo trade is forecast to continue growing in the long term, driven by demand in developing economies; mainly Asian countries, which will need iron ore, coal and other minerals for their industry and power generation.

2. Containerised trade is expected to grow at higher levels, compared to the last couple of years, due to the stabilisation of the financial and economic situation in the US and the expected increase of western consumers' demand for goods manufactured in Asia and other developing countries.
3. Regarding seaborne trade of oil and petroleum products, given world economies' resilience in fossil fuels, the demand is expected to continue growing. The unexpected drop in oil prices is benefiting shipping, as lower bunker costs are providing higher margins for shipowners. The decrease in oil price should lead to an increase in oil to countries such as China, who might seek to increase their oil reserves.
4. The world cruise Industry has faced some challenging times in recent years, linked to both supply (mainly from changing ship size and safety/environmental issues) and demand (economic turmoil, security concerns etc.) By its very nature, the sector is inherently dynamic in that cruise lines are continuously seeking new ways to attract first-time and repeat passengers. The profiles of ships, itineraries, on-board features, and destinations are therefore continuously changing. Given the very different features of many of the leading potential markets (in terms of customer preferences, desired cruise destinations, on-board facilities, culture etc.), and the different niche markets within the larger national markets, the vessel deployment profile for the leading international operators is one involving a delicate balance of cruises/vessels simultaneously geared to very different sectors of the overall markets. The future prospects for different markets are therefore critical in shaping future vessel design, ordering and deployment.

   The distribution of the world cruise fleet in vessel numbers is heavily skewed towards the lower end of size spectrum in respect of passenger capacity. However, while small category vessels with <1,000 lower berths account for 51% in terms of vessel numbers, they account for only 14.4% in overall capacity. Large category vessels of 2,000+ lower berths represent 29% in vessel number but 62% in passenger capacity. Analysis of the development profile of the world cruise fleet over the past decades reveals that there exists a distinct trend of vessels becoming larger. This has led to rapid growth, not only in vessel numbers but more markedly in vessel capacity, for the large categories.

Blue growth

Autonomous and evolutive multi-use offshore platforms will host new industrial activities at sea, developed in coherence with shore based implantations, but also properly integrated the maritime trade sea routes. The first activities could be marine biomass offshore transformation, directly transferred to shipping through reefers, cruisers port visit to offshore resorts adequately linked to educational sea centres and offshore container hub, to allow short sea shipping to link secondary harbours by barges.

Infrastructure

1. The UNCTAD Report refers to a study that estimates that between 2013 and 2030, some $57 trillion in infrastructure investment (including transport, power, water and telecommunications) will be required to keep up with projected GDP growth and yet still be insufficient to meet maintenance deficiencies or the broader development goals of emerging economies, let alone

the cost of adapting to climate change (McKinsey Global Institute, 2013), of which the share for ports would be around $1.5 trillion. Also, that port throughput will rise from 265 million tons in 2009, to more than 2 billion tons in 2040 (Commonwealth Business Council, 2013).

2. The UNCTAD Report goes on to say that in Europe, port developments relate mainly to building new terminals within existing ports rather than developing new green-field sites. As such, much of the reform process is more to do with the organization and operational aspects of ports. The European Commission launched a new initiative to improve port operations at 319 key seaports. The guidelines are aimed at proposing legal changes that will help port operators upgrade their services and facilities as well as giving them more financial autonomy. Currently, 74 per cent of the goods entering or leaving Europe are transported via sea, with one fifth of this volume passing through just three ports: Rotterdam, Hamburg and Antwerp. This concentration results in congestion and extra costs for shippers, transport operators and consumers. The new proposals could save the European economy up to €10 billion ($12.8 billion) by 2030 and help develop new short sea links (Europa, 2013).
3. The results of a recent ESPO survey on the needs of ports in terms of infrastructure shows that participating EU ports would need over €9.8 billion to spend on infrastructure projects during the period 2014 – 2020. 42% of the projects relate to major improvements into port facilities while 24% concern rail, road and inland waterways links to and from the ports [Infrastructure investment and financing needs of the core seaports 2014 – 2020 (Portopia)]
4. According to a presentation by Investment Banking Canaccord Genuity, at the UK Ports Conference, held in London in June 2014:

    - Worldwide throughput in sea ports could quadruple by 2030
    - Port congestion, insufficient intermodal connections and increasing vessel size are factors driving demand for infrastructure investment
    - There is a global investment need of US$830 billion capital expenditure by 2030 for infrastructure facilities
    - Between 2010 and 2030, Port container TEUs will grow by 350%

Waterborne Industries

The market trends were derived from the following studies:

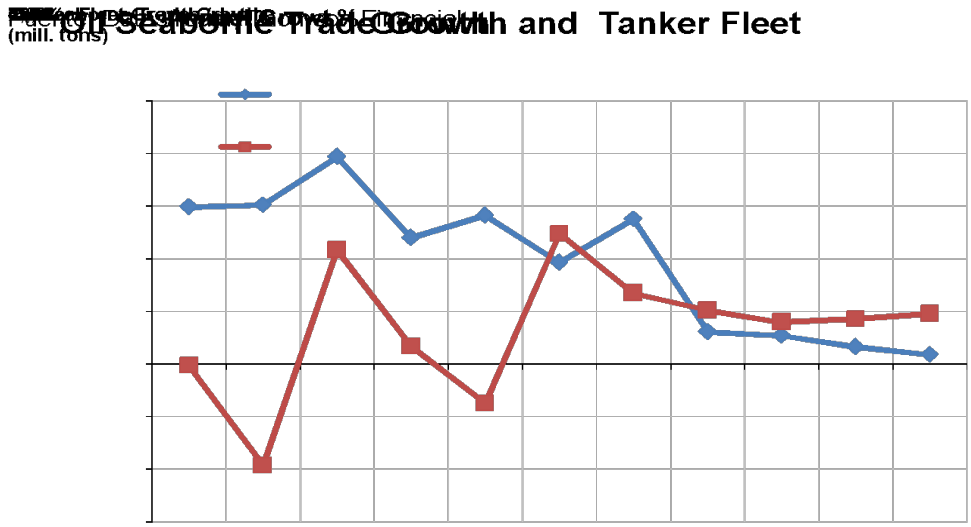
- Review of Maritime Transport, 2013, UNCTAD
- SEA Europe in house report: 2014 Market Forecast Brochure
- ….

Maritime transport

The SEA Europe 2014 Market Forecast Report provides forecasts on newbuilding requirements for the period to 2035, as follows:

<u>Oil Tankers</u>

The oil tanker fleet is expected to expand at a rate of 0.84% per year in terms of deadweight, in contrast to the previous decade, when the tanker fleet grew at a rate close to 5% per year. Forecasts suggest a new building requirement of a mean of 275 units per year (included chemical tankers and oil tankers) for the period 2014-2035.



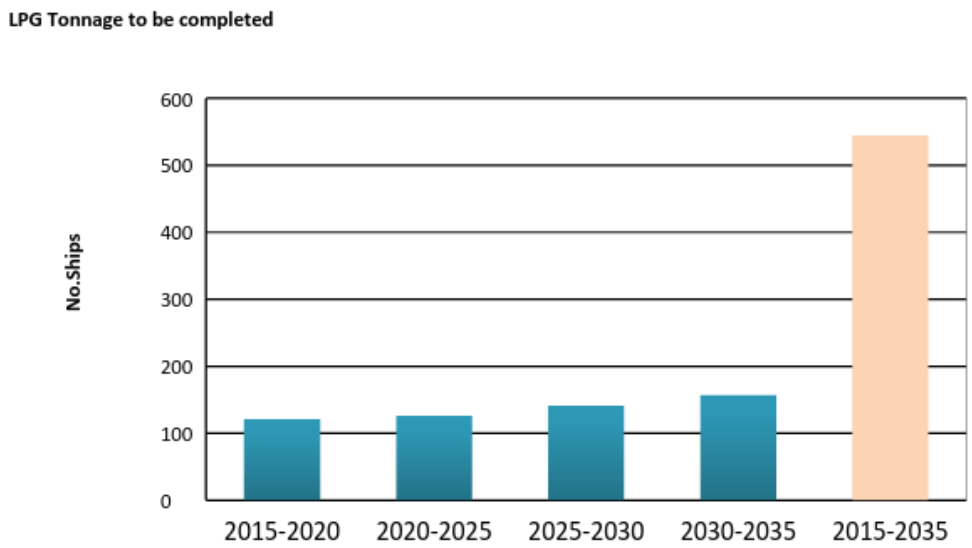
LNG Carriers

Historically, the delivery of new LNG carriers has been somewhat out of sync with LNG market demand for shipping capacity. The primary issue is that there is typically a 2-3 year lead-time for ship delivery. The projected demand and development of the LNG Carrier fleet is as follows:

	Mtons	bton-miles	Needed fleet capacity [Mio m³]
2012	196,9	778,75	40.56
2020	290,9	1.150,5	59.92
2025	371,4	1.468,5	76.47
2030	474,0	1.874,6	97.60

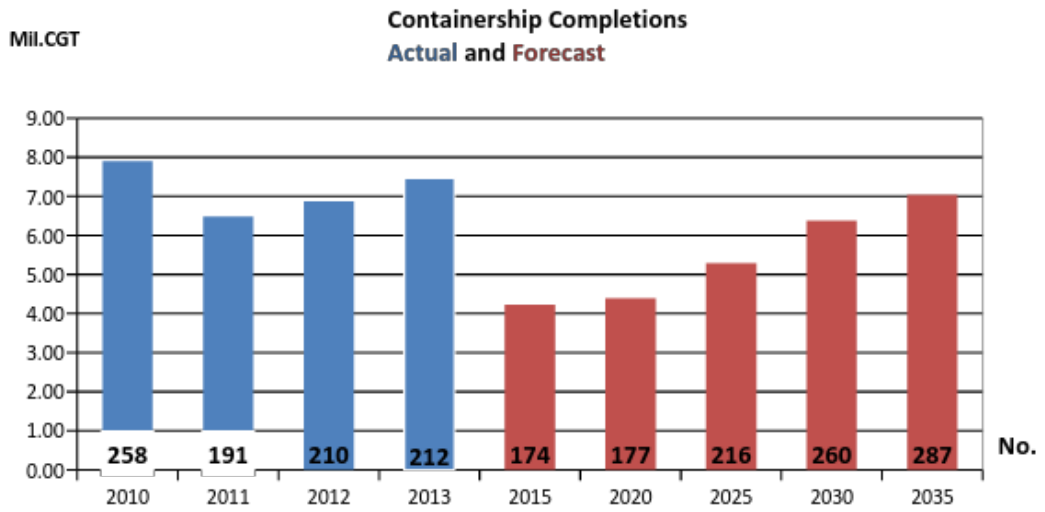
LPG Carriers

The increasing demand for LPG, especially in the Asia Pacific region, is the primary driver bolstering the demand for very large gas carriers [VLGC]. The widening of the Panama Canal in North America would further enhance the demand for these large carriers. However, the market for LPG is still unpredictable and though the demand for LPG will certainly increase in the short term, the long-term trend is still uncertain. This uncertainty in LPG demand and the increasing fuel prices could hamper the demand of VLGCs. European shipyards have now slowly started taking orders for new construction.

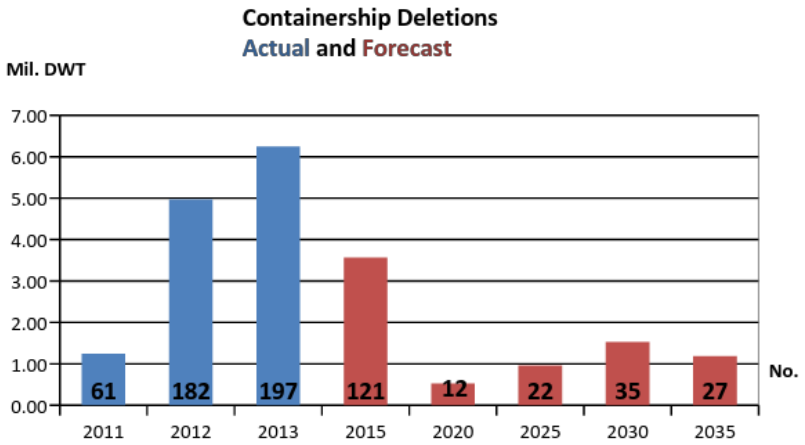


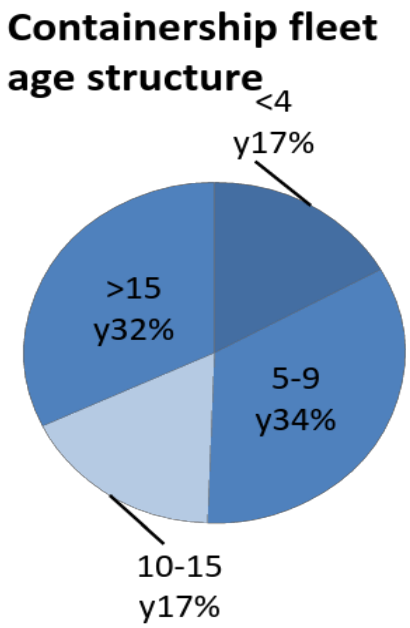
Containerships

Vessel size is expected to increase, in order to improve cost efficiency. In the long term, there will be an additional demand for eco-friendly designs.



An important motivation for new buildings will be the replacement of older vessels. In 2013 ~ 32% of total containers were over 15 years old. Container ship scrapping reached a record level in 2013, when 197 vessels ~ 435.000 TEU were removed. 80% of these vessels were below 4000 TEU, but 15 vessels were in the 4000-6000 TEU range. Scrapping is expected to increase further; the size of ships being scrapped is also expected to increase while the scrapping age is expected to decrease.





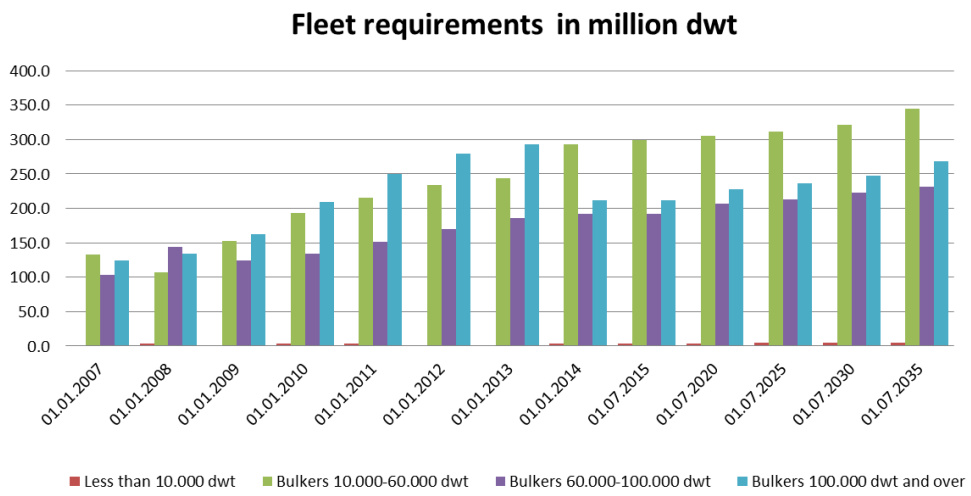
General Cargo

The General Cargo fleet requirement is expected to grow steadily until 2035 with a percentage of 4-5% annually. New orders are still at a very low level, but are expected to rise, especially during 2025-2035 due to need for replacement. Almost 85% of new orders will be acquired by Asia (China, Japan, South Korea, Vietnam), as in previous years.

Bulk Carriers

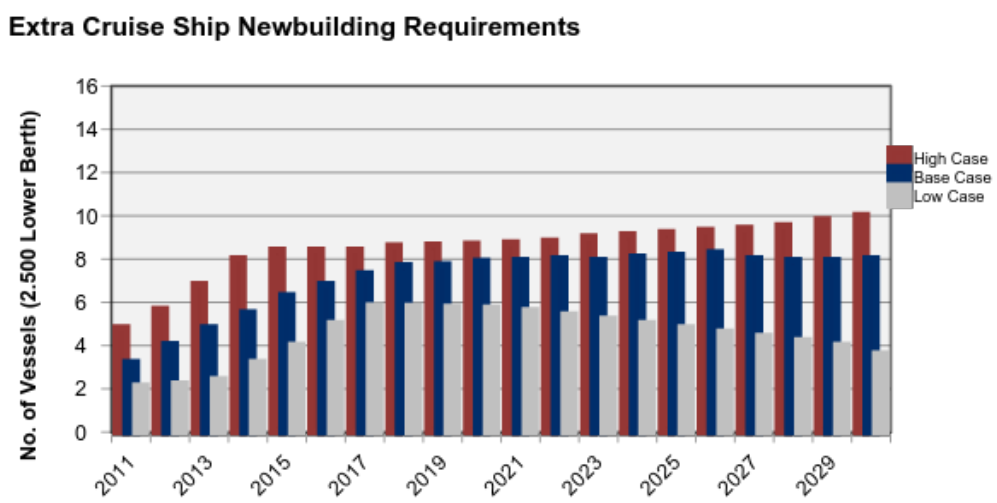
Demand for major bulks is expected to continue growing driven by the imports from Asia. Developing countries like China and India will increase their demand for coal, iron ore and other minerals for their industrial development. Demand for grain is also forecasted to steadily grow, driven by the increase of the global population.

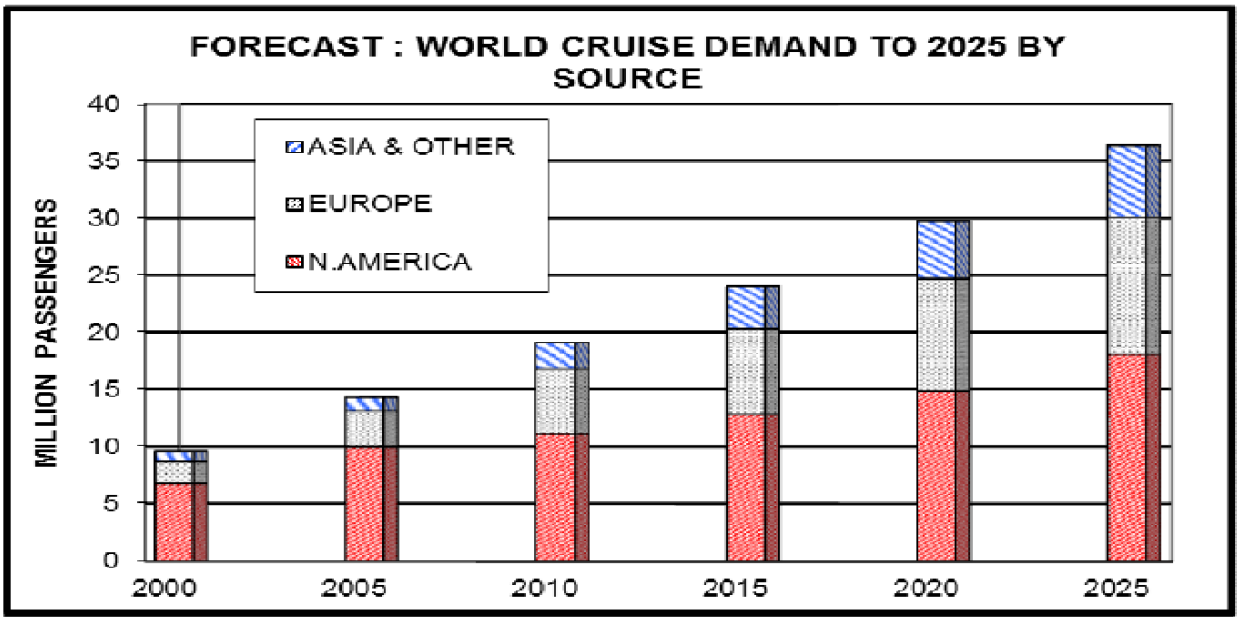
Projected fleet requirement is projected as follows:



Cruise Ships

Cruise ship demand will continue, as in the past, to be partly supply-driven, with the introduction of new ships, new itineraries, and new themes promoting customer interest and sales. Long-term trends will continue to be subject to short-term factors-but will be linked to underlying trends in international tourism, economic growth, and population development.





Blue growth

1.The previous trends related to new Blue Growth activities will also bring forward the need for new vessels concepts and new infrastructures concepts. The maritime technology community will tend to develop more and more new and specific concept of vessel to address those new needs

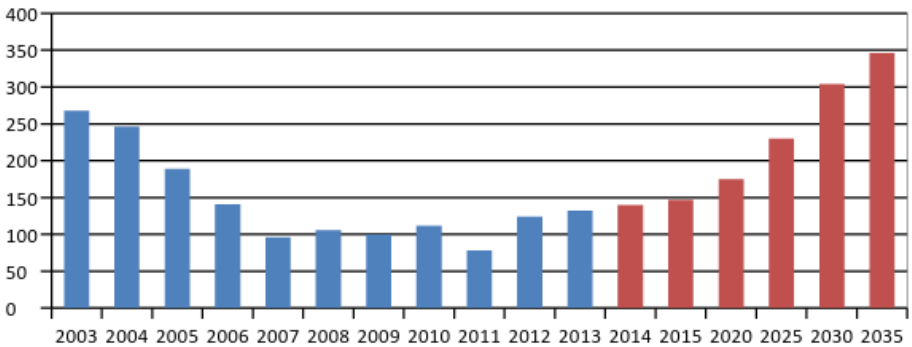
- Regarding the vessels activity, more particularly, specialised ships able to service these new activities, in heavy and harsh conditions e.g. in the arctic regions. These vessels could be: installation and maintenance vessels for renewable energy conversion, offshore platform deployment vessels, specialised vessels for aquaculture, etc.
- An additional range of vessels/vehicles will be operated underwater, either remotely operated, with communications and power provided through umbilicals; or autonomous, i.e. with higher levels of autonomy, with on-board power sources.
- Regarding new Blue Growth infrastructures, there will be a demand for key enabling technologies allowing the new Blue Growth activities and for offshore platforms to host the new offshore marine biomass industrial production (aquaculture farms) and initial transformation before integration in food, cosmetics, drug manufactures.

2. Increasing exploration of the oceans, including seabed survey, whether for deep sea mining, or for marine renewables, will ultimately increase demand for research vessels. However, at present, the market for these kind of vessels basically falls in two categories: research vessels owned by government entities, and geophysical/seismic research vessels owned by private companies and used in the offshore oil and gas industry. Order levels for government research vessels are driven by government planning and government budgets, while order levels for the research vessel related to the offshore industry are driven by the growth in exploration activities for oil and gas.

3. Another Blue Growth sector is fishing. The future market for fishing vessels is one of the hardest markets to predict of all vessel types. This is largely due the fact that fleet size is mostly dictated by government policies rather than market requirements. Several studies have shown that fish stocks have been seriously overfished in many areas of the world. A rise in fish quota restrictions is therefore to be expected. Coupled to these restrictions is a likely decrease in the world fishing fleet size. At the same time, a rise in the number of vessel active in fish farming is to be expected. There will still be a new-build requirement for fishing vessels, as a certain degree of fleet renewal will be necessary to replace part of the current ageing fleet.

The total world fishing fleet, as per IHS Fairplay, currently numbers over 22,000 vessels with a total tonnage of 9.9 million GT. Basis of our forecast is the assumption that the current fleet will shrink by 10% to 9 million GT by 2035. Scrapping is expected to increase gradually from 120,000 GT per year for the period 2016-2020 to 220,000GT per year for the period 2031-2035. New-build deliveries are expected to rise from around 175 vessels in the period 2016-2020 to around 346 vessels per year in the period 2031-2035. While the latter may seem like a significant amount of vessels, it is still lower than the amount of vessels deleted from the fleet in that same period, resulting in a further drop of the fleet size.

Fishing vessels Completions
No of vessels
Actual and Forecast



Infrastructure

The huge increase in port investment and construction will create significant opportunities in the following areas:

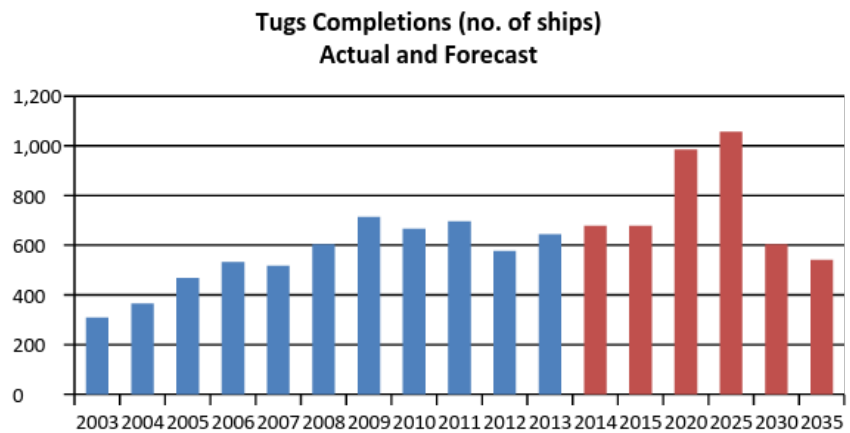
- Shore based and offshore Port design
- New techniques for faster cargo handling to maximise port throughput
- Logistics planning tools.
- Port support vessels, such as harbor tugs
- Equipment, technologies and ships for dredging activities

In relation to the latter bullets, the following market information is available:

Port Tugs

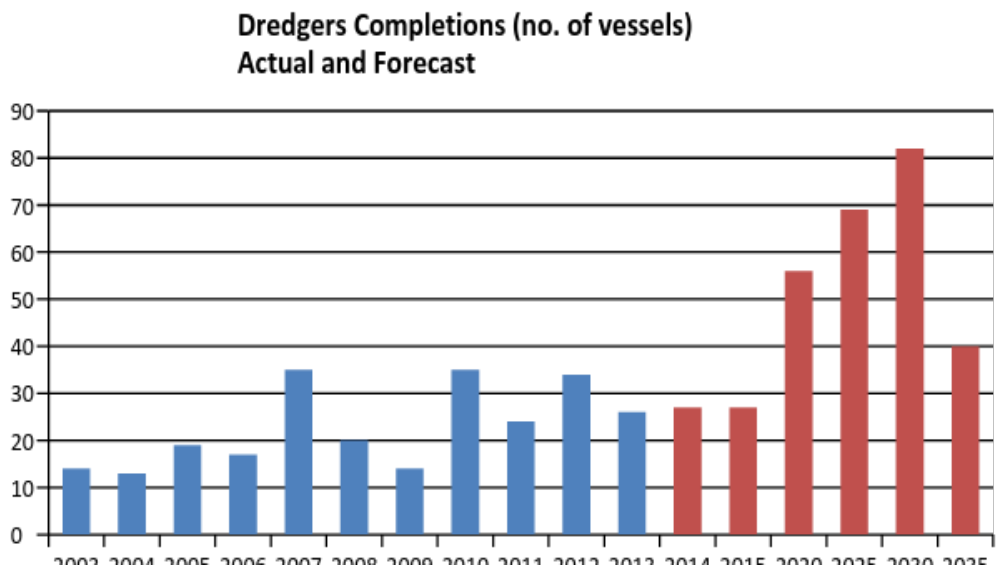
The world fleet of port tugs currently numbers about 16,000 vessels. The average size of the vessels delivered since 2004 is 309 GT. Deliveries from 2009 onwards have been averaging around 660 vessels per year. The high level of deliveries in recent years is reflected by the fact that 40% of the current world port tug fleet was built between 2004 and 2013. However, another 30% is aged 30 years or over, highlighting the longevity of port tugs. This highlights the need for large-scale fleet replacement in the not-too-distant future.

It is expected that the scrapping of tugs will start rising in the period 2016-2020 and peak in the period 2021-2025. Increase in scrapping and continuing growth in world trade will lead to an increase in tug deliveries from around 680 per year, in 2014, to around 1,050 per year, by 2025. Thereafter, tug deliveries will come down again to around 600 per year, in the period 2026-2030, with a further decrease to around 540 per year, in the period 2031-2035.



Another consequence of the predicted significant investment in port construction will be the demand for dredgers. Orders have been somewhat subdued in recent years, but are bound to rise over the next few years. The size of vessels might be more modest sized hopper suction dredgers, of around 5000m3, in contrast with the very large hoppers built in the period before the Lehman crisis. The reason for the expected increase in demand for smaller vessels lies in the current fleet profile. Half of the existing fleet of some 1,600 vessels is 30 years of age or older. However, these older vessels will eventually have to be replaced and many independent dredging companies have had several years of good earnings and conservative spending on vessels. Fleet replacement is therefore expected to start soon and will drive up scrapping from the current 15-20 vessels per year to 35-40 vessels per year, in the period 2016-2030. A further contributing factor to the increase in newbuild orders, is expected to be the rise of national dredging companies from countries like China, India and Russia. The bulk of older vessels should be replaced by 2030 and scrapping is then expected to decrease again to the more usual 15-20 vessels per year.

Fleet replacement and growth in activities will drive a strong growth in dredger deliveries in the period 2016-2030. Deliveries will triple from the current 27 vessels per year to around 82 vessels per year by the year 2030. Thereafter, deliveries are expected to recede to a more modest 40 vessels per year in the period 2030-2035.



ICT

The market trends were derived from the following studies:

- Review of Maritime Transport, 2013, UNCTAD
- Statoil(20143): Energy intensity of world economy
- SEA Europe in house report: 2014 Market Forecast Brochure
- ….

The new offshore activities and the increased complexification of vessels will lead to a rise in the need of ICT technologies, especially regarding the development of USVs and USVs. The report published by the National Intelligence Council (2012): Global trends 2030: Alternative Worlds, identifies ICT and New Technologies as major drivers, with the following global implications:

- Ethical problems by ICT (property rights, privacy, ownership, community participation, etc.).
- Evolving integration of individual people and things.

It identifies that "Game Changers" are possible in:

- Information technology:
  - Data solutions
  - Data Mining
  - Social networking
  - Smart cities technologies
- New manufacturing and automation technologies:
  - Robotics
  - Remote and Autonomous vehicles
  - Additive manufacturing / 3D printing

Maritime transport

1. The continuing development of information communications and technologies will have a significant impact on vessel operations, including:

- Communications between ship and shore
- Vessel monitoring
- Vessel control, leading potentially to unmanned vessel operation
- Improved vessel safety and security
- Well-being of seamen, including medical treatment

3. The development of 3D printing will increase significantly the ability of ships' staff to carry out component replacement and maintenance tasks.

4. Another impact of new ICT/manufacturing technologies is a drive to more production of goods within own markets, and a trend towards reduced costs of manufacture in high wage economies. This might

have an impact on the transport of manufactured goods from South East Asia to Europe and North America.

5. In relation to shipbuilding and equipment manufacture, impact of ICT and new automation/ manufacturing technologies, including robotics, will significantly reduce costs and improve efficiency.

Blue growth

The application of ICT and robotics/autonomy to many Blue Growth sectors is clear, in relation to:

- Remote monitoring of above and below sea surface operations
- Remote monitoring of above and below sea surface environment
- Remote scientific survey
- Real-time high bandwidth communications between remote and autonomous vehicles, and manned vessels, as well as unmanned vehicles/vessels working in cooperatively
- The operation of unmanned subsea, subsurface and surface vessels for all applications, including renewable energies and aquaculture
- The operation of deep ocean ROVs for seabed mining

Infrastructure

- Autonomy will provide efficiencies in cargo handling and vessel operations within port and harbour areas
- Autonomous dredging in port approaches, including near berths, has the ability to ensure both vessel utilisation and safety
- Offshore Quarantine / Custom / Safe Zone, with integration of safety/security authorities using non-intrusive inspection systems,
    - Before suspicious cargo enters protected areas,
    - Saving harbour space for commercial docking

5. Summary of main trends

Maritime Transport

Energy Supply and Consumption:

1. Improved energy efficiency of vessels to reduce emissions
2. Increased use of cleaner and cheaper bunker fuels such as LNG and biodiesel
3. Higher demand of bulks and power generation cargoes from developing countries and consequent increase on seaborne trade and fleet requirements

Economy

1. Stabilization of OECD countries and increasing GDP of developing countries will increase the demand of raw materials and manufactured goods and international seaborne trade
2. Global economic development will increase the demand for cruise lines. The US and European economic stabilization will consolidate the demand, and developing countries such as China are expected to increase considerably the demand by 2030.

Waterborne Industries

1. Continuous improvement of design and manufacturing processes through the improvement of skills and technologies will lead to more energy efficient, clean and safe shipping.

ICT

1. The continuing development of information communications and technologies will have a significant impact on vessel operations, including:
    - Communications between ship and shore
    - Vessel monitoring
    - Vessel control, leading potentially to unmanned vessel operation
    - Improved vessel safety and security
    - Well-being of seamen, including medical treatment

1. The development of 3D printing will increase significantly the ability of ships' staff to carry out component replacement and maintenance tasks.
2. Reduced costs in manufacturing thanks to ICT developments might have an impact on the transport of manufactured goods from South East Asia to Europe and North America.

3. In relation to shipbuilding and equipment manufacture, impact of ICT and new automation/ manufacturing technologies, including robotics, will significantly reduce shipping costs and improve efficiency.

Blue Growth

Energy Supply and Consumption:

1. EU energy and environmental policy objectives will encourage the development and use of marine energy sources;
2. Marie renewable energies will help limit the dependency on fossil fuels for power generation and reinforce the energy security in Europe;
3. The recovery expectations of the oil price by 2020 will increase the surveillance, extraction and production activities and the consequent demand for vessels, platforms and technologies.

Economy

1. The limited availability of mineral resources onshore and the technological developments will lead to the development of new seabed mining and technologies for the exploitation of the ocean floor;
2. Linked to the growth and wealth of global population and the need to identify new food sources aquaculture activities will increase;
3. Increase need for fresh water coming from the population growth and the economic development will increase the need of desalination plants;
4. In order to improve cost effectiveness and safety of offshore activities multi-purpose platforms and related innovative technologies will be required.

Waterborne Trade

1. Integrated maritime trade routes and efficient maritime spatial planning will be needed to ensure safety of new offshore activities and shipping

Waterborne Industries

ICT

1. Remote monitoring of and surface, above and below operations;
2. Remote monitoring of above and below sea surface environment;
3. Remote scientific surveillance;
4. Real-time high bandwidth communications between remote and autonomous vehicles and manned vessels, as well as unmanned vehicles/vessels working cooperatively;
5. The operation of unmanned subsea, subsurface and surface vessels for all applications, including renewable energies and aquaculture;
6. The operations of deep ocean ROVs for seabed mining;
7. Within the maritime technology industry new automation/ manufacturing technologies, including robotics, will significantly reduce manufacturing costs and improve efficiency.

Infrastructure

Energy Supply and Consumption:

1. The shale gas evolution in the US will require new infrastructures for storage and loading of LPG, mainly in US ports
2. The increase development of offshore renewable energies will require new port facilities for the storage and transport of the energy
3. In order to improve energy efficiency in ports to reduce costs and pollution, more efficient energy mix will be utilized, such as LNG or biodiesel as bunkering fuel for feed operations. Port operations and infrastructures will be powered by renewable energy sources.

Economy

1. Increasing trade to and from Africa will require significant investment to build new ports in Africa and to improve the existing port infrastructures (for example: to allow larger vessels call, improving loading/unloading facilities, etc)
2. Higher seaborne trade of goods and saturation of some harbours may lead to the development of offshore hubs where the onshore harbour infrastructure can't be adapted.

Waterborne Trade

1. In order to reduce shipping emissions and costs and responding to EU and IMO legislations to reduce pollution from seaborne trade, LNG use as banker fuel will definitely increase by 2020. In order to respond to the LNG bunker fuel demand, new bunkering infrastructures will be developed worldwide
2. It is expected that the development and use of hydrogen cells will increase for some ship types. Infrastructures for the recharging will also be needed;

Waterborne Industries

1. The size of cargo vessels is expected to increase in the future, following the current trend in order to reduce shipping costs. The same trend exists in the case of cruise vessels, which are larger and have capacity for more passengers. The increased vessel size will influence the need of enlarging port facilities and quays.

ICT

1. Autonomy will provide efficiencies in cargo handling and vessel operations within port and harbour areas
2. Autonomous dredging in port approaches, including near berths, has the ability to ensure both vessel utilisation and safety
3. Offshore Quarantine / Custom / Safe Zone, with integration of safety/security authorities using non-intrusive inspection systems,
    - Before suspicious cargo enters protected areas,
    - Saving harbour space for commercial docking

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